Kenneth W. Jenkins, Westchester County Executive

General Requirements and Proposals
Information for Bidders
General and Special Clauses
Technical Specifications

BUILDING 1 REHABILITATION
WESTCHESTER COUNTY AIRPORT
TOWNS OF HARRISON AND NORTH CASTLE AND
VILLAGE OF RYE BROOK, NEW YORK

Contract No. 25-532

Bid Opening: October 28, 2026

By Bidder (Please Print)	For Official Use Only
Firm/Business Name: _____	
Address: _____	_____
_____	_____

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

CONTRACT NO. 25-532

SPECIAL NOTICE

County of Westchester
New York

ADDENDA TO THE BID DOCUMENTS

Addenda to the Bid Documents will be published on the Empire State Purchasing Group website at (http://www.bidnetdirect.com/new-york) **It is the responsibility of each potential bidder to check the website on a regular basis for further information relative to the bid documents including information relating to any and all addenda** prior to submitting its bid. All Bidders are deemed to have reviewed and considered all addendums in their Bid.

SUBMISSION OF BIDS

Bidders should not submit the entire bid document with its bid submission. Instead, each bidder is required to submit the full set of designated Proposal Pages. The Proposal Pages are denoted by a border and are titled on the bottom as "Proposal Page ___". The Proposal Pages must be accompanied by the "Bid Bond and Consent of Surety" (as set forth in the Proposal Pages) attached to the outside of the sealed bid. A Bid Bond is NOT required for contracts of $100,000 or less. Failure to submit in this manner may cause the bid to be rejected.

The successful bidder will be required to furnish a Performance and Payment Bond.

CONTRACT NO. 25-532

SPECIAL NOTICE

County of Westchester
New York

MANDATORY PRE-BID SITE INSPECTION

A. Superseding the first paragraph of Article "3. PRE-BID SITE INSPECTION" of the Information for Bidders, Bidders are required to attend a Mandatory Pre-Bid Site Inspection at 11:00 a.m. on Wednesday, October 7, 2026 at a meeting at the 2nd Floor Administration Office at the Terminal Building, Westchester County Airport, New York. at which time they will examine the work site under escort by the County's representative.

BIDS FROM CONTRACTORS NOT IN ATTENDANCE AT THIS MEETING, OR THOSE WHO FAIL TO SIGN THE ATTENDANCE SHEET-WILL BE *REJECTED*

B. Bidders shall indicate their interest in the site examination by contacting Jeff Dean, Department of Public Works, Division of Engineering at (914) 995-3361 or jadc@WestchesterCountyNY.gov.

C. All other portions of Article "Pre-Bid Site Inspection" of the Information for Bidders shall remain in full force and effect.

CONTRACT NO. 25-532

SPECIAL NOTICE

County of Westchester
New York

MINORITY PARTICIPATION POLICY

Contractors must comply with the County's Minority Participation Policy, including, but not limited to, the requirement that contractors make a demonstrated good faith effort to utilize Minority Owned Businesses ("MOB") and Women Owned Businesses ("WOB") (see IFB Article 36). To assist contractors in this effort the County has made available a list of MOB and WOB at http://mwbe.westchestergov.com/ Contractors are also encouraged to utilize other sources to identify potential MOB and WOB as subcontractors and suppliers.

All bidders must submit as part of their bid package the Minority/Women Owned Business Enterprise Questionnaire located in the Proposal Page section of the bid documents.

CONTRACT NO. 25-532

SPECIAL NOTICE

County of Westchester
New York

CHANGES IN THE WICKS LAW

Effective July 1, 2008, construction contracts of one million five hundred thousand dollars or less will not require the preparation of separate contracts for plumbing and gas fitting; steam heating, hot water heating, ventilation and air conditioning apparatus; and electric wiring and standard illuminating fixtures and general construction.

Each bidder on a public work contract, where the preparation of separate contracts is not required shall, to the full extent applicable, submit with its bid a separate sealed list that names each Subcontractor that the bidder will use to perform work on the contract and the agreed upon price to be paid to each for (a) plumbing and gas fitting, (b) steam heating, hot water heating, ventilating and air conditioning apparatus and (c) electric wiring and standard illuminating fixtures and (d) general construction. The submission (Proposal Page 6) that contains the agreed upon price shall be acknowledged by both Contractor and Subcontractor. For purposes of this paragraph, the acknowledgment from the Subcontractor may contain the facsimile signature of an officer of the Subcontractor.

After the low bid is announced, the sealed list of subcontractors submitted with the bid shall be opened and the names of such subcontractors shall be announced. Thereafter, any changes of subcontractors or agreed-upon amount to be paid to each shall require the approval of the County upon a showing of legitimate construction need for such change.

The Successful low bidder, before award of the contract, must procure and provide to the County, from each of the above denoted Subcontractors, a Contract Disclosure Statement and the Required Disclosure of Relationships to County forms.

The sealed lists of Subcontractors submitted by unsuccessful bidders shall be destroyed after the contract award.

THIS PROJECT IS NOT SUBJECT TO THE REQUIREMENTS OF THE "WICKS LAW". ACCORDINGLY, EACH BIDDER IS REQUIRED TO SUBMIT SPECIFIC INFORMATION PERTAINING TO ITS PROPOSED SUBCONTRACTORS. PLEASE SEE THE "NOTICE TO CONTRACTORS" THAT FORMS A PART OF THESE BID DOCUMENTS.

SPECIAL NOTICE

County of Westchester
New York

COMPLETION OF GRANT FUNDING FORMS

The bidders are hereby notified that if this project, or any portion thereof, is funded by a grant then the contractor will be responsible to complete all appropriate forms as required by the grant agency in order to complete the application.

PROMPT EXECUTION AND RETURN OF CONTRACT

A. The successful bidder is required to return the completed contract to the County within ten (10) days of receipt of the execution copy of the contract. The contract must be signed, notarized and returned to the County with all insurance certificates, bonds and supporting documentation, including all required Subcontractor information.

B. The County reserves all of its rights, including, but not limited to, proceeding against the bid bond, if the successful bidder fails to submit the complete executed package within the above time frame.

SPECIAL NOTICE

County of Westchester
New York

WESTCHESTER COUNTY LOCAL LAW INTRO. NO. 144-2026

Pursuant to Section 309.81 of Chapter 309 of the Laws of Westchester County, a copy of Local Law Intro No. 144-2026 is set forth below. All bidders are required to comply with Local Law Intro No. 144-2026, as applicable.

LOCAL LAW INTRO. NO. 144-2026

A Local Law adding a new Chapter 309 to the Laws of Westchester County to require that County contractors and subcontractors have in place apprenticeship agreements appropriate for the type and scope of work to be performed, that have been registered with the New York Stace Commissioner of Labor.

BE IT ENACTED by the County Board of the County of Westchester as follows:

Section 1. Chapter 309 of the Laws of Westchester County is hereby added to read as follows:

CHAPTER309

APPRENTICESHIP AGREEMENTS REQUIRED FOR COUNTY CONSTRUCTION CONTRACTS

§309.01	Legislative Intent
§309.11	Definitions
§309.21	Requirement of Apprenticeship Agreements for Construction Contracts.
§309.31	Additional Considerations Permissible
§309.41	Proof of Participation and Apprentice Completion Rates
§309.51	Certified Payrolls
§309.61	Applicability
§309.71	Sanctions and Remedies
§309.81	Copy of Law Provided
§309.91	Severability

§ 309.01. Legislative Intent.

The County Board of Legislators recognizes that the New York State Legislature has declared it the public policy of the State of New York to develop sound apprenticeship training standards and to encourage labor and industry to participate in apprenticeship programs. Section 816-b of the New York State Labor Law authorizes governmental entities like the County that are direct or indirect parties to a construction contract to require contractors and subcontractors to have apprenticeship agreements in place that are appropriate for the type and scope of work to be performed, and that have been registered with by the New York State Commissioner of Labor pursuant to Article 23 of the Labor Law.

The County Board finds that New York State registered apprenticeship programs provide valuable educational and training tools for County residents, and may facilitate the ability of County residents to obtain skilled jobs. The County Board finds that it would be valuable to encourage local businesses to participate in such state registered apprenticeship programs, in order to meet the need for skilled trade persons, while providing residents with the means to earn a better living. New York State-approved apprenticeship programs also encourage equal opportunity for apprentices and applicants for apprenticeship, consistent with state and federal regulations, in order to enhance workforce development and diversification, and to prevent exclusionary practices. *See* 12 N.Y.C.R.R. 600.4; *see also* 29 C.F.R. pt. 30.

§ 309.11. Definitions.

A. "Apprenticeship Agreement" means: (1) an individual written agreement between an employer and an apprentice; (2) a written agreement between an employer or an association of employers, and an organization of employees describing conditions of employment for apprentices; or (3) a written statement describing conditions of employment for apprentices in a plant or plants where there is no bona fide employee organization.

B. "Commissioner" means the Commissioner of the Department of Public Works and Transportation.

C. "Construction Contract" means any contract to which the County or and of its departments or agencies may be a direct or indirect party which involves the construction, reconstruction, improvement, rehabilitation, repair. furnishing. equipping of or otherwise providing for and building facility, or physical structure in excess of S250,000. A public entity need not be part:)' to the Construction Contract. A Construction Contract includes: projects that Westchester County funds directly; projects that Westchester County funds indirectly by providing funds to a separate entity· to perform the construction-type activity: privately financed construction projects specifically built with the intent of leasing the entire property to any agency or department of Westchester County government; and construction projects built under Westchester County's direction and later paid for with Westchester County· funds.

D. "Contractor" means any bidder for, or awardee of, a Construction Contract, as defined in this section, obtained through competitive bidding procedures.

E. "Date of Award of the Construction Contract" means the date that the Construction Contract has been approved by the Board of Acquisition and Contract.

F. "Subcontract" means any agreement between Contractors or any agreement between a Contractor and an}' person or entity under which any portion of the Contractor's obligation is performed, undertaken or assumed.

G. "Subcontractor" means an individual, sole proprietorship, partnership, joint venture or corporation which is engaged by a Contractor or another subcontractor pursuant to a Construction Contract.

§ 309.21. Requirement of Apprenticeship Agreements for Construction Contracts.

A. A Contractor shall have in place at the time of submission of a bid for a Construction Contract an Apprenticeship Agreement appropriate for the type and scope of work to be performed. Such Apprenticeship Agreement shall be registered with the New York State Commissioner of Labor pursuant to the requirements found in Article 23 of the New York State Labor Law.

B. A Contractor shall provide each Subcontractor with notice of the requirements for Apprenticeship Agreements as appropriate, and a copy of this Local Law, at the time of the execution of each respective Subcontract.

C. A Subcontractor shall have in place within ninety (90) days of the Date of the Award of a Construction Contract an Apprenticeship Agreement appropriate for the type and scope of work to be performed. Such Apprenticeship Agreement shall be registered with the New York State Commissioner of Labor pursuant to the requirements found in Article 23 of the New York State Labor Law.

D. This provision shall not apply to Contractors or Subcontractors engaged in occupations which are not registered as apprenticeable by the New York State Commissioner of Labor.

E. This provision shall not apply to emergency procurements entered into pursuant to section 103 of the New York State General Municipal Law and section 167.171 of the Laws of Westchester County.

F. The Commissioner is authorized to enact rules and regulations as may be deemed necessary for the implementation of this Chapter. This authority shall not include providing any further exemptions to the requirements of this Chapter, which are not already stated herein.

§ 309.31. Additional Considerations Permissible.

The County, in addition to whatever considerations are required by law, may consider the degree to which career opportunities in apprenticeship training programs approved by the New York State Commissioner of Labor may be provided.

§ 309.41. Proof of Participation and Apprentice Completion Rates.

A. Any prospective Contractor shall submit with their Construction Contract bid:
   1. proof of an Apprenticeship Agreement;

2. most recently available certificates of completion. which show that each of the Contractor's applicable registered apprenticeship programs has an apprentice completion rate of at least thirty percent (30%) as determined by the New York State Department of Labor; and
3. a certification that it shall fulfill its obligations under Section 309.21(a) of this Chapter.

B. Within ninety (90) days of the Date of the Award of the Construction Contract, the Contractor shall submit to the Commissioner, for all Subcontractors under the Construction Contract:
   1. proof of each Subcontractor's Apprenticeship Agreement(s); and
   2. certificates of completion, which show that each of the Subcontractor's applicable registered apprenticeship programs has an apprentice completion rate of at least thirty percent (30%) as determined by the New York State Department of Labor.

C. Completion Rate Exemptions.
   1. A registered apprenticeship program, under which any Apprenticeship Agreement is executed, shall be exempt from the completion rate requirements of§ 309.41(A)(2) and§ 309.41(B)(2) where that apprenticeship program:
      i. is still in its probation period with the State Department of Labor, consistent with 12 N.Y.C.R.R. ch. IX, pt. 601: or
      ii. is within one year of the projected completion date of its first apprentice(s) eligible to be included in the completion rate calculation.
   2. For the exemption to apply, the Contractor shall submit to the Commissioner. On behalf of the Contractor and/or any Subcontractors, a copy of the relevant fully executed program registration agreement or proof of the State Department of Labor's provisional approval of the apprenticeship program.

§ 309.51. Certified Payroll.

The Contractor shall provide the Commissioner with a certified monthly payroll, which shall include the following information for each person employed to work on the Construction Contract by the Contractor and/or any Subcontractor: worker's name, address, last four digits of Social Security Number, classification(s) in which the worker was employed, hourly wage rate(s) paid, supplements paid or provided, and daily and weekly number of hours worked in each classification.

§ 309.61. Applicability.

A. This Chapter shall apply to Construction Contracts and Subcontracts entered on or after the effective date of the law, but shall not apply to extensions or renewals that were authorized pursuant to a provision contained in a Construction Contract or Subcontract that was executed prior to the effective date of the law. Nothing herein shall impair existing Construction Contracts or Subcontracts.

B. The requirements of Sections 309.21 and 309.41 of this Chapter, although recommended, shall not apply to a Contractor or Subcontractor upon receipt of a verified written statement that the total number of persons employed by such Contractor or Subcontractor is 14 or fewer.

§ **309.71. Sanctions and Remedies.**

A. The failure of a prospective Contractor to provide the following may result in the determination that the bid is non-responsive:
   1. proof of an Apprenticeship Agreement for such Contractor as required by Section 309.21(A) or a verified written statement that the total number of persons employed by such Contractor is 14 or fewer; and/or
   2. a certification that a copy of this Local Law and notice of the requirements therein shall be provided to each Subcontractor. as required by Section 309.41(A)(3).

B. The County may withdraw or suspend its approval of one or more Subcontractors on any Construction Contract, or any portion thereof, in the event that it is established that a Subcontractor failed to comply with the requirements of this Chapter.

§ **309.81. Copy of Law Provided.**

A. The Commissioner shall cause a copy of this Local Law to be provided with the bid specifications for each bid for a Construction Contract.

B. This Local Law shall be included as an Appendix to each Construction Contract.

§ **309.91. Severability.**

If any clause. sentence. paragraph. section. or part of this local law shall be adjudged by any court of competent jurisdiction to be invalid. such judgment shall not affect. impair. or invalidate the remainder thereof. but shall be confined in its operation to the clause, sentence, paragraph, section, or part thereof directly involved in the controversy in which such judgment shall have been rendered.

Section 2.

The Clerk of the Board shall cause a notice of this Local Law to be published at least once a week for two successive weeks, the first publication of which shall be had within ten days after such local law is adopted, in the official newspapers published in the County of Westchester. said notice to contain the number, date of adoption and a true copy of the Local Law, and a statement chat this Local Law changes a provision of law relating to public bidding and/or contracts, and is therefore subject to the provisions of Sections 209.171(2) and 209.181 of the Laws of Westchester County, providing for a permissive referendum.

Section 3.

This Local Law shall take effect ninety (90) days after its adoption, subject to the provisions of Section 209.181 of the Laws of Westchester County

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New York

PROOF OF PAYMENT BY CONTRACTOR TO SUBCONTRACTORS AND MATERIALMEN.

In addition to and without limiting any of the provisions set forth in Section 23 of the Information for Bidders, after the Contractor completes 50% of the work under the contract, the Contractor may be required to supplement each requisition submitted to the County with documentation that establishes that the Contractor has timely and properly paid its subcontractors and materialmen as required by Section 23 of the Information For Bidders. Such documentation required may include copies of both sides of cancelled check(s) paid to the order of the subcontractors and materialmen and such other documentation as may be reasonably requested by the Commissioner. If the Contractor fails to submit such documentation, the Commissioner may, in his sole discretion, withhold payment of the requisition until such time as the documentation is properly submitted. Nothing herein is intended or shall be construed to confer upon or give any subcontractor or materialman, or its successors and assigns, any third party beneficiary rights, remedies or basis for reliance upon, under or by reason of the contract or this Special Notice provision.

SPECIAL NOTICE

County of Westchester
New York

PREVAILING WAGE

All public works contracts are subject to the payment of the prevailing wage and supplements as set forth by the laws of the State of New York, including, but not limited to, Articles 8 and 9 of the New York Labor Law (the "Prevailing Wage Laws"). Westchester County has an active Prevailing Wage Enforcement Officer who enforces the Prevailing Wage Laws within the County for public works contracts, including reviewing certified payroll records, visiting job sites, interviewing the employer and employees (See IFB Article 12) and, if necessary, requesting copies of cancelled checks.

Any Contractor who fails to comply with the Prevailing Wage Laws, including, but not limited to, failing to pay the prevailing wage rates and supplements, failing to submit certified payroll records to the County or failing to post the prevailing wage rates and supplements at the work site, will be subject to enforcement as provided for in the Contract and laws of the State of New York through the Westchester County District Attorney's office, the Commissioner of the New York State Department of Labor, the County and/or the employee who suffered the underpayment. This enforcement could include, but is not limited to, criminal penalties, civil penalties, debarment from future bid awards, the withholding of payment under the Contract to satisfy the unpaid wages and supplements, including interest and civil penalty. In addition, such a failure shall constitute grounds for cancellation of the Contract (IFB 8(C)). Moreover, a prime contractor is responsible for its subcontractor's failure to comply with, or evasion of, the provisions of the Prevailing Wage Laws.

SPECIAL NOTICE

County of Westchester
New York

MANDATORY OSHA CERTIFICATION

When a public works contract is in excess of $250,000.00, all employees are required to have successfully completed the OSHA 10 hours training class. All contractors and subcontractors must attach copies of proof of completion of the OSHA 10 hour course by all employees to the first certified payroll submitted to the County and on each succeeding payroll where any new or additional employee is first listed. Employees may be requested by the County's representative to verify compliance with the OSHA 10 hour course by showing their OSHA card.

When a public works contract is in excess of $1,000,000.00, all employees are required to have successfully completed the OSHA 30 hours training class. All contractors and subcontractors must attach copies of proof of completion of the OSHA 30 hour course by all employees to the first certified payroll submitted to the County and on each succeeding payroll where any new or additional employee is first listed. Employees may be requested by the County's representative to verify compliance with the OSHA 30 hour course by showing their OSHA card.

In addition, on any contract that includes excavation of underground facilities, the excavator is required to be certified and have completed the training and education program provided by the one-call notification system (Dig Safely New York, Inc. Certified Excavator Program in Safe Digging Best Practices) or any other provider authorized by the public service commission to administer such training and education program.

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New York

NEW CONTRACTOR REGISTRY LAW

Beginning December 30, 2024, subsection 220-i in Article 8 of the New York State Labor Law (the "Contractor Registry Law") mandates that all contractors and subcontractors bidding on or performing contracted work on a covered project must register with the New York State Department of Labor (NYSDOL).

A covered project is defined as any project subject to Article 8 of the New York State Labor Law, including but not limited to, public work projects and those subject to the provisions of Section 224-a and 224-d of the New York State Labor Law.

Who Must Register with the NYSDOL?

- Contractors: Defined as any entity entering into a contract to perform construction, demolition, reconstruction, excavation, rehabilitation, repair, installation, renovation, alteration, or custom fabrication.
- Subcontractors: Defined as any entity subcontracting with a contractor to perform construction, demolition, reconstruction, excavation, rehabilitation, repair, installation, renovation, alteration, or custom fabrication, as outlined in Article 8 of the Labor Law.

For more information on how to register with the NYSDOL, please visit: https://dol.ny.gov/how-register-contractor-and-subcontractor-registry

BIDDERS ARE HEREBY NOTIFIED:

- No contractor shall bid on a contract for public work unless such contractor is registered with the NYSDOL.

- Each contractor must submit its certificate of registration at the time the bid is made. Applications for registration shall not be accepted as a substitute for a certificate of registration.

- Subcontractors must be registered prior to commencing any work on the covered project.

- Contractors are responsible for verifying that their subcontractors are registered prior to commencing subcontracted work on the contract and shall submit information regarding their subcontractor's registration as may be requested by the County.

- For a contractor or subcontractor who has been determined unfit by the Commissioner of the NYSDOL while performing contracted work, the contracted work shall only continue if a monitor is appointed to oversee the work completed. Such monitor must be approved by the Commissioner of the NYSDOL. Contractor shall be responsible for securing the appointment of the monitor. The contractor shall take all steps necessary to ensure there is no interruption in the project schedule as a result of such determination. The cost of the monitor shall be at the sole expense of such contractor or subcontractor who has been determined to be unfit. Failure of the contractor to either secure the appointment of a monitor or obtain a replacement contractor or subcontractor to complete the contracted work to the satisfaction of the Commissioner of Public Works and Transportation shall be deemed an act of default under the contract.

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New York

JOINT VENTURES OR CONTRACTORS COMPRISED OF MORE THAN ONE LEGAL ENTITY

(a) If the Contractor is a joint venture or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purpose of undertaking this agreement, each such entity, partner and/or participant acknowledges and hereby affirmatively represents and agrees that each has the power to bind the Contractor and each of the others hereunder; and as such, each acts both as principal and agent of the Contractor and of each of the others hereunder. Each further acknowledges and agrees that all such entities, participants and/or partners of the joint venture associated for the purposes of undertaking this agreement expressly agree to be jointly and severably liable for any and all obligations and/or liabilities of the Contractor arising in any way out of and in connection with this agreement.

(b) If the Contractor is a joint venture, or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purposes of undertaking this agreement, the Contractor represents and warrants to the County that it is duly organized under the laws of the State of New York, and that each and every entity, partner, participant or joint venture of Contractor agrees to separately execute the agreement, by its own authorized representative, with the appropriate acknowledgment and verification.

(c) If the Contractor is a joint venture or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purpose of undertaking this agreement, either at least one such entity, partner and/or participant comprising the Contractor and on behalf of the Contractor or the Contractor itself, shall comply with all requirements of the bid specifications herein and prerequisites to submit a bid, including but not limited to attendance of any mandatory pre-bid meetings, if any, and obtaining the bid documents and any addenda from the Empire State Purchasing Group website, or any successor website for posting of bid documents.

(d) If the Contractor is a joint venture or otherwise comprised of more than one legal entity or any group of partners, participants or joint ventures associated for the purposes of undertaking this agreement, each such entity, partner and/or participant acknowledges and hereby affirmatively represents and agrees that the respective rights, duties and liabilities of each hereunder shall be governed by the laws of the State of New York, including but not limited to the New York Partnership Law.

SPECIAL NOTICE

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PROJECT LABOR AGREEMENT (PLA)

A. The County of Westchester has determined that a Project Labor Agreement will be used on this Project. The successful bidder will be required as a condition of this Contract to execute the PLA with the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO ("Council"). The PLA will be substantially in the same form as the PLA included in this contract specification book. Bidders are urged to familiarize themselves with the terms and conditions of the PLA.

B. It should be noted that Schedule A of the PLA contains a list of the local unions affiliated with the Council. Copies of the applicable Collective Bargaining Agreements of the local unions can be obtained by writing to the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO at 1360 Pleasantville Road, Briarcliff Manor, NY 10510, Attn: Jeff Loughlin, President.

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INSURANCE REQUIREMENTS

1. The Contractor, upon award of the contract and throughout the term of the contract, shall furnish, deliver and maintain at its own cost and expense the required insurance as indicated below from insurance companies licensed in the State of New York, carrying a Best's financial rating of A or better. The Contractor shall provide evidence of such insurance to the County by providing a copy of the policies, endorsements, and/or certificates as may be required and approved by the Director of Risk Management of the County ("Director"). The policies, endorsements, or certificates thereof shall provide that ten (10) days prior to cancellation or material change in the policy, notices of same shall be given to the Board of Acquisition and Contract of the County of Westchester by registered mail, return receipt requested, for all of the following stated insurance policies, with a copy also sent to the Director. All notices shall name the Contractor and identify the contract number.

If at any time any of the policies required herein shall be or become unsatisfactory to the Director, as to form or substance, or if a company issuing any such policy shall be or become unsatisfactory to the Director, the Contractor shall upon notice to that effect from the County, promptly obtain a new policy, and submit the policy, endorsement, or the certificate as requested by the Director for approval by the Director. Upon failure of the Contractor to furnish, deliver and maintain such insurance, the contract, at the election of the County, may be declared suspended, discontinued or terminated.

Failure of the Contractor to take out, maintain, or the taking out or maintenance of any required insurance, shall not relieve the Contractor from any liability under the contract, nor shall the insurance requirements be construed to conflict with or otherwise limit the contractual obligations of the Contractor concerning indemnification.

All property losses shall be made payable to the "County of Westchester" and adjusted with the appropriate County personnel.

Upon policy renewal or expiration, evidence of renewal or replacement of coverage that complies with the insurance requirements delineated below shall be delivered to the County. If any insurance requirements are not complied with at their expiration or renewal dates, the Contractor shall immediately cease work. The Contractor shall not resume work until authorized to do so by the County. In addition, payment to the Contractor may be withheld until those requirements have been met, or, at the option of the County, the County may pay the renewal premium and withhold such payments from any monies due the Contractor under the contract or under any other agreement the Contractor may have with the County.

In the event that claims, for which the County may be liable, in excess of the insured amounts provided herein are filed by reason of Contractor's negligent acts or omissions under the contract or by virtue of the provisions of the labor law or other statute or any other reason, the amount of excess of such claims or any portion thereof, may be withheld from payment due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims in form satisfactory to the Director.

In the event of any loss, if the Contractor maintains broader coverage and/or higher limits than the minimums identified herein, the County shall be entitled to the broader coverage and/or higher limits maintained by the Contractor. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to the County.

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2. The Contractor shall provide evidence of the insurance for each coverage indicated by a blackened box (■) or by an X in a ☐ to the left below:

☒Workers' Compensation and Employer's Liability: Certificate form C-105.2 or State Fund Insurance Company form U-26.3 is required for proof of compliance with the New York State Workers' Compensation Law. State Workers' Compensation Board form DB-120.1 is required for proof of compliance with the New York State Disability Benefits Law. Location of operation shall be "All locations in Westchester County, New York."

Where an applicant claims to not be required to carry either a Workers' Compensation Policy or Disability Benefits Policy, or both, the employer must complete NYS form CE-200, available to download at: http://www.wcb.ny.gov.

If the employer is self-insured for Workers' Compensation, he/she should present a certificate from the New York State Worker's Compensation Board evidencing that fact (Either SI-12, Certificate of Workers' Compensation Self-Insurance, or GSI-105.2, Certificate of Participation in Workers' Compensation Group Self-Insurance).

☒Commercial General Liability Insurance with a combined single limit of $1,000,000 (c.s.l.) per occurrence and either no aggregate limit or, if there is an aggregate limit, a minimum $2,000,000 aggregate limit, naming the "County of Westchester" as an additional insured on a primary and non-contributory basis. This insurance shall include the following coverages:

i. Premises - Operations.
ii. Broad Form Contractual.
iii. Independent Contractor and Sub-Contractor.
iv. Products and Completed Operations.

NOTES: (a) Additional insured status shall be provided by standard or other endorsement that extends coverage to the County of Westchester for both on-going and completed operations.
(b) All Contracts involving the use of explosives, demolition and/or underground work shall provide proof that XCU is covered.

☒Commercial Umbrella/Excess Insurance: $2,000,000 per occurrence and either no aggregate limit, or, if there is an aggregate limit, a minimum $4,000,000 aggregate limit, naming the "County of Westchester" as an additional insured, written on a "follow the form" basis.

NOTES: Notes (a) through (b) above under the Commercial General Liability Insurance shall also apply to Commercial Umbrella/Excess Insurance.

SPECIAL NOTICE

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New York

☒Automobile Liability Insurance with a minimum limit of liability per occurrence of $1,000,000 for bodily injury and a minimum limit of $100,000 per occurrence for property damage or a combined single limit of $1,000,000 unless otherwise indicated in the contract specifications, and naming the "County of Westchester" as an additional insured. This insurance shall include for bodily injury and property damage the following coverages:

(i) Owned automobiles.
(ii) Hired automobiles.
(iii) Non-owned automobiles.

☐Builder's Risk Insurance for Bridges, Viaducts or Similar Structures: For the construction, renovation or repair of bridges, viaducts or similar structures, the Contractor at its own cost and expense shall furnish, deliver and maintain a "Bridge Builder's Risk Form, All Risk Insurance Contract," with flat premium endorsement, until the construction contract is accepted by the Board of Acquisition and Contract of the County of Westchester. The coverage shall also include business interruption and contingent interruption and extra expense coverage. The coverage shall be written for 100% of the completed value, covering and naming the Contractor and "County of Westchester" as the insureds. The Contractor shall provide the original and duplicate copy of the policy, as well as any and all endorsements, to the County.

☐ Builder's Risk Insurance for Buildings and Facilities: For the construction of (a) new buildings and (b) for additions or repairs of existing buildings or facilities, the Contractor at its own cost and expense shall furnish, deliver and maintain a "Builder's Risk Form, All Risk Insurance Contract," with flat premium endorsement, until the construction contract is accepted by the Board of Acquisition and Contract of the County of Westchester. The coverage shall also include business interruption and contingent business interruption and extra expense coverage. The coverage shall be written for 100% of the completed value, covering and naming the Contractor and "County of Westchester" as the insureds. The Contractor shall provide the original and duplicate copy of the policy, as well as any and all endorsements, to the County.

☐Owners Protective Liability Policy covering and naming the "County of Westchester" as insured, with a minimum limit of liability per occurrence of $3,000,000. The Contractor shall provide the original and duplicate copy of the policy to the County.

☒Crane, Rigging, & Crane Operator (Rigger Liability) Insurance with a minimum limit of liability per occurrence of $5,000,000 for bodily injury and a minimum limit of $500,000 per occurrence for property damage or a combined single limit of $5,000,000, naming the "County of Westchester" as an additional insured

☒Pollution Liability, either by separate policy of insurance or through endorsement to the General Liability Policy with a minimum limit of $1,000,000.00, naming the "County of Westchester" as an additional insured. This insurance shall indicate the following coverages:

(i) Transit
(ii) Sudden and Accidental
(iii) Clean-up

SPECIAL NOTICE

County of Westchester
New York

☒ Asbestos and Lead Abatement General Liability Occurrence Policy in amounts not less than $1,000,000 and naming the "County of Westchester" as an additional insured.

☐ Other:_____
_____
_____
_____

3. All policies of the Contractor shall be endorsed to contain the following clauses:

(a) Insurers shall have no right to recovery or subrogation against the County (including its employees and other agents and agencies), it being the intention of the parties that the insurance policies so effected shall protect both parties and be primary coverage for any and all losses covered by the above-described insurance.

(b) The clause "other insurance provisions" in a policy in which the County is named as an insured, shall not apply to the County.

(c) The insurance companies issuing the policy or policies shall have no recourse against the County (including its agents and agencies as aforesaid) for payment of any premiums or for assessments under any form of policy.

(d) Any and all deductibles in the above described insurance policies shall be assumed by and be for the account of, and at the sole risk of, the Contractor.

4. In the event that any portion of the work described in this contract is to be performed by a subcontractor, the Contractor shall require in a written agreement with the subcontractor that the subcontractor furnish and maintain the above insurance, including naming the "County of Westchester" as an additional insured where indicated, unless, in the sole discretion of the County Director of Risk Management, the subcontractor is released from the requirement to provide such insurance. The Contractor shall provide proof of such insurance to the County Director of Risk Management. The subcontractor shall not commence work under the contract unless and until such proof of insurance has been approved by the Director of Risk Management.

5. The above policies for the Contractor and/or any of its subcontractors shall not contain any endorsements, terms, conditions or definitions that result in any labor law or action over exclusions.

6. The types of insurance required and/or policy limits listed above may be adjusted any time during the contract term by the Director when deemed appropriate, even if not indicated above by a blackened box (■) or by an X.

Certificate Holder on all certificates of insurance shall read: The County of Westchester, 148 Martine Avenue, White Plains, New York 10601.

PLEASE NOTE: **Printed copies of all of your full insurance policies, and any and all endorsements, are required.**

CONTRACT NO. 00-000

SPECIAL NOTICE

County of Westchester
New York

Airport Environmental Management System Requirements

General

The Contractor is responsible for complying with all federal, state and local legal environmental requirements.

Training

A two-hour environmental training session by the Airport Environmental Staff is required for the project superintendent, project manager and responsible foreman for contractors and subcontractors.

The Contractor shall designate a staff member who will be responsible for the oversight of environmental project requirements and to work as a liaison with the Airport Environmental Department.

Erosion and Sediment Control Activities

The Contractor shall comply strictly with Erosion and Sediment Control project specifications and regulatory requirements. Erosion and Sediment Controls may include, but not limited to, the following:

- Proper installation and use of erosion and sediment capture devices i.e. silt fences and hay bales
- Protection of storm drain inlets
- Proper and timely backfilling and stabilization of trench excavation
- Inspections of discharge points
- Proper maintenance of erosion and sediment capture devices

The Contractor shall be subject to Erosion and Sediment Control Inspections by the County and/or Airport Environmental Staff.

Airfield Vehicles and Equipment

The contractor shall ensure that all vehicles and equipment going onto the airfield are cooled with propylene glycol

SPECIAL NOTICE

County of Westchester
New York

Waste Management and Minimization

The Contractor shall dispose of waste in a manner that meets all applicable laws and regulations. Contractors shall make every effort to minimize waste production during construction operations.

Spills Prevention, Control and Response Procedures

The Contractors supervisory personnel will be trained in Airport Spill Prevention, Control and Response Procedures Requirements during the two-hour environmental training session. These supervisory personnel shall ensure that these requirements are complied with and that their on-site personnel are properly trained in spill prevention, control and response procedures that comply with Airport requirements. Contractor shall have a copy of these procedures available on site. The Contractor shall have appropriate spill clean-up equipment on site at all times.

In the event of a spill, the Contractor shall immediately respond to the spill in conformance with their spill procedures and as soon as possible report the spill to Airport Operations by radio or by telephone at 995-4850.

The Contractor is responsible for proper clean-up and disposal of waste materials generated by any spill resulting from their activities.

Good Housekeeping

The Contractor shall demonstrate good housekeeping practices and perform daily site clean-ups. The Contractor shall be subject to inspections by the County and/or Airport Environmental Staff.

Wetland Areas & Groundwater Monitoring Wells

The Contractor shall plan all work to avoid any disturbance, impact or destruction of wetland areas and groundwater monitoring wells. If an incident occurs, the Contractor shall be responsible for any costs associated with the restoration of wetland areas, and repair or replacement of groundwater monitoring wells.

Change to Environmental Project Design Specification

The Contractor shall receive approval from an authorized County representative prior to making any modifications that effect environmental project specifications due to field conditions.

SPECIAL NOTICE

County of Westchester
New York

CONTRACTOR SECURITY ID ISSUE

Qualifications

HPN IDs are required for all personnel performing contract work in the Secured Areas of the Airport or within the AOA (Air Operations Area).

Contractors performing work in the **SIDA Area** (Security Identification Display Area) of the terminal complex or airline ramp are required to go through the following process before gaining access to the SIDA:

- ID issue request
- Point of Contact (POC) information
- Complete a SIDA access application
- 2 Hour SIDA Course
- Establish proof of Identification
- Criminal History Record Check (Fingerprint processing)
- ID Security Deposit

Contractors performing work in the **Non-SIDA Areas** of the AOA are required to go through the following process before gaining access to the AOA:

- ID issue request
- POC information
- Complete a Non-SIDA access application
- Establish proof of Identification
- Verified 10 Year Employment History Background Check
- ID Security Deposit

Access to the SIDA or Non-SIDA areas can be also granted through the issuance of a HPN SIDA or Non-SIDA **Visitors ID**. All Visitor ID holders are required to surrender a specified form of ID for deposit at Airport Operations. Visitor ID holders require a HPN ID holder to sign out each recipient and continuously escort the Visitor while in the designated area. A maximum of 8 people can be escorted by an ID card holder at any time.

Submittals

Companies must submit an **ID Issue Request** in writing to the Airport Security office for either SIDA or Non-SIDA IDs. Included must be the reason for needing access, the location of work,

the duration of all phases of work, the names of all ID applicants, their purposes or job titles, and types of vehicles that require access to certain phases of work.

Companies must submit a point of contact (**POC**) as the responsible party for ID accountability. This person must be an ID holder and have daily interaction with planning and construction crews. The POC information must include:

- POC Name
- POC Address
- POC Telephone number
- Company telephone number

Companies requesting Non-SIDA access media must perform a full **10 Employment History Check** on each applicant. Contact of each agency must be verified, and there may be no gaps within the 10-year period.

Accountability

The company is accountable for all IDs issued, and must return all IDs within 1 week of completion of the specified work to Airport Security Personnel.

Lost or missing IDs are to be reported to Airport Operations immediately, and a lost ID processing fee of $100 will be charged before a new ID is reissued. If an individual loses an ID for the second time, a third ID will not be issued, the security deposit will not be refunded, and access to the airfield will be denied.

Airport IDs must be surrendered to Airport Operations personnel upon request.

Security Deposit

A security deposit of $100 (Cash or Check) will be held for each SIDA or Non-SIDA ID issued. Deposits will be returned within 2 weeks of ID return

IDs not returned upon completion of the contract will be considered lost, and a Lost ID processing fee of $100 will be charged to the company in addition to loosing the Security Deposit.

Issue

IDs will be issued within 1 week of receiving all required information, including FBI Fingerprint results posted by the TSA. Waiting periods between when printed, and when results are received may vary.

SPECIAL NOTICE

County of Westchester
New York

ID Processing Information

ID Processing	Tues.-Fri.	0900-1430 or
	Tues.-Thurs.	1600-1800
	Sun.	1130-1430
Bring Proper ID	(i.e. Passport or Drivers License & Social Security card)	

SIDA Course	1st and 3rd Thurs. each Month 1300-1500
	2nd and 4th Mon. each Month 1000-1200

Fingerprints	Tues.	0900-1100
$31.00 cash or check		1330-1430
Bring Proper ID	(i.e. Passport or Drivers License & Social Security card)	

Vehicle Identification

All vehicles on the AOA require a Class 1 or Class 2 permit. Class 2 permits will be issued and returned daily at Airport Operations.

Airport Conditions

Construction activities may be affected by certain conditions at the airport which may result in work delay or stoppage. Such Conditions may include the following:

- VIP Movements
- Emergency Events
- Weather
- Increased Department of Homeland Security Threat Levels
  - Alert Level Orange
    - Pre-access Checkpoints / Vehicle and equipment inspections
  - Alert Level Red
    - Pre-access Checkpoints / Vehicle and equipment inspections
    - or Construction not permitted

CONTRACT NO. 00-000

SPECIAL NOTICE

County of Westchester
New York

CHEMICAL LEAK RESTRICTIONS AT AIRPORT

A. It is now the County of Westchester – Department of Transportation's policy to ban the use of ethylene glycol for deicing aircraft and its use in construction equipment/vehicles (i.e. anti-freeze) at the Airport. This is in addition to the prior prohibition of other chemicals (i.e. gasoline, diesel fuel, lubricants, etc.) that can potentially leak/spill and contaminate the environment.

B. Passenger automobiles are excluded from this policy.

C. Failure to comply with this policy will cause the negligent contractor to be liable for all expenses incurred by damages or delay of work or impediment of Airport operations.

SPECIAL NOTICE

County of Westchester
New York

REQUIRED TRAINING FOR CONTRACTOR PERSONEL

A four hour training session by the airport manager will follow the preconstruction meeting and be required for all flaggers, project superintendent, project manager, and responsible foremen for contractor and subcontractors. All contractor's and subcontractor's personnel shall be trained regarding the importance of following the special procedures outlined in the special notes, inspection of the work for compliance with the special procedures, and safe disposal of trash. Flaggers shall be trained in the proper use of ground control radios and terminology.

An eight hour training session by the airport manager is required for all potential escort vehicle drivers. Scheduling of this training shall be arranged by the Contractor through the airport manager.

The Contract shall supply all escort vehicles with qualified drivers. Escort vehicles shall be pickup trucks or passenger vehicles in good working order. Vehicles shall be equipped with dashboard mounted radios, construction warning flags and rotary beacons. The airport manager reserves the right to reject any drivers and/or vehicles for failure to comply with these provisions.

All training for flaggers and drivers is to be completed prior to start of construction.

NOTICE TO CONTRACTORS

County of Westchester
New York

Sealed proposals for the following construction work:

CONTRACT NO: 25-532

ADVERTISING: September 18, 2026

MANDATORY PRE-BID INSPECTION: October 7, 2026

Building 1 Rehabilitation
Westchester County Airport
Towns of Harrison and North Castle and Village of Rye Brook, New York

will be received by the Board of Acquisition and Contract in Room 104, Michaelian Office Building, 148 Martine Ave., White Plains, New York until 11:00 a.m., **Wednesday, October 28, 2026**, and immediately thereafter, the bids will be publicly opened and read aloud in Room 527 of the said building. The bid opening also will be made accessible to the public via the livestreaming service WebEx. The livestreaming of the bid opening via WebEx is in addition to and not in place of the publicly bid opening to be held in Room 527 of the Michaelian Office Building. For additional bidding information or questions call (914) 995-2274.

Instructions for livestreaming via WebEx. Attendees may join by computer browser at https://westchestergov.webex.com/meet/bac-bidopening or by phone 1-415-655-0001 US Toll or 1-844-621-3956 US Toll Free. The Access Code is 614 981 028.

The Bid Documents **(**General Requirements, Information for Bidders, Technical Specifications, etc. with Authorized Proposal Pages and Contract Drawings) **MUST BE OBTAINED from the Empire State Purchasing Group website at the following web address:** http://www.bidnetdirect.com/new-york.
There is no cost to the bidder for this service. Bid documents will be available after 1:00 p.m. on the advertising date.

PLEASE TAKE NOTICE: IN ORDER TO SUBMIT A BID, BIDDERS MUST REGISTER AND DOWNLOAD THE BID DOCUMENTS FROM THE EMPIRE STATE PURCHASING GROUP WEBSITE AND MUST REGISTER USING THE NAME OF THE PERSON OR BUSINESS ENTITY THAT WILL BE SUBMITTING THE BID. IN ORDER TO ENSURE THAT COUNTY BID DOCUMENTS HAVE NOT BEEN ALTERED IN ANY WAY, THE COUNTY WILL NOT ACCEPT BIDS FROM PERSONS OR BUSINESS ENTITIES THAT HAVE NOT FOLLOWED THIS REQUIREMENT.

Each bidder is required to submit the full set of authorized Proposal Pages and all bids over **$100,000.00** must also be accompanied by the "Bid Bond and Consent of Surety" (as set forth in the Proposal Pages) attached to the outside of the sealed bid. Failure to submit in this manner may cause the bid to be rejected. **The successful bidder, no matter the amount of its bid, will be required to furnish a Performance and Payment Bond with its signed contract.**

To the full extent applicable, each bidder shall submit with its bid a separate sealed list that names each Subcontractor that the bidder will use to perform work on the contract and the agreed upon price to be paid to each for: (a) plumbing and gas fitting, (b) steam heating, hot water heating, ventilating and air conditioning apparatus and (c) electric wiring and standard illuminating fixtures and (d) general construction. The submission (Proposal Page 41) that contains the agreed upon price shall be acknowledged by both Contractor and Subcontractor. For purposes of this paragraph, the acknowledgment from the Subcontractor may contain the facsimile signature of an officer of the Subcontractor.

The Successful low bidder, before award of the contract, must obtain and provide to the County, from each of the above denoted Subcontractors, fully completed and signed Contract Disclosure Statement (Proposal Pages 24-32) and Required Disclosure of Relationships to County (Proposal Pages 33) forms.

The sealed lists of Subcontractors submitted by unsuccessful bidders shall be destroyed, unless you request that it be returned by checking the applicable box on Proposal Page 5.

The County of Westchester reserves the right to waive any informalities in the bids, or to reject any or all bids. No bidder may withdraw its bid within forty-five (45) days after the date of the bid opening.

Pursuant to Chapter 308 of the Laws of the County of Westchester, it is the goal of the County to use its best efforts to encourage, promote, and increase the participation of business enterprises owned and controlled by persons of color or women - Minority Business Enterprise (MBE) and Women Business Enterprise (WBE).

REMINDER: All required licenses should be submitted with the Bid.

COUNTY OF WESTCHESTER, NEW YORK
DEPT OF PUBLIC WORKS AND TRANSPORTATION

BY: Hugh J. Greechan, Jr., P.E., Commissioner

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Section 235216 Condensing Boilers
Section 237413 Commercial Packaged Rooftop Air Conditioning Units
Section 238205 Space Terminal Heating Units
Section 238216 Air Coils

DIVISION 26 – ELECTRICAL

Section 260000 Electrical Table of Contents
Section 260501 Electrical General Provisions
Section 260502 Equipment Connections and Coordination
Section 260504 Firestopping
Section 260513 15 KV Cable
Section 260519 600V Wire and Cable
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Section 260573 Electrical Power System Study
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Section 26 31 00Solar Photovoltaic System
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DIVISION 27– TECHNOLOGY

Section 270000 Technology Table of Contents
Section 270001 Communications Basic Requirements
Section 270528 Pathways for Communications Systems
Section 271101 Communication Equipment Rooms
Section 271300 Communications Backbone Cabling
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Section 274116 Integrated Audio-Video Systems and Equipment
Section 281000 Access Control and Intrusion Detection
Section 282300 Video Surveillance

DIVISION 32 – EXTERIOR IMPROVEMENTS

Section 323136 Security Gates and Barriers

1. GENERAL REQUIREMENTS AND PROPOSALS

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

1. DESCRIPTION OF THE WORK

Work under this Contract includes all necessary labor, materials and equipment required for the complete and comprehensive rehabilitation of Westchester County Airport Word War II Era Building 1. The objective is to repair all spaces within the building without expansion. Work includes fixing deteriorated core structural elements and addressing long-standing weathering external elements. Exterior work includes but is not limited to complete roof replacement, structural/waterproofing repairs to outer brick façade. Interior and systems upgrades include modernizing interior layouts, mechanical, electrical, HVAC, fire alarm and security components to meet current operational and safety standards for County Police and crucial Airport support staff. Refer to the complete set of drawings and specifications for the full scope of work.

It is not intended that this description of work mention each particular item required, but that it give information concerning the general scope and areas of work for the convenience of the bidders.

THIS PROJECT IS NOT SUBJECT TO THE REQUIREMENTS OF THE "WICKS LAW". ACCORDINGLY, EACH BIDDER IS REQUIRED TO SUBMIT SPECIFIC INFORMATION PERTAINING TO ITS PROPOSED SUBCONTRACTORS. PLEASE SEE THE "NOTICE TO CONTRACTORS" THAT FORMS A PART OF THESE BID DOCUMENTS.

2. SUBCONTRACTING & DIRECT EMPLOYMENT OF LABOR

The Contractor shall not subcontract more than ninety (90%) percent of its bid. The Contractor must directly employ at least ten (10%) percent of the personnel working on this contract as measured in man-days worked.

"Directly employ" shall be construed to include only workers employed and paid directly by the Contractor, usually for wages or salary.

The Contractor expressly acknowledges that any violation of this provision constitutes a default under this contract.

3. REQUIRED TIME FOR COMPLETION OF THE WORK

Notification to commence the work will require the mandatory submission of all the executed contracts and the Certificates of Insurance after receipt of authority to award.

The Contractor shall commence the work embraced in this contract within ten (10) days of the service of Notice by the County to do so and shall complete the said work within **730** consecutive calendar days computed from the date of such Notice to commence.

4. SECURITY REGULATIONS

Security Regulations For all County Facilities except County Correctional Facilities:

A. Contractor's attention is called to the fact that this work is to be performed on property which is the responsibility of the County; therefore, all personnel associated with this contract are subject to special conditions affecting security and control of the facilities operations. Every person required to enter the work site will be issued an ID card and be required to fill out appropriate applications. **There is a $30.00 processing fee for each lost ID card**; remitted by check made payable to the County of Westchester. All ID processing will be scheduled by the Construction Administrator.

B. The Contractor/Subcontractor shall issue a copy of the security regulations (Paragraph C) to all personnel engaged on this project.

C. All Contractor/Subcontractor personnel shall be bound by the following security regulations for the duration of this contract.

1) All personnel must conspicuously display the ID card and identify themselves upon request.

2) If an ID card is misplaced or lost, report this immediately to the Inspector.

3) All Contractor/Subcontractor personnel are responsible for all tools and equipment and you must report any loss immediately to the Construction Administrator.

4) All personnel must observe all orders of the Owner.

5) All personnel are to report any unusual incidents or problems to the Construction Administrator immediately.

6) All personnel shall not possess or consume any alcoholic beverage or illegal drug or medication while on the property, or report to work under the influence of alcohol or drugs.

7) Any vehicle left on the property must be locked and the ignition keys must be removed. Vehicles will not be left overnight without prior approval.

8) All personnel shall not enter any other areas of the premises (except the areas agreed to) without prior approval of the Construction Administrator.

Security Regulations For County Correctional Facilities:

A. Contractor's attention is called to the fact that this work is to be performed on property adjacent and/or within the County's Correctional Facilities; therefore, all personnel associated with this project are subject to special conditions affecting security and control of the Correctional Facility Operations. Every person required to enter the work site will be fingerprinted, processed for a photo ID card and be required to fill out appropriate applications. **There is a $100.00 processing fee for each person**, checks made payable to the Commissioner of Finance. All ID processing will be scheduled by the Construction Administrator.

B. All Contractors and Subcontractors shall issue a copy of the security regulations (Paragraph C) to all personnel to be engaged on this project.

C. All Contractor's and Subcontractor's personnel shall be bound by the following security regulations for the duration of this project.

1) All personnel entering the Penitentiary, Jail or Women's Unit must stop and identify themselves to the Control or Desk Officer who will issue the appropriate pass after ascertaining that they have been cleared to enter the facility. Only workers with valid ID will be permitted entry. **NO HELPERS**.

2) All personnel must sign in the Visitor's Book, to include the following information: **PERSON'S NAME, COMPANY NAME, REASON FOR ENTRY, WORK LOCATION IN BUILDING**.

3) All personnel must conspicuously display the ID card and identify themselves upon request.

4) If ID card is misplaced or lost, report this loss immediately to the Shift Captain or Associate Warden.

5) All tradesmen will be required to perform a tool inventory inspection of all tools in their possession to demonstrate to the admitting Correction Officer that the typed inventory list matches the tools each time they enter and leave the building. The tradesmen are responsible for keeping all tools and equipment locked when not in immediate use and they must report any loss of tools or equipment immediately to the Shift Captain or Associate Warden.

6) All tradesmen and helpers shall carry all tools in a locked and secured tool box or tool cart. A typed inventory sheet shall be carried with the tool box/cart listing all hand and power tools. A manufacturer’s MSD Sheet shall be carried with the tool box/cart for any chemical compound that the tradesman has in his/her possession.

7) All debris (i.e. packaging, demolition, etc) shall be removed from the worksite at the end of each workday.

8) All personnel are subject to search at all times.

9) All personnel must observe all orders of Correctional Staff.

10) All personnel are to report any unusual incidents or problems to a Correction Officer, Shift Captain or the Associate Warden immediately.

11) All personnel shall not possess or consume any alcoholic beverage or illegal drug or medication while on County property, or report to work under the influence of alcohol or drugs.

12) Any vehicle left on County property must be locked and the ignition keys must be removed. Vehicles will not be left over-night on County property without prior approval.

13) All personnel shall not enter any other areas of the prison (except the areas agreed to) without prior approval of the Shift Captain or the Associate Warden.

14) All personnel shall not bring anything in for any inmate/detainee or staff member or take out anything for any inmate/detainee or staff member.

15) All personnel shall not engage in any unnecessary conversations with any inmate/detainee.

16) Weapons, i.e., guns, knives, blackjacks, to include any tool activated by gunpowder or other explosive charge is prohibited in the building (i.e., stud gun). Violators of this rule are subject to arrest.

17) All personnel must sign out when leaving and must return the ID card to the Control/Desk Officer before leaving.

18) Failure of the contractor to follow these procedures will result in the contractor being denied access to the facility.

5. PAYMENT FOR BONDS AND INSURANCE

The amount bid for contract bonds and insurance shall not exceed 3%of the total contract price excluding the bid price for Miscellaneous Additional Work (Item W800) and Field Testing Equipment (W851), where applicable. Should the bidder exceed the foregoing three percent (3%), the Department will make the necessary adjustment to determine the total amount bid based on the arithmetically correct proposal.

The amount bid shall be payable with the first contract payment.

GENERAL REQUIREMENTS

CONTRACT DRAWINGS:

CONTRACT NUMBER 25-532

The Design Drawings, as listed on the Contract Drawing Index, herewith made a part of these Specifications, shows in general and/or in detail the work to be done under this Contract and/or the various Contracts forming the entire work for the Project, as described herein.

After sending the executed contract to the County and prior to the first job meeting, the Contractor is responsible for obtaining from Public Works, Division of Engineering, Michaelian Office Building, White Plains, a maximum of five gratis copies of the Contract Drawings and Specifications; for the Contractor's permanent possession. Additional sets, requested by the Contractor, beyond the permitted number and time limit, will be furnished by Public Works; but at the Contractor's expense.

SHEET NO.	TITLE	DRAWING NO.
G-000	COVER SHEET	48-08-T-373-0
G-001	DRAWING LIST	48-08-G-374-0
G-002	GENERAL NOTES	48-08-G-375-0
G-003	MOUNTING HEIGHTS AND STANDARDS	48-08-G-376-0
G-004	FEMA MAP	48-08-G-377-0
G-005	CODE REVIEW	48-08-G-378-0
G-010	ARCHITECTURAL SITE IMPROVEMENT PLAN	48-08-G-379-0
G-101	1ST FLOOR LIFE SAFETY PLAN	48-08-G-380-0
G-102	2ND FLOOR LIFE SAFETY PLAN	48-08-G-381-0
G-103	PLUMBING FIXTURE ANALYSIS	48-08-G-382-0
S-000	COVER SHEET	48-08-S-383-0
S-001	STRUCTURAL NOTES	48-08-S-384-0
SD-101	1ST FLOOR STRUCTURAL DEMOLITION PLAN	48-08-S-398-0
S-002	STRUCTURAL NOTES	48-08-S-385-0
S-101	1ST FLOOR - STRUCTURAL PLAN	48-08-S-386-0
S-102	2ND FLOOR STRUCTURAL PLAN	48-08-S-387-0
S-104	ROOF STRUCTURAL PLAN	48-08-S-388-0
S-300	SECTIONS AND DETAILS	48-08-S-389-0
S-301	SECTIONS AND DETAILS	48-08-S-390-0
S-302	SECTIONS AND DETAILS	48-08-S-391-0
S-400	TYPICAL DETAILS	48-08-S-392-0
S-401	TYPICAL DETAILS	48-08-S-393-0
S-500	SECTIONS AND DETAILS	48-08-S-394-0
S-501	SECTIONS AND DETAILS	48-08-S-395-0
S-502	SECTIONS AND DETAILS	48-08-S-396-0
S-503	SECTIONS AND DETAILS	48-08-S-397-0
FR-001	GENERAL NOTES	48-08-FR-399-0
FR-002	FACADE RESTORATION DESIGN CRITERIA	48-08-FR-400-0
FR-200	FACADE ASSESSMENT BLDG ELEVATIONS	48-08-FR-401-0
FR-201	FACADE ASSESSMENT BLDG ELEVATIONS	48-08-FR-402-0
FR-202	FACADE WALL SECTIONS	48-08-FR-403-0
FR-300	SECTIONS AND DETAILS	48-08-FR-404-0
FR-500	FACADE WALL SECTIONS AND DETAILS	48-08-FR-405-0

GENERAL REQUIREMENTS

FR-501	FACADE WALL SECTIONS AND DETAILS	48-08-FR-406-0
FR-502	SECTIONS AND DETAILS	48-08-FR-407-0
FR-503	SECTIONS AND DETAILS	48-08-FR-408-0
FR-504	FACADE WALL SECTIONS AND DETAILS	48-08-FR-409-0
AD-101	1ST FLOOR - DEMOLITION PLAN	48-08-A-410-0
AD-102	2ND FLOOR/LOWER ROOF - DEMOLITION PLAN	48-08-A-411-0
AD-103	UPPER ROOF - DEMOLITION PLAN	48-08-A-412-0
AD-110	EXTERIOR DEMO ELEVATIONS	48-08-A-413-0
AD-111	EXTERIOR DEMO ELEVATIONS	48-08-A-414-0
AD-130	DEMOLITION SECTION DETAILS	48-08-A-415-0
A-020	PARTITION TYPES	48-08-A-416-0
A-021	PARTITION TYPES - CONT.	48-08-A-417-0
A-101	1ST FLOOR - ARCHITECTURAL PLAN	48-08-A-418-0
A-102	2ND FLOOR - ARCHITECTURAL PLAN	48-08-A-419-0
A-103	ROOF - ARCHITECTURAL PLAN	48-08-A-420-0
A-110	EXTERIOR ELEVATIONS	48-08-A-421-0
A-111	EXTERIOR ELEVATIONS	48-08-A-422-0
A-120	BUILDING SECTIONS	48-08-A-423-0
A-121	WALL SECTIONS	48-08-A-424-0
A-122	WALL SECTIONS	48-08-A-425-0
A-123	EXTERIOR STAIRS & RAMPS ENLARGED PLANS AND ELEV	48-08-A-426-0
A-130	EXTERIOR DETAILS	48-08-A-427-0
A-131	ROOF DETAILS	48-08-A-428-0
A-201	1ST FLOOR - REFLECTED CEILING PLAN	48-08-A-429-0
A-202	2ND FLOOR - REFLECTED CEILING PLAN	48-08-A-430-0
A-500	FINISH SCHEDULE	48-08-A-431-0
A-501	1ST FLOOR - FINISH EXTENT PLAN	48-08-A-432-0
A-502	2ND FLOOR - FINISH EXTENT PLAN	48-08-A-433-0
A-601	1ST FLOOR - FURNITURE PLAN	48-08-A-434-0
A-602	2ND FLOOR - FURNITURE PLAN	48-08-A-435-0
A-700	ENLARGED PLANS & INTERIOR ELEVATIONS	48-08-A-436-0
A-701	ENLARGED PLANS & INTERIOR ELEVATIONS	48-08-A-437-0
A-702	INTERIOR ELEVATIONS	48-08-A-438-0
A-703	INTERIOR ELEVATIONS	48-08-A-439-0
A-800	ARCHITECTURAL DETAILS	48-08-A-440-0
A-801	MILLWORK DETAILS	48-08-A-441-0
A-803	CEILING DETAILS	48-08-A-442-0
A-804	FINISH DETAILS	48-08-A-443-0
A-900	DOOR TYPES & SCHEDULES	48-08-A-444-0
A-901	FENESTRATION TYPES & DETAILS	48-08-A-445-0
A-902	DOOR DETAILS	48-08-A-446-0
A-903	DOOR DETAILS - SILL	48-08-A-447-0
F-001	FIRE PROTECTION LEGEND & ABBREVIATIONS	48-08-FP-448-0
F-002	FIRE PROTECTION GENERAL NOTES	48-08-FP-449-0
F-100	FIRE PROTECTION 1ST FLOOR DEMOLITION PLAN	48-08-FP-450-0
F-101	FIRE PROTECTION 2ND FLOOR DEMOLITION PLAN	48-08-FP-451-0
F-200	FIRE PROTECTION 1ST FLOOR PLAN	48-08-FP-452-0
F-201	FIRE PROTECTION 2ND FLOOR PLAN	48-08-FP-453-0
F-202	FIRE PROTECTION ROOF FLOOR PLAN	48-08-FP-454-0
F-400	FIRE PROTECTION DETAILS #1	48-08-FP-455-0
F-401	FIRE PROTECTION DETAILS #2	48-08-FP-456-0
P-001	PLUMBING LEGEND AND ABBREVIATIONS	48-08-P-457-0

GENERAL REQUIREMENTS

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P-101	PLUMBING SECOND FLOOR DEMOLITION PLAN	48-08-P-459-0
P-200	PLUMBING UNDERGROUND FLOOR PLAN	48-08-P-460-0
P-201	PLUMBING FIRST FLOOR PLAN	48-08-P-461-0
P-202	PLUMBING SECOND FLOOR PLAN	48-08-P-462-0
P-203	PLUMBING ROOF PLAN	48-08-P-463-0
P-300	PLUMBING RISER DIAGRAMS	48-08-P-464-0
P-400	PLUMBING DETAILS SHEET 1	48-08-P-465-0
P-401	PLUMBING DETAILS SHEET 2	48-08-P-466-0
P-500	PLUMBING SCHEDULES	48-08-P-467-0
M-001	MECHANICAL LEGEND AND ABBREVIATIONS	48-08-M-468-0
M-100	MECHANICAL FIRST FLOOR DEMOLITION PLAN	48-08-M-469-0
M-101	MECHANICAL FIRST FLOOR DEMOLITION PLAN	48-08-M-470-0
M-102	MECHANICAL ROOF DEMOLITION PLAN	48-08-M-471-0
M-200	MECHANICAL FIRST FLOOR PLAN	48-08-M-472-0
M-200A	MECHANICAL FIRST FLOOR PART PLAN	48-08-M-473-0
M-201	MECHANICAL SECOND FLOOR PLAN	48-08-M-474-0
M-202	MECHANICAL LOWER ROOF PLAN	48-08-M-475-0
M-203	MECHANICAL UPPER ROOF PLAN	48-08-M-476-0
M-300	MECHANICAL PIPING FIRST FLOOR PLAN	48-08-M-477-0
M-301	MECHANICAL PIPING SECOND FLOOR PLAN	48-08-M-478-0
M-601	MECHANICAL SCHEDULES	48-08-M-479-0
M-602	MECHANICAL SCHEDULES #2	48-08-M-480-0
M-701	MECHANICAL DETAILS SHEET #1	48-08-M-481-0
M-702	MECHANICAL DETAILS SHEET #2	48-08-M-482-0
M-703	MECHANICAL DETAILS SHEET #3	48-08-M-483-0
M-704	MECHANICAL DETAILS SHEET #4	48-08-M-484-0
M-801	MECHANICAL CONTROL DIAGRAMS #1	48-08-M-485-0
M-802	MECHANICAL CONTROL DIAGRAMS #2	48-08-M-486-0
E-001	ELECTRICAL LEGEND & ABBREVIATIONS	48-08-E-487-0
E-002	ELECTRICAL GENERAL NOTES	48-08-E-488-0
E-050	ELECTRICAL SITE PLAN	48-08-E-489-0
E-100	ELECTRICAL 1ST FLOOR DEMOLITION PLAN	48-08-E-490-0
E-101	ELECTRICAL 2ND FLOOR DEMOLITION PLAN	48-08-E-491-0
E-102	ELECTRICAL ROOF DEMOLITION PLAN	48-08-E-492-0
E-200	ELECTRICAL 1ST FLOOR POWER PLAN	48-08-E-493-0
E-201	ELECTRICAL 2ND FLOOR POWER PLAN	48-08-E-494-0
E-202	ELECTRICAL ROOF POWER PLAN	48-08-E-495-0
E-300	ELECTRICAL 1ST FLOOR LIGHTING PLAN	48-08-E-496-0
E-301	ELECTRICAL 2ND FLOOR LIGHTING PLAN	48-08-E-497-0
E-302	ELECTRICAL ROOF LIGHTING PLAN	48-08-E-498-0
E-400	ELECTRICAL PART PLANS	48-08-E-499-0
E-501	ELECTRICAL RISER DIAGRAM	48-08-E-500-0
E-600	ELECTRICAL LIGHTING FIXTURE SCHEDULE	48-08-E-501-0
E-601	ELECTRICAL SCHEDULE SHEET #1	48-08-E-502-0
E-602	ELECTRICAL SCHEDULE SHEET #2	48-08-E-503-0
E-603	ELECTRICAL SCHEDULE SHEET #3	48-08-E-504-0
E-700	ELECTRICAL DETAILS SHEET #1	48-08-E-505-0
E-701	ELECTRICAL DETAILS SHEET #2	48-08-E-506-0
E-702	ELECTRICAL DETAILS SHEET #3	48-08-E-507-0
E-703	ELECTRICAL LIGHTING CONTROL DETAILS SHEET #1	48-08-E-508-0
E-704	ELECTRICAL LIGHTING CONTROL DETAILS SHEET #2	48-08-E-509-0
E-705	ELECTRICAL LIGHTING CONTROL DETAILS SHEET #3	48-08-E-510-0

E-800	ELECTRICAL ROOF LIGHTNING PROTECTION PLAN	48-08-E-511-0
E-801	ELECTRICAL LIGHTNING PROTECTION DETAILS SHEET #1	48-08-E-512-0
E-802	ELECTRICAL LIGHTNING PROTECTION DETAILS SHEET #2	48-08-E-513-0
E-900	ELECTRICAL ROOF PHOTOVOLTAIC PLAN	48-08-E-514-0
E-901	ELECTRICAL PHOTOVOLTAIC RISER DIAGRAM	48-08-E-515-0
FA-001	FIRE ALARM LEGEND AND ABBREVIATIONS	48-08-FA-516-0
FA-002	FIRE ALARM MATRIX	48-08-FA-517-0
FA-200	FIRE ALARM 1ST FLOOR PLAN	48-08-FA-518-0
FA-201	FIRE ALARM 2ND FLOOR PLAN	48-08-FA-519-0
FA-202	FIRE ALARM ROOF PLAN	48-08-FA-520-0
FA-500	FIRE ALARM RISER DIAGRAM	48-08-FA-521-0
FA-700	FIRE ALARM DETAILS	48-08-FA-522-0
T-001	TECHNOLOGY LEGEND & ABBREVIATIONS	48-08-T-523-0
T-200	TECHNOLOGY 1ST FLOOR PLAN	48-08-T-524-0
T-201	TECHNOLOGY 2ND FLOOR PLAN	48-08-T-525-0
T-202	TECHNOLOGY UPPER ROOF PLAN	48-08-T-526-0
T-202A	TECHNOLOGY LOWER ROOF PLAN	48-08-T-527-0
T-450	TECHNOLOGY ENLARGED PLANS	48-08-T-528-0
T-550	TECHNOLOGY DIAGRAMS	48-08-T-529-0
T-551	TECHNOLOGY DIAGRAMS	48-08-T-530-0
T-552	TECHNOLOGY DIAGRAMS	48-08-T-531-0
T-553	TECHNOLOGY DIAGRAMS	48-08-T-532-0
T-554	TECHNOLOGY DISPLAY ELEVATIONS	48-08-T-533-0
T-700	TECHNOLOGY DETAILS	48-08-T-534-0
T-701	TECHNOLOGY DETAILS	48-08-T-535-0

Submit all proposal pages in this section, including all executed and unexecuted pages and fasten with a clip at the upper left hand corner.

Kenneth W. Jenkins, Westchester County Executive

PROPOSAL PAGES

BUILDING 1 REHABILITATION
WESTCHESTER COUNTY AIRPORT
TOWNS OF HARRISON AND NORTH CASTLE AND
VILLAGE OF RYE BROOK, NEW YORK

Contract No. 25-532
Bid Opening: October 28, 2026

By Bidder (Please Print)	For Official Use Only
Firm/Business Name: _____	
Address: _____	_____
_____	_____

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

PROPOSAL REQUIREMENTS

BIDDER'S IDENTIFICATION

CONTRACT NO._____

To the Commissioner of Public Works, Westchester County, New York, acting for the party of the first part.

Proposal made by _____
as party of the second part.

Whose business address is _____

_____

_____

Whose telephone number is _____

Whose E-mail address is _____

Whose Federal ID number is _____

Is bidder an individual,
a partnership or a corporation? _____

If a partnership or corporation,
give the names of all partners
or officers with their titles _____

_____

_____

_____

_____

If operating under a trade name or as partners, has the required Certificate been filed with a County Clerk in accordance with the General Business Law, Section 130?

Yes....[ ] No....[ ] N.A….[ ]

If the answer is NO, Certificate must be filed before the contract can be executed.

NOTE: the bid must be submitted using the Contractor's legal name, not just the "doing business as" (i.e. DBA) name.

COMPLETE THIS FORM USING BLACK INK ONLY

PROPOSAL REQUIREMENTS

1. The undersigned, the bidder, does hereby declare that it has carefully read the contract specifications and has carefully studied the relevant plans, profiles and other drawings (as defined in Article "Contract Drawings" of the General Requirements) relating to the contract work, and has inspected the site(s) of the work..

2. The undersigned does hereby declare that it is the only one interested in its indicated bid; that the bid is in all respects without fraud or reservations; and that no official of the County or of the participating municipalities (if any), or any person in the employ of the County of participating municipalities (if any) is directly interested in the contract bid or in the supplies, equipment or works to which it relates, or in any part of the profits resulting there-from.

3. The undersigned does hereby offer and agree to furnish all materials, to fully and faithfully construct, perform and execute all work under the contract in accordance with the plans, profiles, other drawings and specifications relating thereto, and to furnish all labor, tools, implements, machinery, forms, transportation and materials necessary and proper for said purpose at the following indicated lump sum price for the total work and/or the following indicated unit prices for the various items of the work.

4. The undersigned does hereby declare that the indicated price(s) cover all expenses of every kind incidental to the completion of the contract work, including all claims affecting the work, labor and materials, which may arise through any cause whatsoever, excepting as provided for in Article "Disputed Work-Notice Of Claims For Damages: of the General Clauses.

5. The undersigned hereby agrees that in the event that the quantities of contract work actually performed by the undersigned are less than the approximate quantities indicated in the specifications it will make no claim(s) for loss of anticipated profits.

6. The undersigned does hereby agree that it will execute a contract containing all the terms, conditions, provisions and covenants necessary to complete the work according to the appropriate plans and specifications, within ten working days after receipt by the undersigned of the contract from the County, and that if it fails to execute said contract within said period of time the County may rescind the contract award and may retain as liquidated damages and not as a penalty, any amounts submitted as the bid security accompanying the undersigned's proposal, and/or demand from the Bidder's Surety Company that executed the required Bid Bond and Consent of Surety to pay to the County the difference between the amount bid and the amount for which such contract is thereafter awarded, together with the cost to the County of reletting said contract up to the maximum aggregate amount of 25% of the amount bid.

7. The undersigned does hereby agree to commence the work encompassed under the contract within ten days after notification in writing from the Commissioner of Public Works or his authorized designee, unless a definite earlier or later start has been specified, and will complete the work fully and in every respect on or before the specified completion date; and further agrees that the County has the right to employ such combination of labor, equipment

and materials as may be required for the proper completion of the contract work and to deduct all costs from such monies as may be due the undersigned, in the event the contract work is not completed by the specified completion date.

8. The undersigned does hereby agree to comply with all relevant provisions of the Labor Laws of the State of New York, and agrees to adhere to the provisions relating to the eight-hour day and five-day week, the payments of minimum rates for labor, and the latest laws relative to payments for wages for labor on public contracts.

9. The undersigned does hereby agree to insure all persons connected with the contract work against accident, at its own expense, as prescribed by the Workmen's Compensation Law of the State of New York; and that it will be responsible for payments by itself, its subcontractors and vendors of all taxes applicable to the work, and all other payments as may be required by various laws and rules and regulations of the Federal Government, the State of New York and its political subdivisions and agencies, such payments including but not limited to the following:

   A. Federal Social Security Taxes on employees' wages.

   B. Applicable Federal Excise Taxes.

   C. New York State Unemployment Insurance and Disability Payments, based on employees' wages.

10. The undersigned does hereby agree to accept their indicated lump sum price for the total work and/or their indicated unit prices for the various items of the work as the sole basis in the determination of the value of addition to, or deletions from the specified scope of the contract work.

11. ADDENDUM RECEIPT - CONTRACT NO._____

    (The undersigned shall fill in contract number above, and the required information below.)

    The undersigned does hereby acknowledge receipt of the below listed addenda to the contract specifications:

    Addendum No._____ Dated_____

    Addendum No._____ Dated_____

    Addendum No._____ Dated_____

    Addendum No._____ Dated_____

    Addendum No._____ Dated_____

COMPLETE THIS FORM USING BLACK ONLY

PROPOSAL REQUIREMENTS

12. Bidders should not submit the entire Bid document with its bid submission. Instead, Bidders must submit ALL of the Proposal Pages. Proposal Pages are denoted by a border and are titled on the bottom as "Proposal Page __".

    Be sure that, where required, the forms have been completed and signed by a notary public.

    Proposal Page 12 must be completed by a surety company and submitted with the bid if a Performance and Payment Bond is required in accordance with the "Notice to Contractors".

13. NON-COLLUSIVE BIDDING CERTIFICATION

Made pursuant to Section 103-d of the General Municipal Law of the State of New York as amended by the Laws of 1966.

A. By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in the case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of his knowledge and belief:

   1) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;

   2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and

   3) No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

B. A bid shall not be considered for award nor shall any award be made where a. (1), (2) and (3), above, have not been complied with; provided however, that if any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefore. Where a. (1), (2) and (3), above, have not been complied with, the bid shall not be considered for award nor shall any award be made unless the head of the purchasing unit of the political subdivision, public department, agency or official thereof to which the bid is made, or his designee, determines that such disclosure was not added for the purpose of restricting competition."

14. The undersigned and each person signing in behalf of the undersigned hereby executes the foregoing Affirmative Action Questionnaire, Proposal, Addendum Receipt and Non-Collusive Bidding Certification.

15. The undersigned and each person signing on behalf of the undersigned hereby certifies that

the person, firm or corporation submitting this proposal as the bidder has not been found guilty of a willful violation of the New York State Labor Law for failure to pay prevailing wages and supplements, as those terms are defined by the New York State Labor Law, within the twelve (12) months immediately preceding the submission of this bid.

16. The undersigned, by submitting the Proposal Pages, acknowledges that it has read the complete bid package including any and all addenda thereto and its bid includes all of the terms and conditions set forth in the bid documents, including, but not limited to, the Notice to Contractors, General Requirements and Proposals, Contract plans/drawings (if any), Proposal Forms, Information for Bidders, General Clauses, Sample Forms and Attachments, Sample Contract and Bond, Schedule of Hourly Rates and Supplements, Technical Specifications, any Special Notices and all applicable laws, rules and regulations. The undersigned further acknowledges that by submitting this bid the above denoted items are incorporated by reference and constitute an integral part of its bid.

17. The undersigned agrees that, if it is not the Successful bidder, the Sealed List of Subcontractors submitted with its bid can be destroyed by the County. **Please check the following box if you want the Sealed List of Subcontractors returned to you.** ☐

Dated_____, 20___

_____
Legal Name of Person, Firm or Corporation

(Seal of Corporation)

_____

_____
Business Address of Person, Firm or Corporation

By_____ _____
Signature Title

COMPLETE THIS FORM USING BLACK INK ONLY

LUMP SUM PROPOSAL CONTRACT NO. 25-532

BASE BID ITEMS

ITEM	DESCRIPTION	BID PRICE IN FIGURES	
		DOLLARS	CENTS
1	For providing all labor, material, and equipment necessary to complete all work as shown on the contract drawings and in accordance with the specifications for: Building 1 Rehabilitation at Westchester County Airport, Towns of Harrison and North Castle and Village of Rye Brook, New York.		
2	Contract Bonds and Insurance (Must not exceed 3.00% of Item A above)		
3	Necessary for miscellaneous additional work per Article Miscellaneous Additional Work (Item W-800)" of the Information for Bidders, as directed.	$ 1,500,000	00
4	Testing of Materials and Field Testing Equipment (Item W-851)	$ 20,000	00
5	Subsurface groundwater handling and disposal allowance	$75,000	00
6	Contaminated Soil Handling and disposal allowance	$75,000	00
TOTAL SUM OF AMOUNT BID FOR BASE BID ITEMS 1, 2, 3, 4, 5, 6 (Written in Figures)		DOLLARS	CENTS

COMPLETE THIS FORM USING BLACK INK ONLY

ALTERNATE LUMP SUM ITEMS

ITEM	DESCRIPTION	BID PRICE IN FIGURES	
		DOLLARS	CENTS
A1	**ALTERNATE 1** Roof mounted photovoltaic system including panels, disconnects, inverters, combiners, conduit, circuiting, racking, and mounting hardware, as shown on contract plans and specifications.		
A2	**ALTERNATE 2** Repointing Building 1 facade including helical wall ties, as shown on contract plans and specifications.		
A3	**ALTERNATE 3** Emergency Backup Generator and all associated work including concrete pad, as shown on contract plans and specifications.		

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACT NO. 25-532

GROSS SUM OF TOTAL BID AMOUNT

	DOLLARS	CENTS
TOTAL BID FOR "BASE BID + A1" (Written in Figures)		

	DOLLARS	CENTS
TOTAL BID FOR "BASE BID + A1 + A2" (Written in Figures)		

	DOLLARS	CENTS
TOTAL BID FOR "BASE BID +A1 + A2 + A3" (Written in Figures)		

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR: _____

ADDRESS: _____

_____

BY: _____

Signature/Title

BASIS OF AWARD

This contract consists of the Base Bid and THREE (3) Add Alternates as defined in the Specifications and on the Drawings.

It is the goal of the County to award the Base Bid and Alternates 1 through 3 if the low bid for all items are within the amount budgeted for this project. If the Base Bid and Alternates 1 through 3 exceed the amount budgeted for this project, the contract will be awarded to the bidder submitting the lowest Base Bid plus additional Alternate Bid items in the order they are listed, to include as many Alternate Bid items as possible, up to an amount that does not exceed the project budget. If the Base Bid and Alternate 1 exceed the amount budgeted for this project, the contract will be awarded to the bidder submitting the lowest Base Bid.

CONTRACTOR'S ACKNOWLEDGMENT

(If Corporate)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____ day of _____, 20___, before me personally came _____ _____to me known and known to me to be the_____ _____of_____the corporation described in and which executed the within instrument, who being by me duly sworn did depose and say that he the said_ _____resides at_____ _____and that he is_____of said corporation and knows the corporate seal of the said corporation; that the seal affixed to the within instrument is such corporate seal and that it was so affixed by order of the Board of Directors of said corporation, and that he signed his name thereto by like order.

_____
Notary Public

CONTRACTOR'S ACKNOWLEDGMENT

(If Individual)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____day of _____, 20___, before me personally came _____ _____to me known, and known to me to be the same person described in and who executed the within instrument and he duly acknowledged to me that he executed the same for the purpose herein mentioned and, if operating under the trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the County Clerk of Westchester County.

_____
Notary Public

CONTRACTOR'S ACKNOWLEDGMENT

(If Co-Partnership)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____day of _____, 20___, before me personally came _____ _____ to me known, and known to me to be a member of the firm of _____ and the person described in, and who executed the within instrument in behalf of said firm, and he acknowledged to me that he executed the same in behalf of, and as the act of said firm for the purposes herein mentioned and that the certificate required by the New York State General Business Law Section 130 has been filed with the County Clerk of Westchester County.

_____
Notary Public

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S ACKNOWLEDGMENT

(If Corporation/Sole Officer)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this _____ day of _____, 20__, before me

personally came _____ to me known and
(Name)

known to me to be the _____
(Title)

of _____, the corporation described in and which
(Name of Corporation)

executed the within instrument, who being by me duly sworn did depose and say that he/she,

resides at _____

and that he/she signed the within instrument, on behalf of said corporation, in his/her capacity

as the _____ and sole officer and director of said corporation
(Title)

and that he/she owns all the issued and outstanding capital stock of said corporation.

_____
Notary Public

COMPLETE THIS FORM USING BLACK INK ONLY

LIMITED LIABILITY COMPANY ACKNOWLEDGMENT

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this _____ day of _____, 20__, before me

personally came _____ to me known to be the individual
(Name of individual who signed agreement)

who executed the foregoing instrument, and who, being duly sworn by me, did depose and say that

(s)he is (the)(a) _____ of_____,
(member)(manager) *(name of limited liability company)*

a _____ limited liability company, and that (s)he has authority
(name of state)

to sign the same, and acknowledged that (s)he executed the same as the act and deed of said limited liability company.

Sworn to before me this ____ day
of _____, 20__

_____
Notary Public

My Commission Expires on: _____

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF AUTHORITY

I, _____
(*Officer other than officer executing proposed documents*)

certify that I am _____ of the
(*Title*)

_____
(*Name of Contractor*)

(the "Contractor"), a corporation duly organized and in good standing under the

_____
(*Law under which organized, e.g., the New York Business Corporation Law*)

named in the foregoing agreement; that _____
(*Person executing proposal documents*)

who signed said agreement on behalf of the Contractor was, at the time of execution the

_____ of the Contractor; that said agreement was
(*Title of such person*)

duly signed for and in behalf of said Contractor by authority of its Board of Directors, thereunto duly organized, and that such authority is in full force and effect at the date hereof.

_____
(*Signature*)

(SEAL)

STATE OF NEW YORK)
) ss.:
COUNTY OF)

On this _____ day of, _____, 20___, before me personally came _____ to me known, and known to me to be the _____ of _____, the Corporation described in and which executed the above certificate, who being by me duly sworn did depose and say that he, the said _____ resides at _____ and that he is _____ _____ of said Corporation and knows the Corporate Seal of the said Corporation; that the seal affixed to the above certificate is such Corporate Seal and that it was so affixed by order of the Board of Directors of said Corporation, and that he signed his name thereto by like order.

_____
Notary Public

COMPLETE THIS FORM IN BLACK INK ONLY

CERTIFICATE OF AUTHORITY-LIMITED LIABILITY COMPANY

I, _____,
(member or manager other than person executing the agreement)

certify that I am a _____ of _____
(member/manager) *(Name of Limited Liability Company)*

(the "LLC") duly organized under the Laws of the State of _____; that
(Name of State)

_____who signed said agreement on behalf of the LLC.
(Person Executing Agreement)

was, at the time of execution, a manager of the LLC; that said Contract was duly signed for and on behalf of said LLC and as the act of said LLC for the purposes herein mentioned.

_____
(Signature)

STATE OF NEW YORK)
ss.:
COUNTY OF _____)

On this _____ day of _____, 20___, before me personally came _____, to me known, and known to me to be the _____
(name of member/manager) *(member/manager)*
described in and who executed the above certificate, who being be me duly sworn did depose and say that he resides at _____, and he is a (member/manager) of said LLC; that he is duly authorized to execute said certificate on behalf of said LLC, and that he signed his name thereto pursuant to such authority.

_____
Notary Public *County*

My Commission Expires on:_____

COMPLETE THIS FORM USING BLACK INK ONLY

Required for all Bids over $100,000 where a Performance & Payment Bond is Required in accordance with the "Notice to Contractors"

CONTRACT NO. _____

BID BOND AND CONSENT OF SURETY

KNOW ALL PERSONS BY THESE PRESENTS, That _____
(Name of Contractor)

_____
(Address)

(hereinafter called the "Principal") and the _____ a corporation created and existing under the laws of the State of _____, having its principal office at_____ (hereinafter called the "Surety"),
(PRINT FULL ADDRESS OF SURETY)

are held and firmly bound unto the County of Westchester (hereinafter called the "Obligee"), in the full just sum of *Twenty-Five (25%) Percent of the Attached Bid*, good and lawful money of the United States of America, for the payment of which said sum of money, well and truly to be made and done, the said Principal binds themselves (himself/herself, itself), their (his/her, its) heirs, executors and administrators, successors and assigns, and the said Surety binds itself, its successors and assigns jointly and severally, firmly by these presents:

WHEREAS, the said Principal has submitted to the County of Westchester, New York, a proposal/bid for Contract Number: _____
Project Title: _____
_____ and

WHEREAS, under the terms of the Laws of the State of New York as above indicated, the said Principal has filed or intends to file this bond to guarantee that the Principal will execute all required contract documents, furnish all required insurance and furnish such Performance and Payment Bonds or other bonds as may be required in accordance with the terms of the Principal's said proposal/bid.

NOW, THEREFORE, the Surety agrees:

(i) if the Contract for which the preceding estimate and proposal is made, is awarded to the Bidder by the County, the Surety shall become bound as Surety and guarantor for the faithful performance of the Contract and shall execute and deliver a Performance & Payment Bond, in a form acceptable to the County, in the amount of 100% of the total Contract price, or such other amount as may be specified in the Bid documents, and shall execute the Contract as party of the third part when required to do so by the Board of Acquisition and Contract of the County; and

(ii) if the Bidder shall, upon award of the Contract to the Bidder, fail or refuse to execute the Contract and furnish the necessary bonds and insurance certificates, the Surety shall, on demand by the County, pay to the County the difference between the amount bid and the amount for which such contract is thereafter awarded, together with the cost to the County of reletting said Contract, up to the maximum aggregate amount of this bond.

(iii) the condition of the foregoing obligation is such, that if the said Principal shall promptly execute and submit, and the County shall accept, all required contract documents including insurance and such Performance and Payment Bond or other bonds, all as may be required in accordance with the terms of the Principal's said bid/proposal, then this obligation shall be null and void, otherwise to remain in full force and virtue.

The Surety, for value received, the receipt of which is hereby acknowledged by the Surety, hereby stipulates and agrees that the obligation of the Surety and of its bond shall remain absolute and shall be in no way impaired, affected or discharged by an extension of time, mutually agreed to by the County and the Bidder, within which the County may award said Contract, and the Surety hereby waives notice of any such extension.

IN TESTIMONY WHEREOF, the said Principal has hereunto set his/her (their, its) hand and the said Surety has caused this instrument to be signed by its duly authorized officer this_____ day of _____ 200__.

Signed and delivered this ____ day of _____ 20____ in the presence of:

_____
(Print Name of Contractor)

_____ Principal
(Signature)

_____
(Title of Authorized Officer)

_____
(Print Name of Surety)

By _____ Surety
(Signature)

_____
(Title of Authorized Officer)

(The Surety Company shall append a single copy of a statement of its financial condition, a copy of the resolution authorizing the execution of Bonds by officers of the Surety Company, Power of Attorney, Surety Acknowledgment.)

AFFIRMATIVE ACTION PROGRAM REQUIREMENT

Affirmative Action Program

An approved Affirmative Action Plan shall be required in all contracts for public work where the awarded contract amount exceeds $50,000 or more than fourteen (14) persons are employed by the Contractor and/or his subcontractors.

Does the Contractor participate in an approved Affirmative Action Program? Yes [ ] No [ ]

If Yes, give name of Program: _____

_____

If No, how many employees (total) does the Contractor employ. Please also include in your count the number of employees the Contractor and its Subcontractors expect to use on this project: _____

An approved Affirmative Action Program shall mean a plan approved or adopted by Westchester County including but not limited to, the Home-Town Plan, the Recruitment Training Program or any other program approved or meeting the requirements of the State or Federal government.

The "Monthly Employment Utilization Report" of the Sample Forms, shall be filled out by the Contractor and/or Subcontractor(s) who are required to have an Affirmative Action Program, prior to the start of the work.

Before any subcontractor is approved for use on this contract it will have to complete and submit the "Affirmative Action Program Requirement- Subcontractors" form of the Sample Forms.

COMPLETE THIS FORM USING BLACK INK ONLY

PROPOSAL PAGE
APPRENTICESHIP AGREEMENT REQUIREMENT

In accordance with Chapter 309 of the Laws of Westchester County, the bidder shall complete this form.

Questions the bidder shall answer as part of its bid:

(1) Is the bidder engaged in an occupation which is registered as apprenticeable by the New York State Commissioner of Labor?	Yes [ ] No [ ]
(2) Is the Contract being bid for the construction, reconstruction, improvement, rehabilitation, repair, furnishing, equipping of or otherwise providing for any building, facility or physical structure?	Yes [ ] No [ ]
(3) Is the Contract amount in excess of $250,000?	Yes [ ] No [ ]
(4) Is the total number of persons employed by the bidder more than 14?	Yes [ ] No [ ]

If the bidder answered "No" to Questions (1), (2) or (3) above, the bidder can stop here and should sign this form below before a notary public.

If the bidder answered "No" to Question (4) above, the Bidder must complete the following verification and sign this form below before a notary public:

VERIFICATION AS TO NUMBER OF PERSONS EMPLOYED
I hereby verify on behalf of the bidder and under penalty of perjury that the total number of persons employed by the bidder is 14 or fewer.
Signature of Bidder:_____ Print Name: Print Title:

If the bidder answered "Yes" to Questions (1), (2), (3) and (4) above, the bidder hereby certifies to the following:

1. The bidder has submitted with the bid proof of an Apprenticeship Agreement appropriate for the type and scope of work to be performed and registered with the New York State Commissioner of Labor pursuant to the requirements found in Article 23 of the New York State Labor law.
2. The bidder has submitted with the bid either:
    a. proof of 30% apprentice completion rate for the applicable registered apprenticeship program by the submission of the most recently available certificates of completion, which show that each of the bidder's applicable registered apprenticeship programs has an apprentice completion rate of at least thirty percent (30%) as determined by the New York State Department of Law,
    or
    b. proof of exemption from the 30% completion rate (See § 309.41(C) of the Local Law) by the submission of a copy of the relevant fully executed program registration agreement or proof of the New York State Department of Labor's provisional approval of the apprenticeship program.
3. The bidder shall provide each Subcontractor with notice of the requirements for Apprenticeship Agreements as appropriate, and a copy of Chapter 309 of the Laws of Westchester County, at the time of the execution of each respective Subcontract.

PROPOSAL PAGE
APPRENTICESHIP AGREEMENT REQUIREMENT

4. Within 90 days of the Date of the Award of the Contract, the bidder shall submit to the Commissioner, for all Subcontractors under the Construction Contract proof of an Apprenticeship Agreement and proof of a 30% completion rate for the applicable registered apprenticeship program or an exemption to the 30% completion rate. For this submission, the successful bidder shall use the Subcontractor Apprenticeship Form which can be found in the SAMPLE FORMS.

SIGNATURE

I hereby verify on behalf of the bidder and under penalty of perjury that the above statements are true and know that they will be relied upon by the County in the evaluation of the bid.

Name of Bidder:_____

Signature of Bidder:_____

Print Name:

Print Title:

NOTARY PUBLIC

STATE OF _____)
SS:
COUNTY OF _____)

_____, being duly sworn, deposes and says that he/she is the _____ of the bidder described herein and who executed the foregoing verification, that he/she has read the same and knows the contents thereof, and that the statements contained herein are true.

Sworn to before me this ____ day of _____, 202___.

_____
Notary Public

CERTIFICATE OF LICENSE

(TO BE COMPLETED BY AN ELECTRICAL BIDDER ONLY)

_____, being duly sworn
(Name)

deposes and says that the following statements are true:

(1) I am the _____ of the
(Title)

_____, the bidder named on the
(Name of Contractor)

bid proposal, and I have read and am familiar with: a) the electrical license requirements contained in the Information for Bidders of the bid, b) Chapter 277 Article XVII of the Laws of Westchester County entitled Electrical Licensing Board and the Licensing of Master Electricians, and c) the Westchester County Electrical Licensing Board Rules and Regulations.

(2) I am familiar with, and this bid is being submitted in compliance with, the Westchester County Electrical Licensing Board Rules and Regulations, in particular No. 11, which states as follows:

> No individual holding a Master Electrician's License shall lend such License to any person or allow any other person to carry on, engage in, or labor at the business as defined herein of installing, removing, altering, testing, replacing, or repairing electrical systems. A violation of this section by any person holding a License shall be sufficient cause for revocation of such License.
>
> However, nothing herein shall be construed to prohibit the use of a License by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that fifty-one (51) percent or more of the control of the voting capital stock of such partnership, corporation, or other business association is owned by one (1) or more holders of a Westchester County Master Electrical License and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such License holder or holders.

(3) That, as of this date, the bidder submitting the bid possesses the applicable valid Master/"Special" Electrician's license issued by the Westchester County Electrical Licensing Board; that this License is being used in compliance with the Laws of Westchester County and Westchester County Electrical Licensing Board Rules and Regulations; and **I have provided a copy of such license with the sealed bid proposal**.

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE (Continued)

(TO BE COMPLETED BY AN ELECTRICAL BIDDER ONLY)

(4) That all electrical work shall be performed in accordance with the requirements of Chapter 277 Article XVII of the Laws of Westchester County entitled Electrical Licensing Board and the Licensing of Master Electricians and the Westchester County Electrical Licensing Board Rules and Regulations.

(5) That I make this statement in connection with the submission of the bid as proof of the required electrical license, knowing that this statement will be relied upon by the County in the evaluation of that bid.

_____

Signature

Sworn to before me
this _____ day of _____

_____

License No.

_____

Notary Public - State of New York

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE

(TO BE COMPLETED BY A PLUMBING BIDDER ONLY)

_____, being duly sworn
(Name)

deposes and says that the following statements are true:

(1) I am the _____ of the
(Title)

_____, the bidder named on the
(Name of Contractor)

bid proposal, and I have read and am familiar with: a) the plumbing license requirements contained in the Information for Bidders of the bid, b) Chapter 277 Article XV of the Laws of Westchester County entitled Westchester County Board of Plumbing Examiners and County-wide Plumbing License, and c) the Westchester County Board of Plumbing Examiners Rules and Regulations.

(2) I am familiar with, and this bid is being submitted in compliance with, Section 277.509A of Article XV of Chapter 277 of the Laws of Westchester County, which states as follows:

> A. No holder of a license or certification issued under this article shall authorize, consent to or permit the use of his or her license or certification by or on behalf of any other person. No person who has not qualified or obtained a license or certification under this article shall represent himself or herself to the public as holder of a license or certification issued under this article, either directly, by means of signs, sign cards metal plates or stationery, or indirectly in any other manner whatsoever. However, nothing herein shall be construed to prohibit the use of a license by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that 51 percent or more of the control of the voting capital stock of such partnership, corporation or other business association is owned by one or more holders of a Westchester County master plumbing license and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such license holder or holders.

(3) That, as of this date, the bidder submitting the bid possesses a valid Master Plumber's license issued by the Westchester County Board of Plumbing Examiners; that this License is being used in compliance with the Laws of Westchester County and the Westchester County Board of Plumbing Examiners Rules and Regulations; and **I have provided a copy of such license with the sealed bid proposal**.

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE (Continued)

(TO BE COMPLETED BY A PLUMBING BIDDER ONLY)

(4) That all plumbing work shall be performed in accordance with the requirements of Chapter 277, Article XV of the Laws of Westchester County entitled Westchester County Board of Plumbing Examiners and County-wide Plumbing License, and the Westchester County Board of Plumbing Examiners Rules and Regulations.

(5) That I make this statement in connection with the submission of the bid as proof of the required plumbing license, knowing that this statement will be relied upon by the County in the evaluation of that bid.

_____

Signature

Sworn to before me
this _____ day of _____

_____

License No.

_____
Notary Public - State of New York

COMPLETE THIS FORM USING BLACK INK ONLY

CERTIFICATE OF LICENSE

(TO BE COMPLETED BY A HAULING BIDDER OR SUBCONTRACTOR ONLY)

_____, being duly sworn
(Name)

deposes and says that the following statements are true:

(1) I am the _____ of the
(Title)

_____, the bidder/subcontractor (circle one)
(Name of Contractor)

named on the foregoing bid proposal, and I have read and am familiar with the hauling license requirements contained in the Information for Bidders of the foregoing bid.

(2) That, as of this date, the bidder submitting the foregoing bid/subcontractor of the bidder submitting the foregoing bid (circle one) possesses a valid _____ license
(License type, i.e. Class "A")
issued by the Westchester County Solid Waste Commission.

(3) That all hauling work shall be performed in accordance with the requirements of Chapter 826-a of the Laws of Westchester County.

(4) That I make this statement in connection with the submission of the foregoing bid as proof of the required hauling license, knowing that this statement will be relied upon by the County in the evaluation of that bid.

_____

Signature

Sworn to before me
this _____ day of _____

_____

License No.

_____
Notary Public - State of New York

COMPLETE THIS FORM USING BLACK INK ONLY

STORMWATER POLLUTION PREVENTION CERTIFICATION

I certify under penalty of law that I understand and agree to comply with the terms and conditions of the Stormwater Pollution Prevention Plan ("SPPP") for the construction site identified in such SPPP as a condition of authorization to discharge stormwater. I also understand the operator must comply with the terms and conditions of the New York State Pollutant Discharge Elimination System ("SPDES") general permit for stormwater discharges from construction activities and it is unlawful for any person to contribute to a violation of water quality standards.

_____

Signature

Sworn to before me
This _____day of _____, 200_.

_____

Notary Public – State of New York, County of _____
My Commission Expires on _____.

This Certification will also have to be signed by your subcontractors. *Additional copies of this form can be acquired from the Department of Public Works.*

COMPLETE THIS FORM USING BLACK INK ONLY

PREVAILING WAGE RATES AND SUPPLEMENTS

Compliance with the New York State Construction (Article 1, Section 17) and the New York State Labor Law (Section 220)

Is your firm in full compliance with the New York State Labor Law?
(Please check one)

Yes _____ No _____

Are the wage supplements paid into a Federally approved program?
(Please check one)

Yes _____ No _____

If Yes, please indicate which program:

_____

_____

_____

If No, please indicate how the supplements are being paid:

_____

_____

_____

Yes, I have read and understand the terms of this Contract and the laws of this Agreement:

_____ Date: _____
Signature

_____ Date: _____
Notary Public

COMPLETE THIS FORM USING BLACK INK ONLY

MINORITY/WOMEN BUSINESS ENTERPRISE PROGRAM QUESTIONNAIRE
QUESTIONNAIRE REGARDING BUSINESS ENTERPRISES
OWNED AND CONTROLLED BY WOMEN OR PERSONS OF COLOR

As part of the County's program to encourage the meaningful and significant participation of business enterprises owned and controlled by persons of color or women in County contracts, and in furtherance of Section 308.01 of the Laws of Westchester County, completion of this form is required.

A "business enterprise owned and controlled by women or persons of color" means a business enterprise, including a sole proprietorship, limited liability partnership, partnership, limited liability corporation, or corporation, that either:

1.) meets the following requirements:
   a. is at least 51% owned by one or more persons of color or women;
   b. is an enterprise in which such ownership by persons of color or women is real, substantial and continuing;
   c. is an enterprise in which such ownership interest by persons of color or women has and exercises the authority to control and operate, independently, the day-to-day business decisions of the enterprise; and
   d. is an enterprise authorized to do business in this state which is independently owned and operated.

2.) is a business enterprise certified as a minority business enterprise ("MBE") or women business enterprise ("WBE") pursuant to Article 15-a of the New York State Executive Law and the implementing regulations, 9 New York Code of Rules and Regulations subtitle N Part 540 et seq., **OR**

3.) is a business enterprise certified as a small disadvantaged business concern pursuant to the Small Business Act, 15 U.S.C. 631 et seq., and the relevant provisions of the Code of Federal Regulations as amended.

Please note that the term "persons of color," as used in this form, means a United States citizen or permanent resident alien who is and can demonstrate membership of one of the following groups:

(a) Black persons having origins in any of the Black African racial groups;
(b) Hispanic persons of Mexican, Puerto Rican, Dominican, Cuban, Central or South American descent of either Indian or Hispanic origin regardless of race;
(c) Native American or Alaskan native persons having origins in any of the original peoples of North America; or
(d) Asian or Pacific Islander persons having origins in any of the Far East countries, South East Asia, the Indian subcontinent or the Pacific Islands.

1. Are you a business enterprise owned and controlled by women or persons of color in accordance with the standards listed above?

_____ No

_____ Yes

Please note: If you answered "yes" based upon certification by New York State and/or the Federal government, official documentation of the certification must be attached.

2. If you answered "Yes" above, please check off below whether your business enterprise is owned and controlled by women, persons of color, or both.

_____ Women

_____ Persons of Color (*please check off below all that apply)*

_____ Black persons having origins in any of the Black African racial groups
_____ Hispanic persons of Mexican, Puerto Rican, Dominican, Cuban, Central or South American descent of either Indian or Hispanic origin regardless of race
_____ Native American or Alaskan native persons having origins in any of the original peoples of North America
_____ Asian or Pacific Islander persons having origins in any of the Far East countries, South East Asia, the Indian sub-continent or the Pacific Islands

Name of Business Enterprise: _____

Address: _____

_____

Name and Title of person completing questionnaire: _____

_____

Signature: _____

_____ _____

Notary Public Date

CONTRACTOR'S DISCLOSURE STATEMENT

Instructions:

The County of Westchester, in order to insure that it employs responsible contractors for its major construction projects, requires all bidders for construction contracts (which includes reconstruction and repair) with an estimated value of One Hundred Thousand ($100,000.00) or more Dollars to answer completely and swear to the questions below. If a Contractor Disclosure Statement has been included with this bid specification, then the County has determined that it is applicable to this bid. All subcontractors whose contract has a value of One Hundred Thousand ($100,000.00) or more Dollars must also submit a Contractor Disclosure Statement.

Please read the questions carefully and answer them completely. Before you answer these questions, please read the definitions of terms used in these questions. While you may contact the Department of Public Works if you have questions about this form, the County cannot provide you with any legal advice for which you must contact your own lawyer. **FAILURE TO COMPLETE THIS CONTRACTOR DISCLOSURE STATEMENT IN GOOD FAITH MAY RESULT IN THE REJECTION OF YOUR BID**.

If you have previously filled out a Contractor Disclosure Statement for another County bid and only some but not all of your responses have changed, attach a copy of the prior Contractor Disclosure Statement and check #2 below indicating changes only and only answer those questions which have changed since you last filled out the Contractor Disclosure Statement.

If you have previously completed a Contractor Disclosure Statement for another County bid and nothing has changed in your responses to the questions, then check #3 and fill out the attached No Change Affidavit. Attach a copy of the prior Contractor Disclosure Statement to the No Change Affidavit.

NOTE IF THE SPACES PROVIDED FOR ANSWERS ARE NOT SUFFICIENT FOR YOU TO COMPLETE YOUR ANSWER TO A PARTICULAR QUESTION, THEN ATTACH ADDITIONAL PAGES TO THIS CONTRACTOR DISCLOSURE STATEMENT WHICH INDICATE THE NUMBER OF THE QUESTION THAT YOU ARE COMPLETING THE ANSWER FOR.

ALSO DO NOT LEAVE ANY ANSWERS BLANK. IF A QUESTION IS NOT APPLICABLE, ANSWER - N/A – AND OFFER A BRIEF EXPLANATION AS TO WHY THE QUESTION DOES NOT APPLY.

Definitions:

Affiliate – is another Business Entity in which the Contractor or one or more of the Principals of the Contractor has an ownership interest of more than fifty (50%) percent. An Affiliate is also another Business Entity in which the Parent of the Contractor owns more than fifty (50%) percent of that other Business Entity.

Agency or Government Agency – is any Federal, State, City or other local agency including, but not limited to, departments, offices, quasi-public agencies, public authorities and

corporations, boards of education and higher education, public development corporations and local development corporations.

Assignee – is a person or Business Entity to whom an assignment (e.g., a transfer to another of any property, real or personal, including a transfer of any rights in such property) is made.

Business Address – is the location of principal executive offices and is also the primary place of business in Westchester County, if different.

Business Entity – is any profit-seeking business including, but not limited to, corporations, limited and general partnerships, joint ventures and individual (sole) proprietorships.

Contract – is any binding agreement with any Government Agency or other Business Entity for the provision of goods, or services including, but not limited to, construction.

Contractor – is the Business Entity submitting this Contractor Disclosure Statement.

Contractor Disclosure Statement – is this document.

Control – A Business Entity controls another Business Entity when:

- The controlling Business Entity owns more than fifty (50%) percent of the controlled Business Entity, or
- The controlling Business Entity directs or has the right to direct daily operations of the controlled Business Entity, or
- The same person is a Principal in both businesses and directs the daily operations of the controlled Business Entity.

Investigations – is any official inquiry by any Government Agency, with the exception of background investigations for employment.

Officer – is any individual who serves in the function of chief executive officer, chief financial officer or chief operating officer of the Business Entity by whatever titles known.

Parent – is a Business Entity which owns more than fifty (50%) percent of another Business Entity.

Principal – is an individual, partnership, joint venture or corporation which holds ten (10%) percent or more ownership interest in the Business Entity.

Partner – shall mean a person or Business Entity that has a joint ownership in a particular business, but the ownership interest is not as a shareholder of a corporation.

Successor – is a person or Business Entity that takes the place that another has left. With reference to a corporation, a successor shall mean another corporation which, through amalgamation, consolidation, or other legal succession, becomes invested with the rights and assumes the burdens of the first corporation.

CONTRACTOR'S DISCLOSURE STATEMENT

CONTRACT NO.:_____
☐ Check if Subcontractor

Type Of Submission

(*Put a X or √next to the applicable type of submission*)

1. **Fully Completed Contractor Disclosure Statement** _____
(*Sign Oath on last page of Disclosure Statement*)

2. **Changes Only Contractor Disclosure Statement** _____
(*Attach copy of previously filed Contractor Disclosure Statement that you are amending. Denote any changes on the following Contractor Disclosure Statement. Sign Oath on last page of this Disclosure Statement*)

3. **No Change** _____
(*Fill out "No Change Affidavit" [below] and attach copy of previously filed Contractor Disclosure Statement*)

NO CHANGE AFFIDAVIT

I swear that the attached Contractor Disclosure Statement was submitted to the County of Westchester on _____ and was true as signed, and that
(*Date*)
since the above date nothing has occurred which changes in any way the responses made to the questions contained in the attached Contractor Disclosure Statement.

Submitted by: _____
(Signature)
Name (Print): _____
Title (Print): _____

Sworn to before me this ____ day of _____, 200_

_____
NOTARY PUBLIC

COMPLETE THIS FORM USING BLACK INK ONLY

CONTRACTOR'S DISCLOSURE STATEMENT

Questions:

1. The Business Address and taxpayer identification number of Contractor and primary telephone number for such location.

_____
_____
_____
_____

2. List the Business Addresses and primary telephone numbers for such locations, if different from answer to #1 above, where Contractor has been located over the last five (5) years.

_____
_____
_____
_____
_____
_____

3. List all other names and taxpayer identification numbers under which the Contractor, or the Principals and Officers of Contractor, have conducted business within the prior five (5) years.

_____
_____
_____
_____
_____

4. For any response to #3 above, list any and all Westchester County contracts that were awarded to such "other name" Business Entity.

_____
_____
_____
_____
_____

5. List the type of Business Entity that the Contractor is presently organized as (for example - sole proprietorship, partnership, joint venture or corporation).

_____
_____
_____
_____
_____
_____

COMPLETE THIS FORM USING BLACK INK ONLY

6. If Contractor is a corporation, list the date that the Contractor was incorporated. Also list the name of the Government Agency and location of said Agency in which a certificate of incorporation, certificate of doing business or equivalent, has been filed and the date of any amendments thereto. If, however, the Contractor is a partnership, list the date that the partnership was formed and the name of the Government Agency and location of said Agency in which a business certificate for partnership or equivalent has been filed.

7. List all the names, current Business Addresses and business telephone numbers of the Principals and Officers of the Contractor. If the Contractor is a partnership, list all partners and their business telephone numbers.

8. List the names, current Business Addresses, telephone numbers and taxpayer identification numbers of all Affiliates of the Contractor.

9. List all the names, Business Addresses and telephone numbers of the Principals and Officers of the Affiliates listed in response to #7 above. If the Affiliate is a partnership, list the Business Addresses and business telephone numbers of all partners.

COMPLETE THIS FORM USING BLACK INK ONLY

10. Is the Contractor Controlled by another Business Entity? ____Yes ____No. If you answered yes, please identify the name, Business Address and telephone number of that Controlling Business Entity and list any contracts that the Controlling Business Entity has had with Westchester County in the past five (5) years?

    _____
    _____
    _____
    _____
    _____

11. If the Contractor has Control of any other Business Entity that has had a Contract with the County of Westchester in the past five (5) years, please identify the name, Business Address and telephone number of that Controlled Business Entity.

    _____
    _____
    _____
    _____
    _____

12. List any and all contract sanctions imposed on the Contractor or on a Business Entity listed in response to #3 above that was imposed by a Government Agency during the prior five (5) years, including, but not limited to, all cautions, suspensions, debarments, cancellations of a contract based on business conduct, declarations of default, determinations of ineligibility to bid or whether any proceedings to determine eligibility to bid are pending.

    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____
    _____

13. List the contract sanction history for the past five (5) years, as defined in #12 above, for any Affiliate of the Contractor.

    _____
    _____
    _____
    _____
    _____
    _____
    _____

COMPLETE THIS FORM USING BLACK INK ONLY

14. If you answered yes to #10 above, list the contract sanction history as defined in #12 above for the Controlling Business Entity during the past five (5) years.

15. List any and all prevailing wage or supplement payment violations; state labor law violations deemed willful and any other federal or state citations, notices, violation orders, pending administrative hearings or proceedings or determinations of a violation of any labor law or regulation regarding the Contractor.

16. List all Investigations of the Contractor, its Principals and Officers or, if a partnership, of the Contractor's Partners. Also list all investigations of Affiliates, their Principals and Officers or, if a partnership, of their Partners.

COMPLETE THIS FORM USING BLACK INK ONLY

17. Have all Federal and State income tax returns, if required, been filed by Contractor during the last five (5) years? ____Yes ____No If you answered no, please explain why such returns were not filed.

_____
_____
_____
_____
_____

18. Are there any criminal proceedings pending against the Contractor or any Principal or Officer of the Contractor or partner, if Contractor is a partnership? ____Yes _____No If you answered yes, please provide details of the pending criminal proceedings.

_____
_____
_____
_____
_____
_____

19. List the record of all criminal convictions of the Contractor, any Principal or Officer or partner, if Contractor is a partnership, and of any former Principal or Officer, of the Contractor or former partner, if Contractor is a partnership, for any crime related to truthfulness or business conduct and for any felony committed within the prior ten (10) years.

_____
_____
_____
_____
_____
_____
_____
_____

20. List all bankruptcy proceedings that the Contractor or its Affiliates have been the subject of within the past seven (7) years, whether pending or completed.

_____
_____
_____
_____
_____
_____
_____
_____

COMPLETE THIS FORM USING BLACK INK ONLY

21. Is the Contractor a successor, assignee or Affiliate of a Business Entity that has ever been denied a Contract or deemed ineligible to bid on a Government Agency contract?
____Yes No ____ If you answered yes, explain below.

_____
_____
_____
_____
_____
_____
_____
_____

OATH

I swear that all of the above answers are true based on my knowledge of the facts, or are believed by me to be true, based upon a review of records containing the facts or based upon information I obtained from someone who has knowledge of the facts; and that I have authority to sign this document; and that the answers given above have not been made in a manner intended to deceive or to defeat the purpose of the Contractor Disclosure Statement, which is to assist the County of Westchester in determining if the Contractor is a responsible bidder.

Submitted by: _____
(Signature)

Name (Print): _____

Title (Print): _____

Sworn to before me this ____ day of

_____, 20__

_____
NOTARY PUBLIC

COMPLETE THIS FORM USING BLACK INK ONLY

REQUIRED DISCLOSURE OF RELATIONSHIPS TO COUNTY

(Prior to execution of a contract by the County, a potential County contractor must complete, sign and return this form to the County)

Contract Name and/or ID No.:
(To be filled in by County)
Name of Contractor:
(To be filled in by Contractor)

A potential County contractor must complete this form as part of the proposed County contract.

1.) Are any of the employees that the Contractor will use to carry out this contract also a County officer or employee, or the spouse, child, or dependent of a County officer or employee?

Yes _____ No _____

If yes, please provide details (attach extra pages, if necessary): _____
_____

2.) Are any of the owners of the Contractor or their spouses a County officer or employee?

Yes _____ No _____

If yes, please provide details (attach extra pages, if necessary): _____
_____

3.) Do any County officers or employees have an **interest**[1] in the Contractor or in any approved subcontractor that will be used for this contract?

Yes _____ No _____

If yes, please provide details (attach extra pages, if necessary): _____
_____

By signing below, I hereby certify that I am authorized to complete this form for the Contractor.

_____

Name: _____
Title: _____
Date: _____

[1] "Interest" means a direct or indirect pecuniary or material benefit accruing to a County officer or employee, his/her spouse, child or dependent, whether as the result of a contract with the County or otherwise. For the purpose of this form, a County officer or employee shall be deemed to have an "interest" in the contract of:

1.) His/her spouse, children and dependents, except a contract of employment with the County;
2.) A firm, partnership or association of which such officer or employee is a member or employee;
3.) A corporation of which such officer or employee is an officer, director or employee; and
4.) A corporation of which more than five (5) percent of the outstanding capital stock is owned by any of the aforesaid parties.

QUESTIONNAIRE REGARDING BUSINESS ENTERPRISES OWNED AND CONTROLLED BY SERVICE-DISABLED VETERANS

The County believes it is a laudable goal to provide business opportunities to veterans who were disabled while serving our country, and wants to encourage the participation in County contracts of certified business enterprises owned and controlled by service-disabled veterans. As part of the County's program to encourage the participation of such business enterprises in County contracts, and in furtherance of Article 17-B of the New York State Executive Law, we request that you answer the questions listed below.

The term "Certified Service-Disabled Veteran-Owned Business" shall mean a business that is a certified service-disabled veteran-owned business enterprise under the New York State Service-Disabled Veteran-Owned Business Act (Article 17-B of the Executive Law).

1. Are you a business enterprise that is owned and controlled by a service-disabled veteran in accordance with the standards listed above?

_____ No
_____ Yes

2. Are you certified with the State of New York as a Certified Service-Disabled Veteran-Owned Business?

_____ No
_____ Yes

3. If you are certified with the State of New York as a Certified Service-Disabled Veteran-Owned Business, please attach a copy of the certification.

Name of Firm/Business Enterprise: _____
Address: _____
Name/Title of Person completing Questionnaire: _____
Signature: _____

STATE OF NEW YORK)
) ss.:
COUNTY OF)

_____

Notary Public

Date:

SCHEDULE "F"
CRIMINAL BACKGROUND DISCLOSURE
INSTRUCTIONS

Pursuant to Executive Order 1-2008, the County is required to maintain a record of criminal background disclosure from all persons providing work or services in connection with any County contract, including leases of County-owned real property and licenses:

a.) If any of the persons providing work or services to the County in relation to a County contract are not subject to constant monitoring by County staff while performing tasks and/or while such persons are present on County property pursuant to the County contract; and
b.) If any of the persons providing work or services to the County in relation to a County contract may, in the course of providing those services, have access to sensitive data (for example SSNs and other personal/secure data); facilities (secure facilities and/or communication equipment); and/or vulnerable populations (for example, children, seniors, and the infirm).

In those situations, the persons who must provide a criminal background disclosure ("Persons Subject to Disclosure") include the following:

a.) Consultants, Contractors, Licensees, Lessees of County-owned real property, their principals, agents, employees, volunteers or any other person acting on behalf of said Contractor, Consultant, Licensee, or Lessee who is at least sixteen (16) years old, including but not limited to Subconsultants, subcontractors, Sublessess, or Sublicensees who are providing services to the County, and
b.) Any family member or other person, who is at least sixteen (16) years old, residing in the household of a County employee who lives in housing provided by the County located on County property.

Under Executive Order 1-2008, it is the duty of every County Consultant, Contractor, Licensee, or Lessee to inquire of each and every Person Subject to Disclosure and disclose whether they have been convicted of a crime or whether they are subject to pending criminal charges, and to submit this form with that information.[1] Accordingly, you are required to complete the attached Criminal Background Disclosure Form and Certification.

Please note that under no circumstances shall the existence of a language barrier serve as a basis for the waiver of or an exception from the disclosure requirements of Executive Order 1-2008. If translation services are required by the Consultant, Contractor, Licensee, or Lessee to fulfill this obligation, it shall be at the sole cost and expense of the Consultant, Contractor, Licensee, or Lessee.

Please also note that the conviction of a crime(s) and/or being subject to a pending criminal charge(s) will not automatically result in a denial of a person's right to work on a County contract, right to be on County property, or license, but may, if the County determines that the prior conviction(s) or pending criminal charge(s) create an unacceptable risk. However, if a person fails to list or falsifies any part of his/her conviction history or any pending criminal charge(s) for any reason, he/she may be prohibited from working or being on County property without any risk assessment. If it is later determined that a Person Subject to Disclosure failed to disclose a criminal conviction or pending criminal charge for any reason, his/her right to work on a County contract, be on County property, or license may be terminated at any time.

Please further note that, pursuant to Executive Order 1-2008, and subject to the applicable provisions of New York Correction Law §§ 752 and 753, the County has the right to bar a Person Subject to Disclosure from providing work or services to the County or from being on County property if any such person has:

a.) A conviction of a crime(s);
b.) A pending criminal proceeding for a crime(s); or
c.) Refused to answer questions concerning his/her criminal background

[1] For these disclosures, a "crime" or "pending criminal charge" includes all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State.

Please finally note that any failure by a County Consultant, Contractor, Licensee, or Lessee to comply with the disclosure requirements of Executive Order 1–2008 may be considered by the County to be a material breach and shall be grounds for immediate termination by the County of the related County contract.

Exemptions

Executive Order 1-2008 exempts from the aforementioned disclosure requirements Persons Subject to Disclosure:

a.) for whom the County has already conducted a background check and issued a security clearance that is in full force and effect; and

b.) for whom another state or federal agency having appropriate jurisdiction has conducted a security and/or background clearance or has implemented other protocols or criteria for this purpose that apply to the subject matter of a County contract that is in full force and effect.

If you are claiming an exemption for one or more Persons Subject to Disclosure, you must notify the Procuring Officer[2]. The Procuring Officer will then determine whether the Person(s) Subject to Disclosure are actually exempt, and provide written notification of his/her determination. If the Procuring Officer determines that a Person Subject to Disclosure is not exempt, the Procuring Officer will notify you of that determination, and you will have to include disclosures for that person on your Criminal Background Disclosure Form and Certification.

[2] Procuring Officer" shall mean the head of the department or the individual or individuals authorized by the head(s) of the department(s) undertaking the procurement and with respect to those matters delegated to the Bureau of Purchase and Supply pursuant to Section 161.11(a) of the Laws of Westchester County, the Purchasing Agent.

Subconsultants, Subcontractors, Sublessees, or Sublicensees

Under Executive Order 1-2008, it is your duty to ensure that any and all approved subconsultants, subcontractors, sublessees, or sublicensees complete and submit the attached Criminal Background Disclosure Form and Certification for all of their respective Persons Subject to Disclosure. This must be done before such a subconsultant, subcontractor, sublessees, or sublicensees can be approved to perform work on a contract.

New Persons Subject to Disclosure

Under Executive Order 1-2008, you have a **CONTINUING OBLIGATION** to maintain the accuracy of the Criminal Background Disclosure Form and Certification (and any accompanying documentation) for the duration of this contract, including any amendments or extensions thereto. Accordingly, it is your duty to complete and submit an updated Criminal Background Disclosure Form and Certification whenever there is a new Person Subject to Disclosure for this contract. **NO NEW PERSON SUBJECT TO DISCLOSURE SHALL PERFORM WORK OR SERVICES OR ENTER ONTO COUNTY PREMISES UNTIL THE UPDATED CRIMINAL BACKGROUND DISCLOSURE FORM AND CERTIFICATION IS FILED WITH THE PROCURING OFFICER.** You shall also provide the County with any other updates that may be necessary to comply with the disclosures required by Executive Order 1-2008.

PLEASE CONTINUE TO THE

Criminal Background Disclosure Form and Certification

BEGINNING ON THE NEXT PAGE

CONTRACT #:_____

Name of Consultant, Contractor, Lessee, or Licensee: _____

CRIMINAL BACKGROUND DISCLOSURE FORM AND CERTIFICATION

If this form is being completed by a subconsultant, subcontractor, sublessee, or sublicensee, please consider all references in this form to "consultant, contractor, lessee, or licensee" to mean "subconsultant, subcontractor, sublessee, or sublicensee" and check here: _____

I, _____, certify that I am a principal or a
(Name of Person Signing Below)

representative of the Consultant, Contractor, Lessee, or Licensee and I am authorized to complete and execute this Criminal Background Disclosure Form and Certification. I certify that I have asked each Person Subject to Disclosure the following questions:

- **Have you or your company ever been convicted of a crime (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State) including, but not limited to, conviction for commission of fraud, embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements or receiving stolen property?**

- **Are you or your company subject to any pending criminal charges (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State)?**

I certify that the names and titles of Persons Subject to Disclosure who refused to answer **either** of the questions above are:

1. _____
2. _____
3. _____
4. _____
5. _____

(If more space is needed, please attach separate pages labeled "REFUSED to Answer - Continued.")

I certify that the names and titles of Persons Subject to Disclosure who answered "Yes" to **either of the** questions above are:

1. _____

2. _____

3. _____

4. _____

5. _____

(If more space is needed, please attach separate pages labeled "YES Answers - Continued.")

Each Person Subject to Disclosure listed above who has either **been convicted of a crime(s)** and/or **is subject to a pending criminal charge(s)** must answer additional questions. Those questions are below.

A Person Subject to Disclosure who has **been convicted of a crime(s)** must respond to the following (please attach separate pages with responses for each person, with their name and title):

1.) Describe the reason for being on County property if applicable, identify the specific duties and responsibilities on this project which you intend to perform for the County, including but not limited to, access to sensitive data and facilities and access to vulnerable populations.
2.) Please list all criminal convictions along with a brief description of the crime(s) (including all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State).
3.) Please provide the date and place of each conviction.
4.) Please provide your age at the time of each crime for which you were convicted.
5.) Please provide the legal disposition of each case.
6.) Please provide any information either produced by yourself or someone on your behalf in regards to your rehabilitation and good conduct.

A Person Subject to Disclosure who **is subject to a pending criminal charge(s)** must respond to the following (please attach separate pages with responses for each person, with their name and title):

1.) Describe the reason for being on County property and if applicable, identify the specific duties and responsibilities on this project which you intend to perform for the County, including but not limited to, access to sensitive data and facilities and access to vulnerable populations.
2.) Please identify all pending criminal charges (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State).
3.) Please briefly describe the nature of the pending charges and the date upon which it is alleged that a crime was committed.

I hereby certify that all of the information provided herein (and in any and all attachments) is true and accurate and that all disclosures required by Executive Order 1-2008 and this Criminal Background Disclosure Form and Certification have been completed. By my signature below, I hereby affirm that all of the facts, statements and answers contained herein (and in any and all attachments) are true and correct. I understand that providing false or incomplete information or withholding by omission or intention pertinent information will be cause for refusing further consideration of my being utilized under this contract.

It is understood and agreed that no Person Subject to Disclosure shall perform work or services or enter onto County property until this required Criminal Background Disclosure Form and Certification is filed with the Procuring Officer.

It is understood and agreed that to the extent that new Persons Subject to Disclosure are proposed to perform work or provide services under this contract after filing of this Criminal Background Disclosure Form and Certification with the Procuring Officer, such new Persons Subject to Disclosure shall not perform work or provide services or enter into County property until an updated Criminal Background Disclosure Form and Certification has been filed with the Procuring Officer.

It is further understood and agreed that the consultant, contractor, lessee, or licensee has a continuing obligation to maintain the accuracy of the Criminal Background Disclosure Form and Certification for the duration of this contract, including any amendments or extensions thereto, and shall provide any updates to the information to the County as necessary to comply with the requirements of Executive Order 1-2008.

_____

Name: _____
Title: _____
Date: _____

_____ _____
Notary Public Date

SUBCONTRACTOR'S SEALED BID SUBMISSION

Westchester County Contract No.:_____

Name of Subcontractor:_____

Address:_____

Phone #:_____ **Fax #:**_____

E-mail address:_____

Name of Contractor to whom this bid is submitted:_____

Scope of Work to be performed by Subcontractor (e.g., electrical, plumbing, HVAC):

_____

_____

The price agreed upon by and between Contractor and Subcontractor for the full performance of the Subcontractor's work:

$:_____

In words (e.g, one hundred thousand dollars and xx/100):

_____

_____

Subcontractor	**Contractor**
_____	_____
Signature	Signature
By_____	**By**_____
(print name & title)	**(print name & title)**

THE SUCCESSFUL LOW BIDDER, BEFORE AWARD OF THE CONTRACT, MUST PROCURE AND PROVIDE TO THE COUNTY, FROM EACH OF THE ABOVE DENOTED SUBCONTRACTORS, A CONTRACT DISCLOSURE STATEMENT (PROPOSAL PAGES 24-32) AND THE REQUIRED DISCLOSURE OF RELATIONSHIPS TO COUNTY (PROPOSAL PAGES 33-34)

COMPLETE THIS FORM USING BLACK INK ONLY

2. INFORMATION FOR BIDDERS

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

INFORMATION FOR BIDDERS

1. ADDENDA AND INTERPRETATION

No interpretation of the meaning of the plans, specifications or other contract documents will be made to any bidder orally. Every request for such interpretation should be in writing addressed to the Westchester County Department of Public Works, Division of Engineering, Room 512, Michaelian Office Building, White Plains, New York, and to be given consideration must be received at least five (5) days prior to the date fixed for the opening of bids. Any and all such interpretations and any supplemental instructions will be in the form of written addenda to the specifications which, if issued, will be posted on the internet not later than three (3) days prior to the date fixed for the opening of bids. Revisions to plans or drawings requiring the issuance of additional or revised drawings will be noted on the internet with instructions how to acquire copies of such revised plans or drawings. Failure of any bidder to receive any such addendum or interpretation or any other form, instrument or document shall not relieve any bidder from any obligation under its bid as submitted. All addenda so issued shall become part of the contract documents.

A bidder's failure to request a clarification, interpretation, etc. of any portion of the plans, specifications, or contract or to point out any inconsistency therein will preclude such bidder from thereafter claiming any ambiguity, inconsistency, or error which should have been discovered by a reasonably prudent bidder and from asserting any claim for damages arising directly or indirectly therefrom.

2. VOIDED CLAUSES

Wherever in this booklet any page is stamped "VOID", only the section(s) or paragraph(s) so stamped are void. All other sections(s) and paragraph(s) remain in full force and effect.

3. PRE-BID SITE INSPECTION

Unless otherwise stated, on building construction work, bidders are free and encouraged to examine the work site during normal work hours preceding the date on which bids are to be opened. For those bidders requesting further clarification of the conditions, an appointment with the County's representative, on the eighth day (Tuesday) prior to the bid opening date, can be requested, by contacting the, Department of Public Works, Division of Engineering at (914) 995-2553.

Each bidder must inform itself fully of the conditions relating to the work to be performed. Failure to do so will not relieve a successful bidder of the obligation to furnish all material and labor necessary to carry out the provisions of the contract documents and to complete the contemplated work for the consideration set forth in its Bid.

At the time of the opening of bids each bidder will be presumed to have inspected the sites and to have read and to be thoroughly familiar with the Plans and Contract Documents (including all addenda).

4. BID SECURITY

Bid Security shall be provided in accordance with the "Notice to Contractors." Where

a Performance and Payment bond is required in the Notice to Contractors, the executed "Bid Bond and Consent of Surety" of the Proposal Pages must be submitted with the Bid when the bid is more than $100,000. The successful bidder, no matter the size of its bid, will be required to furnish a Performance and Payment Bond.

Where a Performance and Payment Bond is not specified in the Notice to Contractors, then the required Security may be furnished in the form of a Certified Check; drawn to the order of "County of Westchester, clipped to the top of the front cover and submitted with the Bid.

Certified checks submitted will be returned to all bidders submitting certified checks within three (3) days after the opening of bids unless the bidder or bidders submitting certified checks are among the two lowest bidders. At any time after the opening of bids, the second lowest bidder, if the second lowest bidder has submitted a certified check, may substitute a bid bond for the certified check by presenting the bond to the Secretary of the Board of Acquisition and Contract. This bond shall be in the form and coverage required by the County and shall be in an amount not less than the amount of the bidder's certified check. After receipt, approval and acceptance of the bond by the County, the County will forward to the bidder a County check in an amount equal to the bidder's certified check.

All certified checks submitted will be returned to the two lowest bidders within 48 hours after the successful bidder executes the required contract and furnishes the County with all necessary bonds and insurance certificates.

In the event that the successful bidder has not executed the required contract and furnished the required bonds and insurance certificates within forty-five (45) days after the opening of bids, the County, upon demand from a bidder (except for the successful bidder), will send a County check to the bidder in the amount of the bidder's certified check.

Failure of the successful bidder to execute the contract and furnish the necessary bonds and insurance certificates shall result in forfeiture of the bid security, such sum to be retained by the County as liquidated damages.

5. PERFORMANCE AND PAYMENT BOND

If required pursuant to "Notice to Contractors."

If a Performance and Payment bond is required in accordance with the "Notice to Contractors", the "Bid Bond and Consent of Surety" of the Proposal Pages must be executed by the Contractor's Surety Company and submitted with the Bid for all bids over $100,000.

Simultaneously with its delivery of the executed contract, the successful bidder shall deliver to the County an executed bond in the amount of one hundred percent of the accepted bid as security for the faithful performance of its contract and in the amount of one hundred percent for the payment of all persons performing labor or furnishing materials in connection therewith, prepared in satisfactory form and having as surety thereon such bond underwriter or surety that appears on the U.S. Treasury's listing of approved sureties (Department Circular 570), and is licensed to transact business in New York State. In the event such Surety ceases to appear on the U.S. Treasury's listing of approved sureties (Department Circular 570) or ceases to be licensed to transact business in New York State or becomes insolvent or enters liquidation proceedings, the Contractor, at its sole cost, shall furnish a replacement bond from a surety satisfactory to the County.

The form of contract and Performance and Payment Bond to be used in connection with this Contract and to become a part of the contract documents is attached in the section entitled "Sample Contract and Bond for Construction".

6. INDEMNIFICATION AGREEMENT

The Contractor agrees:

A. that except for the amount, if any, of damage contributed to, caused by or resulting from the negligence of the County, the Contractor agrees to indemnify and hold harmless the County of Westchester, its officers, employees, elected officials, and agents from and against any and all liability, damage, claims, demands, costs, judgments, fees, attorneys' fees or loss arising directly or indirectly out of the performance or failure to perform hereunder by the Contractor or third parties under the direction or control of the Contractor; and

B. to provide defense for and defend, at its sole expense, any and all claims, demands or causes of action directly or indirectly arising out of the Agreement and to bear all other costs and expenses related thereto.

7. INSURANCE REQUIREMENTS

The Contractor, upon award of the contract and throughout the term of the Agreement, shall obtain at its own cost and expense the required insurance as delineated below from insurance companies licensed in the State of New York, carrying a Best's financial rating of A or better. Contractor shall provide evidence of such insurance to the County of Westchester ("County"), either by providing a copy of policies and/or certificates as may be required and approved by the Director of Risk Management of the County ("Director"). The policies or certificates thereof shall provide that ten (10) days prior to cancellation or material change in the policy, notices of same shall be given to the Board of Acquisition and Contract of the County of Westchester by registered mail, return receipt requested, for all of the following stated insurance policies, with a copy also sent to the Director of Risk Management of the County. All notices shall name the Contractor and identify the Contract Number.

If at any time any of the policies required herein shall be or become unsatisfactory to the Director, as to form or substance, or if a company issuing any such policy shall be or become unsatisfactory to the Director, the Contractor shall upon notice to that effect from the County, promptly obtain a new policy, and submit the policy or the certificate as requested by the Director to the Office of Risk Management of the County for approval by the Director. Upon failure of the Contractor to furnish, deliver and maintain such insurance, the Agreement, at the election of the County, may be declared suspended, discontinued or terminated.

Failure of the Contractor to take out, maintain, or the taking out or maintenance of any required insurance, shall not relieve the Contractor from any liability under the Agreement, nor shall the insurance requirements be construed to conflict with or otherwise limit the contractual obligations of the Contractor concerning indemnification.

All property losses shall be made payable to the "County of Westchester" and adjusted with the appropriate County personnel.

In the event that claims, for which the County may be liable, in excess of the insured amounts provided herein are filed by reason of Contractor's negligent acts or omissions under the

agreement or by virtue of the provisions of the labor law or other statute or any other reason, the amount of excess of such claims or any portion thereof, may be withheld from payment due or to become due the Contractor until such time as the Contractor shall furnish such additional security covering such claims in form satisfactory to the Director.

In the event of any loss, if the Contractor maintains broader coverage and/or higher limits than the minimums identified herein, the County shall be entitled to the broader coverage and/or higher limits maintained by the Contractor. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to the County.

The Contractor shall provide proof of the following coverage. (Other coverage may be required by the County of Westchester based on specific needs. If such other coverages are required for a specific contract, those coverages will be described in the "Special Clauses" of the contract specifications):

a) Workers' Compensation and Employer's Liability. Certificate form C-105.2 or State Fund Insurance Company form U-26.3 is required for proof of compliance with the New York State Workers' Compensation Law. State Workers' Compensation Board form DB-120.1 is required for proof of compliance with the New York State Disability Benefits Law. Location of operation shall be "All locations in Westchester County, New York."

Where an applicant claims to not be required to carry either a Workers' Compensation Policy or Disability Benefits Policy, or both, the employer must complete NYS form CE-200, available to download at: http://www.wcb.ny.gov.

If the employer is self-insured for Workers' Compensation, he/she should present a certificate from the New York State Worker's Compensation Board evidencing that fact (Either SI-12, Certificate of Workers' Compensation Self-Insurance, or GSI-105.2, Certificate of Participation in Workers' Compensation Group Self-Insurance).

b) Commercial General Liability Insurance with a combined single limit of $1,000,000 (c.s.1) per occurrence and a $2,000,000 aggregate limit naming the "County of Westchester" as an additional insured on a primary and non-contributory basis. This insurance shall include the following coverages:
   i. Premises - Operations.
   ii. Broad Form Contractual.
   iii. Independent Contractor and Sub-Contractor.
   iv. Products and Completed Operations.

NOTE: Additional insured status shall be provided by standard or other endorsement that extends coverage to the County of Westchester for both on-going and completed operations.

All Contracts involving the use of explosives, demolition and/or underground work shall provide proof that XCU is covered.

c) Commercial Umbrella/Excess Insurance: $2,000,000 each Occurrence and Aggregate naming the "County of Westchester" as additional insured, written on a "follow the form" basis.

d) Owners Protective Liability Policy naming the County as insured, with a minimum limit of liability per occurrence of $3,000,000 (where applicable, or as determined by the Director, Risk Management)

e) Automobile Liability Insurance with a minimum limit of liability per occurrence of $1,000,000 for bodily injury and a minimum limit of $100,000 per occurrence for property damage or a

combined single limit of $1,000,000 unless otherwise indicated in the contract specifications. This insurance shall include for bodily injury and property damage the following coverages and name the "County of Westchester" as additional insured:

i. Owned automobiles.
ii. Hired automobiles.
iii. Non-owned automobiles.

f) Construction Insurance: For the construction, renovation or repair of bridges, viaducts or similar structures, the Contractor at its own cost and expense shall provide and maintain a "Bridge Builder's Risk Form, All Risk Insurance Contract," with flat premium endorsement, until the construction contract is accepted by the Board of Acquisition and Contract of the County of Westchester. The coverage shall be written for 100% of the completed value, covering the Contractor and County of Westchester as the insureds. The Contractor shall provide the original and duplicate policy to the County (unless the County shall accept, in lieu thereof, all contained endorsements including all applicable provisions and coverages).

For the construction of (a) new buildings and (b) for additions or repairs of existing buildings or structures, the Contractor at its own cost and expense shall provide and maintain a "Builder's Risk Form, All Risk Insurance Contract," with flat premium endorsement, until the construction contract is accepted by the Board of Acquisition and Contract of the County of Westchester. The coverage shall be written for 100% of the completed value, covering the Contractor and County of Westchester as the insureds. The Contractor shall provide the original and duplicate policy to the County (unless the County shall accept, in lieu thereof, all contained endorsements including all applicable provisions and coverages).

All policies of the Contractor shall be endorsed to contain the following clauses:

(a) Insurers shall have no right to recovery or subrogation against the County (including its employees and other agents and agencies), it being the intention of the parties that the insurance policies so effected shall protect both parties and be primary coverage for any and all losses covered by the above-described insurance.

(b) The clause "other insurance provisions" in a policy in which the County is named as an insured, shall not apply to the County.

(c) The insurance companies issuing the policy or policies shall have no recourse against the County (including its agents and agencies as aforesaid) for payment of any premiums or for assessments under any form of policy.

(d) Any and all deductibles in the above described insurance policies shall be assumed by and be for the account of, and at the sole risk of, the Contractor.

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8. PREVAILING WAGE RATES AND SUPPLEMENTS

A. Wages to be Paid and Supplements to be Provided

Each laborer, workman or mechanic employed by the Contractor(s), Sub-contractor(s) or other person(s) doing or contracting to do the whole or part of the work contemplated by this Contract, shall be paid the prevailing wages and provide the supplements (including but not limited to health, welfare and pension benefits) as required by Article 8 (Section 220-223) and Article 9 (230-239) of the New York State Labor Law.

B. Schedule of Hourly Rates/Supplements

The "Schedule of Hourly Rates and Supplements" shows the prevailing hourly rates of wages to be paid and supplements to be provided. It is the County's preference that such supplements shall be paid to a Federally qualified Pension, Health and Welfare program and New York State Registered Apprentice Training Program.

Classifications not appearing on the rate sheet can be used only with the consent of the Commissioner of Public Works and then the rate to be paid will be given by the Commissioner of Public Works after advising with the State Department of Labor.

C. Grounds for Cancellation of Contract

In the event of a failure, to pay the prevailing wages and provide the supplements in accordance with the New York State Labor Law, and as described in this Contract, it shall be considered a material breach. For the breach or violation of this provision, without limiting any other rights or remedies to which the County or any individual may be entitled or any civil or criminal penalty for which any violator may be liable, the County shall have the right, in its discretion, to terminate this agreement immediately upon notice. In such event, the Contractor(s), Sub-Contractor(s), et al shall be liable to the County for any additional costs incurred by the County in the completion of the project.

In addition to any other remedies available to the County and irrespective of any applicable penalties pursuant to law, the County may deduct from the amount payable to the Contractor under this contract five hundred ($500.00) dollars as reimbursement for the costs it incurs in investigating any violation of Section 220 of the Labor Law.

D. Records to be kept on Site

The Contractor(s), Sub-contractor(s), et al. shall certify their payrolls and keep them on site and available, in addition to the following informative records:

1) Record of hours worked by each workman, laborer and mechanic on each day;

2) Record of days worked each week by each workman, laborer and mechanic;

3) Schedule of occupation or occupations at which each workman, laborer and mechanic on the project is employed during each work day and week;

4) Schedule of hourly wage rates paid to each workman, laborer and mechanic for each occupation.

5) A statement or declaration signed by each workman, laborer and mechanic attesting that they have been provided with a written notice, informing them of the prevailing wage rates and supplements requirement for this contract.

E. Responsibility of the Contractor, Sub-Contractor, et al.

The Contractor(s), Sub-Contractor(s), et al. will display the posters in a conspicuous location at the site and distribute the wallet cards to the employees. These posters and wallet cards will inform the employees that they are entitled to receive the prevailing wages and supplements as determined by the Department of Labor and will list the

Department of Labor's Public Work field offices, with phone numbers for individuals to call if they believe their rights are being violated.

F. Pay for a Legal Day's Work & Use of Apprentices

The wages to be paid for a legal day's work, as hereinbefore defined, to laborers, workmen or mechanics upon such public works, shall be not less than the prevailing rate of wages as hereinafter defined. Serving laborers, helpers, assistants and apprentices shall not be classified as common labor and shall be paid not less than the prevailing rate of wages as hereinafter defined. No employee shall be deemed to be an apprentice unless he is individually registered in an apprenticeship program which is duly registered with the Industrial Commissioner in conformity with the provision of Article 23 of the Labor Law. The wages to be paid for a legal day's work, as hereinbefore defined, to laborers, workmen or mechanics upon any material to be used upon or in connection therewith shall be not less than the prevailing rate for a day's work in the same trade or occupation in the locality within the state where such public work on, about or in connection with which such labor is performed in its final or completed form is to be situated, erected or used and shall be paid in cash; provided, however, that an employer may pay his employees by check upon a Certificate of the Industrial Commissioner to be issued only after a hearing upon the application to pay by check, which hearing shall be with notice of at least five days to be served personally or by mail on all interested persons, or if not served as aforesaid, then to be published in a manner directed by the Industrial Commissioner, which shall afford interested persons the opportunity to appear and to be heard at such hearing, and after proof has been furnished satisfactorily to the Industrial Commissioner of the employer's financial responsibility and the employer gives assurance that such checks may be cashed by employees without difficulty and for the full amount for which they are drawn. Such Contracts shall contain a provision that each laborer, workman or mechanic, employed by such Contractor, Subcontractor or other person about or upon such public works, shall be paid the wages herein provided.

G. Fiscal Officer's Duty to Determine Schedule of Wages

It shall be the duty of the fiscal officer (the "New York State Commissioner of Labor"), to ascertain and determine the schedule of wages to be paid workmen, laborers and mechanics on each such public work, prior to the time of the advertisement for bids, and such schedule of wages shall be annexed to and form a part of the specifications for the work. Such fiscal officer shall file with the department having jurisdiction such schedule of wages to the time of the commencement of the advertisement for bids on all public works proposed to be constructed. The term "Contract" as used in this subdivision also shall include reconstruction and repair of any such public work.

Where Contracts are not awarded within ninety days of the date of the establishment of the prevailing rate of wages by the fiscal officer, the department of jurisdiction shall request of the fiscal officer a redetermination of a schedule of wages.

H. Penalty for Payment of Less than Prevailing Wages

Any person or corporation that willfully pays after entering into such Contract, less than such stipulated wage scale as established by the fiscal officer shall be guilty of a

misdemeanor and upon conviction shall be punished for such first offense by a fine of five hundred dollars or by imprisonment for not more than thirty days, or both fine and imprisonment; for a second offense by a fine of one thousand dollars, and in addition thereto the Contract on which the violation has occurred shall be forfeited and no such person or corporation shall be entitled to receive any sum nor shall any officer, agent, or employee of the state, municipal corporation or commission or board appointed pursuant to law pay the same or authorize its payment from the funds under his charge or control to any person or corporation for work done upon any Contract, on which the Contractor has been convicted for a second offense in violation of the provisions of this section.

9. LABOR AND COMPLIANCE WITH LABOR LAW

A. Preference for Westchester Residents

The Contractor agrees that in the performance of the work under this Contract he will give preference, and so far as legally possible, to employ citizens and residents of Westchester County.

B. Certifications To Be Filed

It is agreed that, in accordance with Section 220-d of the Labor Law as amended before final payment by or on behalf of the County for any sum due on account of a Contract for a public improvement, the Contractor and each and every Subcontractor of the Contractor or a Subcontractor is required to file a statement in writing in form satisfactory to the Commissioner of Finance certifying to the amounts then due and owing from such Contractor or Subcontractor filing such statement to or on behalf of any and all laborers for daily or weekly wages or supplements on account of labor performed upon the work under the Contract, setting forth therein the names of the persons whose wages or supplements are unpaid and the amount due to each or on behalf of each respectively, which statement so to be filed shall be verified by the oath of the Contractor or Subcontractor as the case may be that he has read such statement subscribed by him and knows the contents thereof, and that the same is true to his own knowledge.

C. Retention of Funds

It is further agreed that in accordance with Section 220b of the Labor Law, as amended:

1) In case any interested person shall have previously filed a protest in writing objecting to the payment to any Contractor or Subcontractor to the extent of the amount or amounts due or become due to him/her for daily or weekly wages or supplements for labor performed on the public improvement for which such Contract was entered into, or if for any other reason it may be deemed advisable, the Commissioner of Finance may deduct from the whole amount of any payment on account thereof the sum or sums admitted by any Contractor or Subcontractor in such statement or statements so filed to be due and owing by him on account of labor performed on such public improvement before making payment of the amount certified for payment in any estimate or voucher, and may withhold the amount so deducted for the benefit of the laborers, workmen or mechanics whose

wages or supplements are unpaid or not provided, as the case may be, as shown by the verified statements filed by any Contractor or Subcontractor, and may pay directly to any person the amount or amounts shown to be due to him or his duly authorized collective bargaining labor organization, as the case may be, for such wages or supplements by the statements filed as hereinbefore required, thereby discharging the obligation of the Contractor or Subcontractor to the person or his duly authorized collective bargaining labor organization receiving such payment to the extent of the amount thereof, or

2) When any interested person shall file a written complaint with the fiscal officer as defined in section 220-b of the Labor Law, alleging unpaid wages or supplements due for labor performed on a public improvement for which a Contract has been entered into, and said labor is alleged to have been performed within the two year period immediately preceding the date of the filing of said complaint, or if, on the fiscal officer's own initiative, unpaid wages or supplements appear to be due, the fiscal officer shall immediately so notify the financial officer of the civil division interested, or, if there are insufficient moneys still due to the Contractor or Subcontractor to satisfy said wages and supplements, including interest and penalty, the financial officer of another civil division which has entered or subsequently enters into a public improvement contract with the Contractor or Subcontractor, who shall withhold from any payment due or earned by the Contractor or Subcontractor executing said public improvement, sufficient moneys to satisfy said wages and supplements, including interest at the rate provided herein, and any civil penalty that may be assessed as provided herein, pending a final determination. The Commissioner of Finance shall immediately confirm in writing to the fiscal officer the amount of money withheld.

3) Moneys withheld pursuant to this section shall be held by the Commissioner of Finance for the sole and exclusive benefit of the workers employed on said public improvement and for payment of any civil penalty that may be assessed as provided herein and shall not be used for any other purpose except upon court order. Any person, partnership, association, corporation or governmental body who files a lien or commences a judicial proceeding with respect to any moneys withheld pursuant to this section shall notify the fiscal officer in writing of the lien or claim on or before the date of filing of the lien or commencement of the judicial proceeding. In any proceeding to obtain moneys withheld pursuant to this section by any person, partnership, association, corporation or governmental body, the Commissioner of Labor shall have the right to appear and be heard.

4) The fiscal officer shall then cause an investigation to be made to determine whether any amounts are due to the laborers, workmen or mechanics, or on their respective behalves, on such public improvement, for labor performed after the commencement of the three-year period immediately preceding the filing of the complaint or the commencement of the investigation on his own initiative, as the case may be, and shall order a hearing therein at a time and place to be specified and shall give notice thereof, together with a copy of such complaint, or a statement of the facts disclosed upon such investigation, which notice shall be served personally or by mail on all interested persons, including the person complained

against and upon the financial officer of the civil division; such person complained against shall have an opportunity to be heard in respect to the matters complained of, at the time and place specified in such notice, which time shall be not less than five days from the service of said notice. The fiscal officer in such an investigation shall be deemed to be acting in a judicial capacity and shall have the rights to issue subpoenas, administer oaths and examine witnesses. The enforcement of a subpoena issued under this section shall be regulated by the Civil Practice Law and Rules. Such investigation and hearing shall be expeditiously conducted, and upon such hearing and investigation, the fiscal officer shall determine the issues raised thereon and shall make and file an order in his office stating such determination and forthwith serve a copy of such order, either personally or by mail, together with notice of filing, upon the parties to such proceedings, and if the fiscal officer be the Comptroller, upon the Commissioner of the Department of Labor. Such order shall direct payment of wages or supplements found to be due, including interest at the rate of interest then in effect as prescribed by the Superintendent of Banks pursuant to Section fourteen (a) of the Banking law per annum from the date of the underpayment to the date of payment.

5) In addition to directing payment of wages or supplements, including interest found to be due, the order of the fiscal officer may direct payment of a further sum as a civil penalty in an amount not exceeding twenty-five percent of the total amount found to be due. In assessing the amount of the penalty, due consideration shall be given to the size of the employer's business, the good faith of the employer, the gravity of the violation, the history of previous violations of the employer or any successor or substantially-owned affiliated entity or any of the partners if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, as determined by the fiscal officer, and any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article, and the failure to comply with record keeping or other non-wage requirements. Upon the fiscal officer's determination of the penalty, where the fiscal officer is the Commissioner of the Department of Labor, the penalty shall be paid to said Commissioner for deposit in the State Treasury.

6) Upon the entry and service of such order, the Commissioner of Finance shall pay to the claimant, from the moneys due to the Contractor or Subcontractor, the amount of the claim as determined by the fiscal officer and the amount of the civil penalty, if any, shall be paid as provided herein, provided that no proceeding pursuant to Article Seventy-Eight of the Civil Practice Law and Rules for review of said order is commenced by any party aggrieved thereby within thirty days from the date of said order was filed in the office of the fiscal officer. Said proceeding shall be directly in the appellate division of the Supreme Court. Where the fiscal officer is the Commissioner of the Department of Labor, the civil penalty shall be paid to said Commissioner for deposit in the State Treasury. In the event that such a proceeding for review is instituted, moneys sufficient to satisfy the claim and civil penalty shall be set aside by the Commissioner of Finance, subject to the order of the Court.

7) When final determination has been made and such determination is in favor of the complainant, said complainant may in addition to any other remedy provided by this article, institute an action in any Court of appropriate jurisdiction against the person or corporation found violating this article, any substantially-owned affiliated entity or any successor of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article, and any of the partners if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, as determined by the fiscal officer, for the recovery of the difference between the sum, if any, actually paid to him by the Commissioner of Finance pursuant to said order and the amount found to be due him as determined by said order. Such action must be commenced, within three years from the date of the filing of said order, or if the said order is reviewed in a proceeding pursuant to Article Seventy-eight of the Civil Practice Law and Rules, within three years after the termination of such review proceeding.

8) When two final determinations have been rendered against a Contractor, Subcontractor, successor, or any substantially owned affiliated entity of the Contractor or Subcontractor, any of the partners if the Contractor or Subcontractor is a partnership, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article, any of the five largest shareholders of the Contractor or Subcontractor or any successor within any consecutive six-year period determining that such Contractor, Subcontractor, successor, or any substantially-owned affiliated entity of the Contractor or Subcontractor, any of the partners or any of the five largest shareholders of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article has willfully failed to pay the prevailing rate of wages or to provide supplements in accordance with this article, whether such failures were concurrent or consecutive and whether or not such final determinations concerning separate public work projects are rendered simultaneously, such Contractor, Subcontractor, successor, or any substantially-owned affiliated entity of the Contractor or Subcontractor, any of the partners if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with the State, any municipal corporation or public body for a period of five years from the second final determination, provided, however, that where any such final determination involves the falsification of payroll records or the kickback of wages or supplements, the Contractor, Subcontractor, successor, or any substantially-owned affiliated entity of the Contractor or Subcontractor, any partner if the Contractor or Subcontractor is a partnership or any of the five largest shareholders of the Contractor or Subcontractor, any officer of the Contractor or Subcontractor who knowingly participated in the violation of this article shall be ineligible to submit a bid on or be awarded any public work contract with the State, any municipal corporation or public body for a period of five years from the first final determination.

9) Nothing in this subdivision shall be construed as affecting any provision of any other law or regulation relating to the awarding of public contracts.

Pursuant to Section 220-C of the Labor law, any Contractor or Subcontractor who shall upon his oath verify any statement required to be filed herein, which is known by him to be false, shall be guilty of perjury and punishable as provided by the Penal Law.

10. CONTRACTOR'S REPORT OF EMPLOYMENT AND WEEKLY AFFIDAVIT

Each week the Contractor shall furnish to the Commissioner of Public Works the "Contractor's Report Of Employment And Weekly Affidavit" of the Sample Forms.

11. LAWS/REGULATIONS AND APPROPRIATIONS

A. The Contractor shall, at its own cost and expense, comply with all provisions of the Labor Law (i.e. prevailing rate of wages and supplements), Lien Law, Workmen's Compensation Law and all other laws and ordinances affecting this contract or order, either Federal, State or local.

B. It is recognized and understood by the Parties that when this Agreement is subject to future appropriation by the Westchester County Board of Legislators for funds not presently appropriated to pay for this Agreement; the County shall have no liability under this agreement beyond the funds, if any, that are appropriated and available for payment of the amounts due under this Agreement. The Parties understand and intend that the obligation of the County to pay the amounts due hereunder shall constitute a current expense of the County and shall not in any way be construed to be a debt of the County in contravention of any applicable constitutional or statutory limitations or requirements concerning the creation of indebtedness by the County, nor shall anything contained in this Agreement constitute a pledge of the general tax revenues, funds or monies of the County. The County shall pay amounts due under this Agreement exclusively from legally available funds appropriated for this purpose. Notwithstanding the foregoing, the County will do all things lawfully within its power to obtain, maintain, and properly request and pursue funds from which payments under this Agreement may be made, including: (i) the County Executive making provisions for such payments to the extent necessary in the annual budget submitted to the Board of Legislators for the purpose of obtaining funding; and (ii) using its reasonable efforts to have such portion of the budget approved.

12. REFUSAL TO ANSWER QUESTIONS

It is understood and agreed by the Contractor that he/she bears an affirmative obligation to answer questions specifically or directly relating to this agreement before any official, board or agency authorized or empowered to inquire into such matters. This section shall not be construed as barring the Contractor, its directors, officers or employees from exercising their constitutional privilege against self-incrimination.

The foregoing, however, shall not be construed as limiting the rights and remedies of the County in the event of such refusal, and when such body or agency is wholly civil in nature,

failure or refusal to fully cooperate with and diligently answer the inquiries of such official, board or agency may constitute grounds for the termination of this agreement and/or the exercise of any and all other rights or remedies which the County may have by reason of such failure or refusal.

Any and all contracts made with the State, the County of Westchester, or any public department, agency or official thereof, since July 1, 1959 by such person and by any firm, partnership or corporation of which he is a member, partner, director or officer, may be canceled or terminated by the County of Westchester, without incurring any penalty or damages on account of such cancellation or termination, but any monies owing pursuant to said transaction or contract prior to the cancellation and termination, shall be paid.

The successful bidder will be required to make all books and records concerning this contract available during business hours, upon reasonable notice, to duly authorized County personnel for the purpose of ascertaining compliance and/or performance of all provisions of this contract. This provision shall survive the termination of this agreement and for a period of six (6) years thereafter.

13. BID REQUIREMENTS

The Bid must be made on the "Proposal Pages" included in this specification or as provided with an addendum. All blank spaces on said Proposal Pages must be filled in and no change shall be made in the phraseology or in the items as contained therein.

Any bid which fails to name a price per unit of measurement for each of the items for which quantities are given, may be held to be informal and rejected. Bids submitted on Proposal Pages that contain any omissions, alterations, additions or items not called for in the bid documents, or that are illegible, unbalanced, conditional, incomplete or contain irregularities of any kind, may be rejected as informal. If the various parts of the work have been divided into classes and/or items to enable the bidder to bid for different portions of the work in accordance with its estimate of their costs, in the event of any increase or decrease in the quantity will be paid for at the price bid for that particular item. The sum of the amounts for each class or item, obtained by multiplying the approximate quantity by the unit price, shall constitute the total sum bid.

In the event of a discrepancy between the written bid amount and the numerical bid amount, the written amount will take precedence and be controlling as to the amount of the Bid. Any such discrepancy shall be corrected as set forth in Article "Correction Of Errors" of the Information for Bidders.

14. MISCELLANEOUS ADDITIONAL WORK (ITEM W-800)

A. Description - Under this item each Contractor shall furnish all labor, material and equipment required to accomplish miscellaneous additional work:

1) Necessitated by encountering during the course of the work field conditions of a nature not determinable during design; or

2) For which no unit prices are applicable.

B. Method of Measurement - Only that miscellaneous additional work shall be performed by the Contractor and will be paid for by the County, which has been authorized by the Commissioner or the Construction Administrator in writing, prior to its commencement.

C. Article "Increase or Decrease of Quantities: Elimination of Items" of the Information for Bidders, will still apply relative to the percentage of the total awarded contract price that the work under the contract may be increased or decreased.

D. Payment - The total amount paid to the Contractor will be determined in strict accordance with the provisions of Article "Extra Work: Increased Compensation/ Decreased Work: Credit to the Owner" of the General Clauses, and such payment will include only that overhead and profit that is applicable to the work performed under this item.

E. Each Contractor shall include in its total bid the lump sum printed in the Proposal and any bid other than the specified amount will be considered informal.

15. CORRECTION OF ERRORS

Relative to dollar bid items and the required computations as submitted and performed by bidders on the proposal sheets, if there are any inconsistencies derived in multiplying unit bid prices by the stated quantities, the Commissioner reserves the right to reconcile the unit bid prices or the products of the unit bid prices and the stated quantities, when in the Commissioner's professional opinion such reconciliation(s) would concur with the apparent intent of a bidder and the Commissioner's estimated values of the respective bid items of the proposed contract work. In addition to the foregoing, the Commissioner reserves the right to correct all mathematical errors in additions or subtractions.

16. SHOWN QUANTITIES

All bids shall be submitted upon the following express conditions, which shall apply to and become a part of every bid received. The Bidders accept the quantities shown on the Proposal Pages opposite items of the work for which unit prices are to be bid as being approximate estimated quantities. Bidders shall satisfy themselves by personal examination of the location of the proposed work and surroundings thereof, and by such other means as they may prefer, as to the scope of the work and the accuracy of the approximate estimated quantities; and shall not at any time after submission of their bids dispute such approximate estimated quantities nor assert that there was any misrepresentation by the County or any misunderstanding by the Contractor in regard to the quantity or kind of materials to be furnished, or work to be done.

17. QUALIFICATION OF BIDDERS

The County may make such investigation as it deems necessary to determine the ability of the bidder to perform the work, and the bidder shall furnish all information and data for this purpose as may be requested. The County reserves the right to reject any bid if the evidence submitted by, or the investigation of such bidder fails to satisfy the County, in the County's sole discretion, that it is properly qualified to carry out the obligations of the contract and to complete the contemplated work.

18. REQUIRED EXPERIENCE

The County requires that each contractor possess not less than five (5) year's experience in performing work substantially similar in scope and size to the work for which it is bidding. The contractor agrees that upon request of the County the contractor will furnish a detailed statement of each project that it has performed during the most recent five (5) years (including but not limited to the name and address of the project, the name of the awarding entity/owner, the name of the awarding entity's/owner's representative, a current telephone number where that representative can be reached, the description of the project, general scope of the contractor's work, contract price, dates of performance, whether the contract was terminated for cause or convenience, whether the contract was completed and whether liquidated damages were assessed against the contractor [and if so, provide a written explanation]). The County reserves the right to require additional information as it deems appropriate concerning the history of the contractor's performance of each such contract. The final determination of whether the contractor possesses the requisite experience rests in the sole discretion of the County.

19. INCREASE OR DECREASE OF QUANTITIES: ELIMINATION OF ITEMS

In entering into this contract, the Contractor agrees that quantities shown on the Proposal Pages opposite items of the work for which unit prices have been requested are approximate estimated quantities, and that during the progress of the work the County may find it advisable and shall have the right to omit portions of the work, and to increase or decrease the shown approximate estimated quantities, or the scope of the whole work; and that the County reserves the right to add to or take from the total amount of the work up to a limit of thirty percent of the total amount of the contract based upon the executed contract price for all the specified work.

The Contractor shall make no claim for anticipated profits or loss of profits, because of any difference between the quantities of the various classes of work actually done, or of the materials actually furnished, and the original specified scope of work and the shown approximate estimated quantities.

The aforesaid thirty- percent pertains to the total amount of the contract and not to any individual item. Individual items may be increased or decreased any amount or may be eliminated entirely if so ordered by the Commissioner, excepting that the total amount of the contract as adjusted shall not result in a net increase or decrease of more than thirty percent except by mutual agreement between both parties thereto.

The Contractor waives all claims of any nature due to a misunderstanding of the location, character, or other conditions surrounding the work or of the shown approximate estimated quantities of items of the work.

20. BREAKDOWN COST OF LUMP SUM ITEMS AND CONTRACTS

After award of the contract and prior to actual start of the work, the successful bidder shall submit an itemized schedule of its estimated costs of lump sum items and or lump sum total contract work, for approval by the County. The schedule shall be submitted as an outline series with minor subdivisions, in accordance with the directives of the County. As part of

this Schedule, the Contractor will be required to include a sum sufficient, as determined in the County's sole discretion, for the preparation and submission of approved final "As-builts", record drawings, guarantees, warranties, and operations and maintenance manuals.

21. ENGINEERING CHARGES

In addition to any and all other remedies available to the County when the work embraced in the contract is not completed on or before the date specified herein, engineering and inspection expenses incurred by the County of Westchester upon the work from the completion date originally fixed in the contract to the final date of completion of the work may be charged to the Contractor and be deducted from monies due the Contractor. Consideration of any extra work or supplemental contract work added to the original contract, as well as extenuating circumstances beyond the control of the Contractor, will be given due consideration by the County before assessing engineering and inspection charges against the Contractor. Such charges will be assessed, however, in cases where in the opinion of the Commissioner, the Contractor has delayed the work.

22. ESTIMATES AND PAYMENTS

As the work progresses but not more often than once a month and then on such days as the Construction Administrator may fix, the Contractor will submit a requisition in writing of the amount and value of the work performed and the materials and equipment provided to the date of the requisition, less any amount previously paid to the Contractor. The Contractor must complete at least ten (10%) percent of the work before submitting any claims for mobilization. From each requisition, the County will retain five percent (5%) plus one hundred fifty percent (150%) of the amount necessary to satisfy any claims, liens or judgments against the Contractor that have not been suitably discharged. The Commissioner will thereupon cause the balance of the requisition therein to be paid to the Contractor. In lieu of all or part of the cash retainage the County shall only accept bonds or notes of United States of America, New York State or political subdivisions thereof. As a condition to the making of any progress payment as set forth in this paragraph, the County, in its sole discretion may require the Contractor to submit such document as may be reasonably required to establish that the Contractor (and its subcontractor(s)) have timely and properly paid their respective subcontractor(s) and materialmen of whatever tier.

VENDOR DIRECT PAYMENT: All payments made by the County to the Contractor will be made by electronic funds transfer ("EFT") pursuant to the County's Vendor Direct program. The Contractor is required to complete the Vendor Direct Payment Authorization Form, which is located in the Forms Section on page 11 and 12. Payments will be automatically credited to the Contractor's designated bank account at the Contractor's financial institution. Payments are anticipated to be deposited two business days after the voucher/invoice is processed for payment. Saturdays, Sundays, and legal holidays are not considered business days. Under the Vendor Direct program you will receive an e-mail notification two days prior to the day the payment will be credited to your designated account. The e-mail notification will come in the form of a remittance advice with the same information that currently appears on County check stubs and will contain the date that the funds will be credited to your account. If there is a discrepancy in the amount received please contact

your Westchester County representative as you would have in the past if there were a discrepancy in a check.

In the unlikely event that you do not receive the money in your designated bank account on the date indicated in the e-mail, please contact the Westchester County Accounts Payable Department at 914-995-3748. Whenever you change your bank or change or close your account a new Vendor Direct Payment Authorization Form must be submitted. Please contact the Westchester County Accounts Payable Department at 914-995-3748 and a new form will be e-mailed to you. When completing the payment authorization form you must either supply a voided check or have it signed by a bank official to ensure the authenticity of the account being set up to receive your payments. Failure to return the completed authorization form prior to award of the contract may result in the bid being considered non-responsive and the bid may be rejected.

When the work or major portion thereof, as contemplated by the terms of the contract (see Substantial Completion Payment and Final Payment later in this article), are substantially completed in the judgment of the Commissioner, the Contractor shall submit a requisition for the remainder of the contract balance. An amount equal to two (2) times the value of the remaining items to be completed plus one hundred fifty percent (150%) of the amount that the Commissioner deems necessary to satisfy to satisfy any claims, liens or judgments against the Contractor which have not been suitably discharged shall be deducted from the requisition. As the remaining items of work are satisfactorily completed or corrected, the County will, upon receipt of a requisition, pay for these items less one hundred fifty percent (150%) of the amount necessary to satisfy any claims, liens or judgments.

Contractor agrees, in the event of any withdrawal by the contractor of amounts retained from payments to the contractor pursuant to the terms hereof, that notwithstanding any contrary interpretation of Section 106 of the New York General Municipal Law, the contractor will be obliged to maintain the market value of securities deposited in an amount equal to the amount withdrawn pursuant to said Section 106. The Contractor will, within five (5) days of demand therefore by the fiscal officer of the County, deposit with such fiscal officer cash, or securities of the kind provided in Section 106, of a market value sufficient to maintain the market value of all securities on deposit at a level equal (as of the date such notice of the fiscal officer is given to the contractor) to the amount which the County shall be entitled to retain from payments to the contractor pursuant to the terms of the contract.

All estimates will be made for actual quantities for work performed and materials and equipment incorporated in the work as determined by the measurements of the Engineer, and this determination shall be accepted as final, conclusive and binding upon the Contractor. All estimates will be subject to correction in any succeeding estimate.

Payment will be made for materials pertinent to the project which have been delivered to the site or off-site by the Contractor and/or Subcontractor and suitably stored and secured in first-class condition as required by the Construction Administrator. Payment may be limited to materials in short and/or critical supply and materials specially fabricated for the project, as defined by the contract. Payment will be made only upon the written request of the contractor. The Contractor must submit certified copies of the manufacturer's or vendor's invoices or statements establishing the true purchase value of the material or equipment; freight bills, release of liens and certificate of insurance covering all equipment and materials. Then the County will include in the following monthly payment an amount not to

exceed the lesser of the bid breakdown or the total purchase price of the stored equipment and materials less retainage provided that such equipment and materials are suitable for their intended use.

The Contractor shall be responsible for safeguarding stored equipment and materials against loss or damage of any nature whatsoever, shall retain title until incorporated into the work and acceptance by the County and in case of loss or damage, the Contractor shall replace such lost or damaged equipment and materials at no cost to the County.

After receipt of payment, the Contractor shall not remove from the site equipment and materials for which such payment was made without written authorization from the Commissioner.

No major equipment item shall be brought to the site until the following conditions are met:

1) The County must have received the manufacture's recommendations for on-site storage in writing.

2) The structure in which the equipment is to be installed is roofed (roofing must be watertight) and has such protection of doorways, windows, and other openings that will provide reasonable protection from the weather.

3) Prior to the County making a Partial Payment on a major equipment item the following conditions must be met:
   a. The Contractor must certify to the County, in writing, that the equipment has been properly stored.
   b. The Shop Drawings must be approved and the draft Operation and Maintenance Manuals must have been submitted.

The Contractor shall furnish to the Construction Administrator, prior to the making up of any Partial or Final Estimate, a copy of its and its Subcontractors' weekly payrolls for each and every preceding payroll period. The payroll submitted shall be a certified true copy and shall contain full information including but not limited to the number of hours worked, rate, classification and total sum paid each employee charged to or working on the job. With all except the first estimate, the Contractor shall furnish to the Construction Administrator a sworn statement listing all unpaid bills and liabilities incurred under the Contract.

A. Substantial Completion Payment

1) Within thirty (30) days after receiving written notice from the Contractor of substantial completion of the work under this Agreement, the Commissioner will cause an inspection to be made of the work done under this contract. If, upon such inspection, the Engineer determines that the work is substantially complete, a Substantial Completion Payment to the Contractor for the work done under this Contract, less any and all deductions authorized to be made by the Commissioner under this contract or by law, will be issued.

2) Such a Payment shall be considered a Partial and not a Final Payment.

3) As a condition precedent to receiving payment therefore, the Contractor must have received County approval of all Shop Drawing submittals, the Operation and Maintenance Manuals, and As-Built Drawing(s). Together with its application for substantial completion payment the Contractor shall also deliver to the

Construction Administrator a verified statement certifying that all claims or liabilities arising from the completed work, including all charges for Extra Work, Change Orders, additional time, damages or credits (collectively referred to as "claims") have been presented to the County. All such claims shall be described in sufficient detail so as to be easily identified. The Contractor's failure to submit the verified statement shall constitute a full and final waiver of all claims against the County from the beginning of the project through the date of substantial completion as established by the County. The presentation of the verified statement to the County shall not constitute an acknowledgement by the County that any such claim is valid. The County expressly reserves its right to assert that any such claim(s) is waived or precluded by reason of other provisions of the contract documents. Only claims particularly identified on the Contractor's verified statement shall be preserved; all other claims whatever nature shall be deemed waived and released. It shall also submit proof of title of the materials and equipment covered by the contract. The Contractor shall also, prior to the issuance of said Substantial Completion Payment, supply to the County affidavits and certificates for labor, material and equipment (where applicable).

B. Final Payment

1) Within ten (10) days after receiving written notice from the Contractor of completion of all the work, the Engineer will make a final inspection. If upon inspection the Engineer determines that no further work is needed, the Commissioner will request that the Board of Acquisition and Contract approve the completion of the project and authorize payment of the Final Estimate. Also required prior to the Board of Acquisition and Contract approval is a Condition Report by the Contractor that any damage of public or privately owned properties resulting from the Contractor's work has been satisfactorily repaired.

2) As a condition precedent to receiving Final Payment therefore the Contractor shall submit a supplementary verified statement similar to that required under, "A. Substantial Completion Payment", hereof. This verified statement must include only those charges for Extra Work, Change Orders, additional time, damages or credits (collectively referred to as "claims") that accrued between substantial completion and final completion. The Contractor's failure to submit the verified statement shall constitute a full and final waiver of all claims against the County from the beginning of the project through the date of substantial completion as established by the County. The presentation of the verified statement to the County shall not constitute an acknowledgement by the County that any such claim is valid. The County expressly reserves its right to assert that any such claim is waived or precluded by reason of other provisions of the contract documents. Only claims particularly identified on the Contractor's supplementary verified statement shall be preserved; all other claims of whatever nature shall be deemed waived and released.

3) The Contractor shall also, prior to the issuance of Final Payment, supply to the County affidavits and certificates for labor, material and equipment (where applicable).

4) The County will, not less than thirty (30) days after the Final Acceptance of the work under this contract, by the Board of Acquisition and Contract, pay the Contractor upon the receipt of all required documentation the balance of funds due thereunder after deduction of all previous payments, liens and all percentages and amounts to be kept and retained under provision of this contract.

   All prior Partial Payments, being merely estimates made to enable the Contractor to prosecute the work more advantageously, shall be subject to correction in the Final Estimate and Payment

5) The acceptance by the Contractor or by anyone claiming by or through him of the Final Payment shall operate as and shall be a release to the County and every officer and agent thereof, from any and all claims of the Contractor for anything done or furnished in connection with this work or project and for any act or omission of the County or of any others relating to or affecting the work. No payment, however, final or otherwise, shall operate to release the Contractor or its Sureties from any obligation under this contract or the Performance and Payment Bond. Should the Contractor refuse to accept the final payment as tendered by the County, it shall constitute a waiver of any rights to interest thereon. Nor shall refusal to accept final payment extend any applicable statute of limitation.

23. PAYMENTS TO SUBCONTRACTORS AND MATERIALMEN BY CONTRACTOR

Within fifteen calendar days of the receipt of any payment from the County, the contractor shall pay each of its sub-contractors and materialmen the proceeds from the payment representing the value of the work performed and/or materials furnished by the subcontractor and/or materialmen as reflected in the payment from the owner less an amount necessary to satisfy any claims, liens or judgment against the subcontractor or materialman which have not been suitably discharged and less any retained amount as hereafter described. The contractor shall retain not more than five per centum of each payment to the subcontractor and/or materialman except that the contractor may retain in excess of five per centum but not more than ten per centum of each payment to the subcontractor provided that prior to entering into a subcontract with the contractor, the sub-contractor is unable or unwilling to provide a performance bond and a labor and material bond both in the full amount of the sub-contract at the request of the contractor. However, the contractor shall retain nothing from those payments representing proceeds owed the subcontractor and/or materialman from the County's payments to the contractor for the remaining amounts of the contract balance as provided in Article “Estimates and Payments” of the Information For Bidders. Within fifteen calendar days of the receipts of payment from the contractor, the subcontractor and/or materialman shall pay each of its subcontractors and materialmen in the same manner as the contractor has paid the subcontractor.

Nothing provided herein shall create any obligation on the part of the County to pay or to see the payment of any moneys to any subcontractor or materialman from any contractor nor shall anything provided herein serve to create any relationship in contract or otherwise, implied or expressed between the subcontractor or materialman and the County. Notwithstanding anything to the foregoing, the County may tender payments to the Contractor in the form of joint or dual payee checks.

NOTICE: No direct payment will be made for work done or materials furnished under the General Clauses, Information for Bidders, General Clauses and Special Clauses, except where expressly stated elsewhere, but compensation shall be deemed to be included in the contract lump sum price for the total work and/or the contract unit prices for the various items of the work.

24. TIME OF STARTING

Time being of the essence, all bidders shall take notice that the timely completion of the work called for under this contract is of the greatest importance. The contractor shall commence its work within ten (10) days after "notice to proceed" has been given it by the Commissioner (unless a definite starting date is stated). Prior to commencing its work, the Contractor shall notify the Director of Project Management, Division of Engineering and Department of Public Works, at least forty-eight (48) hours prior to the planned date of its "start", so that a Construction Administrator can be assigned to the work.

25. SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION AND DEMOLITION WORK

At all times the Contractor shall use all required and necessary precautions for the safety and protection of the public, County personnel, construction employees, and private and public property on or adjacent to the work.

The Contractor shall comply fully with all the applicable provisions of the following listed governmental regulations and standards, noting that in case of conflict, the Contractor shall comply with the most stringent rule or regulation:

1) State of New York, Department of Labor, Bureau of Standards and Appeals, Industrial Code Rule 23 "Protection of Persons Employed in Construction and Demolition Work."

2) United States Department of Labor, Bureau of Labor Standards, "Safety and Health Regulations for Construction," as promulgated in accordance with the Occupational Safety and Health Act of 1970, Public Law 91-596; 84 Stat. 1590, Laws of 91st Congress - 2nd Session.

It shall be the sole responsibility of the Contractor to ascertain which of the regulations and standards contained in the foregoing listed publications effect its construction activities, and it shall be solely responsible for the penalties resulting from its failure to comply with such applicable rules and regulations. Copies of the listed publications are available for reference purposes only, in the Westchester County Department of Public Works, Division of Engineering, Design Section, Room 500, Michaelian Office Building, White Plains, New York.

The West Nile Mosquito control program:

1) Routinely, the work site should be inspected for potential habitats (i.e. stagnant/standing water) for mosquitoes.

2) Conditions that would require remediation include: improper site grading, ruts/other depressions, water in debris (i.e. containers, tires, etc.), stored or

discarded materials, and excavations, and those cited by the Construction Administrator.

3) Under the direction of the Construction Administrator, the Contractor shall take all necessary preventive and/or corrective action to eliminate the potential breeding grounds.

26. ACCIDENT PREVENTION AND FIRST AID FACILITIES

In addition to conforming to the applicable governmental regulations and standards referred to in Article “Fire Prevention And Control” of the Information For Bidders, the Contractor shall conduct its work in accordance with the recommendations contained in the latest edition of the "Manual of Accident Prevention in Construction," as published by the Associated General Contractors of America, Inc. and the most recent safety codes approved by the American Standards Association. In case of the conflict with the referenced governmental regulations and standards, the most stringent regulation, standard or recommendation shall govern.

Further, and without in any way limiting the Contractor’s obligations hereunder, and in accordance with the instructions of the Construction Administrator, the Contractor shall provide barricades, warning lights, danger and caution signs and other safeguards at all places where the work in any way is a hazard to the public.

The Contractor shall also provide and maintain upon the site at each location where major work is in progress, a completely equipped first aid kit that shall be readily accessible when construction activities are in progress. Posted on each first aid kit shall be the name, location and telephone number of the nearest hospital or doctor with whom the Contractor has previously made arrangements for emergency treatment in case of accident.

27. FIRE PREVENTION AND CONTROL

The Contractor shall abide by such rules and instructions as to fire prevention and control as the municipality having jurisdiction may prescribe. It shall take all necessary steps to prevent its employees from setting fires not required in the construction of the facility and shall be responsible for preventing the escape of fires set in connection with the construction.

It shall at all times provide the proper housekeeping to minimize potential fire hazards, and shall provide approved spark arresters on all steam engines, internal combustion engines and fuels.

Free access to fire hydrants and standpipe connections shall be maintained at all times during construction operations, and portable fire extinguishers shall be provided by the Contractor and made conveniently available throughout the construction site. The Contractor shall also notify its employees of the location of the nearest fire alarm box at all locations where work is in progress.

28. STATE AND LOCAL SALES TAX EXEMPTION

The Contractor's attention is directed to Section 1115 of the Tax Law of New York State, Chapters 513 and 514 of the Laws of 1974. In connection with capital improvement contracts entered into on or after September 1, 1974, all tangible personal property which will become an integral component of a structure, building or real property of New York State, or any of its political sub-divisions, including the County of Westchester, is exempt from State and local retail sales tax and compensating use tax.

Bidders' proposals shall exclude dollar amounts for the payment of State and Local retail sales tax and compensating use tax, for tangible personal property defined above.

The successful bidder shall be obliged to file the required Contractor Exempt Purchase Certificates, which may be obtained from the New York State Department of Taxation and Finance (1-800-462-8100), in order to utilize such exemption.

29. APPRENTICES

The attention of all bidders is directed to Section 220(3-e) of the New York State Labor Law, which is hereby incorporated herein by reference, which requires, among other things, that "Apprentices who are registered under a Bona Fide New York State Registered Apprentice Training Program shall be permitted to work."

30. AFFIRMATIVE ACTION PROVISION

During the performance of this Contract, the Contractor agrees that it will not discriminate against any employee or applicant for employment because of race, color, religion, sex, national origin, age or handicap. Contractor shall take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, sex, national origin, age or handicap. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoffs or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. Contractor agrees to include, or require the inclusion of the above provision in any subcontract made pursuant to its contract with the County.

31. AFFIRMATIVE ACTION PROGRAM REQUIREMENT

Relative to the award of this Contract, it is required that all bidders completely answer all questions contained in the questionnaire entitled "Affirmative Action Program Requirement" of the Proposal Pages, and properly attest to same.

It is also required that all subcontractors completely answer all questions contained in the questionnaire entitled " Affirmative Action Program Requirement-Subcontractors" of the Sample Forms, and properly attest to same. This form is to be submitted with the request to utilize subcontractor(s).

32. AUTHORITY TO DO BUSINESS IN NEW YORK

Any corporation not incorporated under the Laws of New York State, must furnish a copy of its certificate of authority, from the New York State Secretary of State, to do business in the State of New York, in accordance with Article 13 of the New York State Business Corporation Law.

33. LICENSE REQUIREMENTS (ELECTRICAL)

A. In accordance with the requirements of Local Law No. 20-1997 of Westchester County, no person shall perform work under any contract with the County of Westchester except (i) a licensed Master Electrician; (ii) a licensed "Special Electrician"; or (iii) a Journeyman Electrician working under the direct supervision and control of a Master Electrician.

In no event shall the County incur any liability to pay for any electrical work performed in violation of the licensing requirements of Local Law No. 20-1997 of Westchester County.

B. Contract with separate bids:

If the project is one where separate bid specifications are required pursuant to the provisions of the New York General Municipal Law, then any person, partnership, corporation, business organization or other business entity submitting a bid for the electrical portion of the project must possess, at the time of submission of the Bid, a valid Master/"Special" Electrician's license issued by the Westchester County Electrical Licensing Board in accordance with Chapter 277 Article XVII of the Laws of Westchester County and the Westchester County Electrical Licensing Board Rules & Regulations, in particular No. 11, which states as follows:

> No individual holding a Master Electrician's License shall lend such License to any person or allow any other person to carry on, engage in, or labor at the business as defined herein of installing, removing, altering, testing, replacing, or repairing electrical systems. A violation of this section by any person holding a License shall be sufficient cause for revocation of such License.
>
> However, nothing herein shall be construed to prohibit the use of a License by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that fifty-one (51) percent or more of the control of the voting capital stock of such partnership, corporation, or other business association is owned by one (1) or more holders of a Westchester County Master Electrical License and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such License holder or holders.

C. Contract with single bid:

Where the project does not involve separate bids pursuant to the New York General Municipal Law but where some electrical work is contemplated along with other work, the person, firm, partnership or corporation engaged to perform said electrical work

must possess a valid Master/"Special" Electrician's license issued by the Westchester County Electrical Licensing Board.

D. An electrical bidder must complete the "Certificate of License (Electrical)" of the Proposal Pages and will be required to furnish a copy of such license with the sealed Bid. Other bidders will be required to furnish a copy of such license for the applicable person engaged to perform the electrical work when request by the County, prior to awarding the contract.

E. The license must be maintained at all times during the performance of the work contemplated under the contract. The suspension, revocation or the failure to maintain or renew such license shall, in addition to any other right or remedy available to the County, be grounds for immediate termination of the contract, effective immediately upon notice from the Commissioner.

34. LICENSE REQUIREMENTS (PLUMBING)

A. In accordance with the requirements of Chapter 277, Article XV of the Laws of Westchester County, no person shall perform plumbing work under any contract with the County of Westchester except (i) a licensed Master Plumber; (ii) a certified Journey Level Plumber employed by and under the direction of a licensed Master Plumber; or (iii) an Apprentice Plumber working under the direct supervision and control of a Master Plumber or under the direct supervision and control of a certified Journey Level Plumber in the employ of a licensed Master Plumber.

In no event shall the County incur any liability to pay for any plumbing work performed in violation of the licensing requirements of Chapter 277, Article XV of the Laws of Westchester County.

B. Contract with separate bids:

If the project is one where separate bid specifications are required pursuant to the provisions of the New York General Municipal Law, then any person, partnership, corporation, business organization or other business entity submitting a bid for the plumbing portion of the project must possess, at the time of submission of the Bid, a valid Master Plumber's license issued by the Westchester County Board of Plumbing Examiners in accordance with the Westchester County Board of Plumbing Examiners Rules and Regulations and Chapter 277 Article XV of the Laws of Westchester County, in particular Section 277.509A, which states as follows:

> A. No holder of a license or certification issued under this article shall authorize, consent to or permit the use of his or her license or certification by or on behalf of any other person. No person who has not qualified or obtained a license or certification under this article shall represent himself or herself to the public as holder of a license or certification issued under this article, either directly, by means of signs, sign cards metal plates or stationery, or indirectly in any other manner whatsoever. However, nothing herein shall be construed to prohibit the use of a license by the holder thereof for or on behalf of a partnership, corporation or other business association, provided that 51 percent or more of the control of the voting capital stock of such partnership, corporation or other business

association is owned by one or more holders of a Westchester County master plumbing license and that all work performed by such partnership, corporation or other business association is performed by or under the direct supervision of such license holder or holders.

C. Contract with single bid:

Where the project does not involve separate bids pursuant to the New York General Municipal Law but where some plumbing work is contemplated along with other work, the person, firm, partnership or corporation engaged to perform said plumbing work must possess a valid Master Plumber's license issued by the Westchester County Board of Plumbing Examiners.

D. A plumbing bidder must complete the "Certificate of License (Plumbing)" of the Proposal Pages and will be required to furnish a copy of such license and the County issued identity badge with the sealed Bid. Other bidders will be required to furnish a copy of such license and the County issued identity badge for the applicable person engaged to perform the plumbing work when request by the County, prior to awarding the contract.

E. A restricted Master Plumber's license issued by the Westchester County Board of Plumbing Examiners shall satisfy the requirements of this section provided such restricted license authorizes the Master Plumber to engage in the business of plumbing within the local municipality in which the work under the contract is to be performed.

F. The license must be maintained at all times during the performance of the work contemplated under the contract. The suspension, revocation or the failure to maintain or renew such license shall, in addition to any other right or remedy available to the County, be grounds for immediate termination of the contract, effective immediately upon notice from the Commissioner.

35. LICENSE REQUIREMENTS (HAULERS)

(Haulers Of Solid Waste; Recyclables; Construction And Demolition Debris; Garden And Yard Waste And/Or Scrap Metal)

A. DEFINITIONS:

1) "Class A" refers to all haulers except those whose hauling business is limited solely to Class C, Class D or Class E activities or whose recycling business is limited to Class B activities. Class A Licensees may also conduct Class B, Class C, Class D and Class E activities.

2) "Class B" refers to Recyclable brokers. Class B Licensees may also conduct Class C, Class D and Class E activities.

3) "Class C" refers to haulers who exclusively handle construction and demolition debris. Class C Licensees may also conduct Class D and Class E activities. With respect to Class C haulers, the following shall apply: a. Class "C-1" shall refer to a business or subsidiary which generates construction and demolition debris, as defined herein, and which, incidental to such business, transports, stores, processes, transfers or disposes of the construction and demolition debris generated by the

operations of such business or subsidiary. Class "C-1" Licensees may also conduct Class E activities; b. Class "C-2" shall refer to all other businesses which otherwise transport, collect, store, transfer, process, or dispose of construction and demolition debris. Class "C-2" haulers may also conduct Class "C-1", Class D and Class E activities.

4) "Class D" refers to (i) haulers who collect, store, transport, transfer, process or dispose of garden and yard waste generated, originated or brought within the County where such garden and yard waste was previously generated by a person or entity other than the Licensees and/or (ii) haulers who collect, store, transport, transfer, process or dispose of garden and yard waste and which own, lease, or control one or more vehicles having three (3) or more axles which vehicles will be used in the collection, storage, transfer, transportation, processing or disposal of garden and yard waste generated, originated or brought within the County.

5) "Class E" refers to haulers who exclusively conduct a scrap peddler business.

6) "Construction and Demolition Debris" means uncontaminated Solid Waste resulting from the construction, remodeling, repair and demolition of structures and roads, and uncontaminated Solid Waste consisting of vegetation resulting from land clearing and grubbing, utility line maintenance and seasonal and storm-related cleanup. Such waste includes, but is not limited to, bricks, concrete and other masonry materials, soil, rock, wood, wall coverings, plaster, drywall, plumbing fixtures, non-asbestos insulation, roofing shingles, asphaltic pavement, glass, plastics that are not sealed in a manner that conceals other waste, electrical wiring and components containing no hazardous liquids, metals, and trees or tree limbs that are incidental to any of the above.

7) "Hauler" means any person excluding municipalities, the County and any County district including, but not limited to, Refuse Disposal District No. 1 and all County sewer and water districts, who, for a fee or other consideration, collects, stores, processes, transfers, transports or disposes of Solid Waste, Recyclables or construction and demolition debris that is generated or originated within the County or brought within the boundaries of the County for disposal, storage, transfer or processing.

8) "Recyclables" means those materials defined as "Recyclables" under Section 825.30 (8) of the Westchester County Source Separation Law.

9) "Scrap Peddler" shall mean any person who collects scrap materials for sale to a Recyclable broker using no more than one vehicle for collection and transportation of such materials.

10) "Solid Waste" means all putrescible and non-putrescible materials or substances, except as described in Paragraph 4 of 6 NYCRR Part 360-1.2(a), and/or regulated under 6 NYCRR Part 364, that are discarded or rejected as being spent, useless, worthless or in excess to the owners at the time of such discard or rejection including, but not limited to, garbage, refuse, commercial waste, rubbish, ashes, incinerator residue and construction and demolition debris. "Solid Waste" shall not be understood to include Recyclables as defined above.

B. **PLEASE TAKE NOTICE -** In accordance with the requirements of Chapter 826-a, Article III of the Laws of Westchester County, it is unlawful for any person to collect, store, transfer, transport or dispose of solid waste; recyclables; construction and demolition debris; garden and yard waste and/or scrap metal, as defined herein, that is generated or originated within the County or brought within the boundaries of the County for disposal, storage, transfer or processing, or to conduct any activities defined as Class A, Class B, Class C, Class D or Class E activities under Chapter 826-a of the Laws of Westchester County, in Westchester County (hereinafter collectively referred to as "hauling") without having first obtained a license therefore from the Westchester County Solid Waste Commission.

In no event shall the County incur any liability with respect to any hauling activities conducted by the bidder or any subcontractor of the bidder in violation of Chapter 826-a of the Laws of Westchester County.

C. Where the project necessitates that hauling be performed, either the bidder or the person, partnership, corporation, business organization or other business entity engaged to perform such hauling work on behalf of the bidder (hereinafter the "subcontractor") must possess a valid license issued by the Westchester County Solid Waste Commission at the time of submission of the bid and throughout the duration of any contract issued pursuant thereto.

D. A hauler bidder must complete the “Certificate of License (Hauler)” of the Proposal Pages and will be required to furnish a copy of such license with the sealed bid. Other bidders will be required to furnish a copy of such license for the applicable person engaged to perform the hauling work when requested by the County, prior to awarding the contract.

E. The suspension, revocation, or the failure to maintain or renew such license may, in addition to any other right or remedy available to the County, be grounds for termination of the contract, effective immediately upon notice from the Commissioner. The bidder which is awarded the contract hereunder shall have a continuing obligation to notify the Commissioner, within (2) business days, of any suspension, revocation or other action taken with respect to any license issued by the Westchester County Solid Waste Commission which may limit or impair the bidder's ability, or the ability of any authorized subcontractor, to perform such hauling work in the County of Westchester.

It shall be the bidder's responsibility to ensure that any subcontractor who will perform the hauling services required under any contract issued pursuant to this bid specification has a valid license for the duration of the term of any contract awarded hereunder.

F. In the event that a license held by the bidder or its subcontractor is revoked, suspended or otherwise discontinued by the Westchester County Solid Waste Commission, or in the event that the bidder is otherwise required to obtain the services of a new or alternate subcontractor for the hauling work, the bidder shall immediately notify the Commissioner and seek the Commissioner's approval for the use of such subcontractor to provide the hauling services which are required under the contract, and shall provide the Commissioner with a copy of the license issued by the Westchester County Solid Waste Commission to such subcontractor. No bidder or subcontractor shall provide

hauling services under the contract until a copy of its license has been provided to the Commissioner and the Commissioner has approved of such bidder or subcontractor.

36. MINORITY PARTICIPATION POLICY

A. Pursuant to Chapter 308 of the Laws of the County of Westchester, the County encourages the meaningful and significant participation of business enterprises owned by persons of color and women - Minority Business Enterprise (MBE) and Women Business Enterprise(WBE); on County of Westchester contracts.

B. It is the goal of the County of Westchester to use its best efforts to encourage, promote and increase participation of business enterprises owned and controlled by persons of color or women (MBE/WBE) in contracts and projects funded by all departments of the County and to develop a policy to efficiently and effectively monitor such participation.

C. In recognition of the need to promote the development of business enterprises owned and controlled by persons of color and women to achieve a goal of equal opportunity, and overcome the existing under representation of these groups in the business community, the County of Westchester acting through its Office of Economic Development shall as a lawful public and County purpose provide technical and informational assistance to such business enterprises with a particular emphasis on education programs to encourage participation in the contract procurement process.

D. For the purposes of this Local Law, a business enterprise owned and controlled by women or persons of color shall be construed to mean a business enterprise including a sole proprietorship, partnership or corporation that is: (a) at least 51% owned by one or more persons of color or women; (b) an enterprise in which such ownership by persons of color or women is real, substantial and continuing; (c) an enterprise in which such ownership interest by persons of color or women has and exercises the authority to control and operate, independently, the day-to-day business decisions of the enterprise; and (d) an enterprise authorized to do business in this state which is independently owned and operated. In addition, a business enterprise owned and controlled by persons of color or women shall be deemed to include any business enterprise certified as an MBE or WBE pursuant to Article 15-a of the New York State Executive Law and implementing regulations, 9 NYCRR Subtitle N Part 540 et seq., or as a small disadvantaged business concern pursuant to the Small Business Act, 15 U.S.C. 631 et seq., and the relevant provisions of the Code of Federal Regulations as amended.

E. The Contractor hereby acknowledges and agrees:

1) That in the hiring of employees for the performance of work under this contract or any subcontract hereunder, no contractor, subcontractor, nor any person acting on behalf of such contractor or subcontractor, shall be reason of race, creed, color, religion, gender, age, ethnicity, disability, sex, alienage or citizenship status, national origin, marital status, sexual orientation, familial status, genetic predisposition or carrier status discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates;

2) That no contractor, subcontractor, nor any person on its behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, creed, color, religion, gender, age, ethnicity, disability, sex, alienage or citizenship status, national origin, marital status, sexual orientation, familial status, genetic predisposition or carrier status;

3) That there may be deducted from the amount payable to the contractor by the County under this contract a penalty of fifty (50) dollars for each person for each calendar day during which such person was discriminated against or intimidated in violation of the provisions of the contract;

4) That this contract may be canceled or terminated by the County, and all moneys due or to become due hereunder may be forfeited, for a second or any subsequent violation of the terms or conditions of this section of the contract; and

5) The aforesaid provisions of this section covering every contract for or on behalf of the County for the manufacture, sale or distribution of materials, equipment or supplies shall be limited to operations performed within the territorial limits of the State of New York.

6) Contractor agrees to include, or require the inclusion of the above provision in any subcontract made pursuant to its contract with the County.

F. In furtherance of the Contractor's obligation to make documented good faith efforts to utilize Minority Business Enterprises (MBE) and Women's Business Enterprises (WBE) for the Work required by this Contract, the Contractor shall provide the Minority/Women Business Enterprise Questionnaire signed by an officer of the Contractor, and any additional information requested by the County, including but not limited to the following, which shall be delivered to the Construction Administrator and , Program Manager of Minority- and Women-Owned Business Program, County of Westchester, Room 911, 148 Martine Avenue, White Plains, New York 10601 coincident with the Contractor's delivery to the County of its bid and shall be provided by the Contractor with any request for approval of subcontractors:

1 (a) The name, address, telephone number and contact person of each MBE and WBE solicited verbally by Contractor during the applicable period for the performance of any portion of the Contractor's Work and the date(s) that each such solicitation was made;

1 (b) A description of the portion of the Contractor's Work for which each such solicitation is made.

1 (c) A listing of the project documents, if any, furnished to each such MBE and WBE.

2. A copy of each written solicitation sent by the Contractor to each MBE and WBE and the name and address of each MBE and WBE to whom the solicitation was made.

3) The name and address of each MBE and WBE that performs any portion of the Contractor's Work, a description of such portion of the Work and the dollar

amount therefore.

4) A statement that the Contractor reviewed a list of MBE and WBE contractors in their outreach efforts. A list can be found at www.westchestergov.com/mwob.

5) Indicate those MBE and WBE contractors found on the list that provided the type of subcontractor services required for this project. If none were found, please indicate.

6) Describe other outreach efforts, including other MBE and/or WBE lists, organizations or individuals that were contacted.

The failure of the low bidder to comply with the provisions of this subparagraph F may result in the County NOT awarding this contract to your firm. Failure of the Contractor to comply with the provisions of this subparagraph F may constitute a material breach of this Contract. Failure to comply with the Minority Participation Policy may be considered by the County when awarding contracts.

37. SEXUAL HARASSMENT POLICY

A. As with discrimination involving race, color, religion, age, sexual orientation, disability, and national origin, Westchester County also prohibits sex discrimination, including sexual harassment of its employees in any form. The County will take all steps necessary to prevent and stop the occurrence of sexual harassment in the workplace.

1) **This policy applies to all County employees and all personnel in a contractual relationship with the County**. Depending on the extent of the County's exercise of control, this policy may be applied to the conduct of non-County employees with respect to sexual harassment of County employees in the workplace.

2) This sexual harassment policy includes, but is not limited to, inappropriate forms of behavior described by the Equal Employment Opportunity Commission.

B. Sexual advances that are not welcome, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitutes sexual harassment when:

1) Submission to such conduct is made either explicitly or implicitly a term or condition of an individual's employment; -OR-

2) Submission to or rejection of such conduct by an individual is used as the basis for employment decisions, such as promotion, transfer, or termination, affecting such individuals; -OR-

3) Such conduct has the purpose or effect of unreasonably interfering with an individual's work performance or creating an intimidating, hostile or offensive working environment.

C. Sexual harassment refers to behavior that is not welcome, that is personally offensive, that fails to respect the rights of others, that lowers morale and that, therefore, interferes

with an employee's work performance and effectiveness or creates an intimidating, hostile or offensive working environment.

38. SMOKE-FREE WORKPLACE POLICY

A. By way of Executive Order No. 5 of 1998 and Local Law 3 of 2003, it is now the policy of the County of Westchester to institute a smoke-free "workplace".

B. Every indoor County "workplace", shall become a smoke-free area. The smoking or carrying of lighted cigarettes, cigars, pipes, or any other tobacco-based products, or products that result in smoke, is hereby banned.

C. Every indoor County "workplace" shall be covered under this Executive Order, including the County Jail in Valhalla and the Westchester County Center in White Plains. This Executive Order shall not, however, apply to County-owned facilities that are not County "workplaces", such as employees housing or privately run restaurants on County property (e.g. at the County golf courses).

D. The Richard J. Daronco County Courthouse shall not, for purposes of this Executive Order, be considered a County "workplace", and therefore shall not be required to be smoke-free.

E. This Executive Order is intended to be consistent with, and not modify, any provisions of the New York State Public Health Law.

F. This Executive Order shall take effect immediately and remain in full force and effect until otherwise superseded or revoked.

39. COUNTY ENERGY EFFICIENT PURCHASING POLICY

A. By way of Executive Order No. 9 of 2002, it is now the policy of the County of Westchester to institute an Energy Efficient Purchasing Policy.

B. This policy shall apply to all purchases made by and for the County in accordance with applicable laws, rules and regulations.

C. Wherever the price is reasonably competitive and the quality adequate for the purpose intended, purchase and utilization of products that meet Energy Star requirements for energy efficiency as determined by the United States Environmental Protection Agency and the United States Department of Energy is hereby recommended.

D. If the Energy Star label is not available with respect to a particular product, than it is recommended that products in the upper twenty-five percent of energy efficiency as designated by the United States Federal Energy Management Program shall be purchased and utilized if the prices of those products are reasonably competitive and the quality adequate for the purpose intended.

40. RESTRICTION ON USE OF TROPICAL HARDWOODS

A. The bidder/proposer shall not use or propose to use any tropical hardwoods or tropical hardwood products in any form, except in accordance with State Finance Law § 165 (Use of Tropical Hardwoods), as may be amended from time to time. Pursuant to the

State Finance Law § 165, any bid/proposal which proposes or calls for the use of any tropical hardwood or wood product in the performance of the contract shall be deemed non-responsive.

41. DISCLOSURE OF RELATIONSHIPS TO COUNTY

A. The successful bidder is required to complete the form entitled "Required Disclosure of Relationships to County" on Proposal Pages 32-33 before award of the contract.

B. In the event that any information provided on the completed Proposal Pages entitled "Required Disclosure of Relationships to County" changes during the term of this agreement, the Contractor shall notify the Commissioner in writing within ten (10) days of such event by submitting a revised "Required Disclosure of Relationships to County" form.

42. CONTRACTOR DISCLOSURE STATEMENT

The Contractor and each Major Subcontractor represents that all information provided by the Contractor and Major Subcontractor in the form entitled "Contractor Disclosure Statement" on Proposal Pages 23-31 is in all respects true and correct. In the event the information provided on that document changes during the term of this agreement or for a period of three (3) years after the date that the Contractor and/or the Major Subcontractor receives final payment under this agreement, the Contractor and/or Major Subcontractor shall notify the Commissioner in writing within ten (10) days of such event by submitting a revised "Contractor/Major Subcontractor Disclosure Statement". Bidders must complete the Required Disclosure of Relationships to County form. The Required Disclosure of Relationships to County form is located on Proposal Pages 32-33.

43. CRIMINAL BACKGROUND INFORMATION

Pursuant to Executive Order 1-2008 and subject to the applicable provisions of New York Correction Law §§ 752 and 753, the County shall have the right to bar the following "Persons Subject to Disclosure" (Persons shall mean individuals or legal entities) from providing work or services to the County or from being on County property:

(a) Consultants, Contractors, Licensees, Lessees of County owned real property, their principals, agents, employees, volunteers or any other person acting on behalf of said Contractor, Consultant, Licensee, or Lessee who is at least sixteen (16) years old, including but not limited to Subconsultants, Subcontractors, Sublessees or Sublicensees who are providing services to the County; and

(b) Any family member or other person, who is at least sixteen (16) years old, residing in the household of a County employee who lives in housing provided by the County located on County property.

If any of the above mentioned Persons Subject to Disclosure has either one of the following:

(a) A conviction of a crime (all felonies and misdemeanors as defined under the New York State Penal Law or the equivalent under Federal law or the laws of any other State);

(b) A pending criminal proceeding for a crime(s) as defined above; or

(c) A refusal to answer such questions.

Where the following criteria apply:

(a) If any of the Persons Subject to Disclosure providing work or services to the County in relation to a County Contract are not subject to constant monitoring by County staff while performing tasks and/or while such persons are present on County property pursuant to the County Contract; and

(b) If any of the Persons Subject to Disclosure providing work or services to the County, in relation to a County Contract may, in the course of providing those services, have access to sensitive data (for example, Social Security Numbers and other personal/secure data); facilities (secure facilities and/or communication equipment); and/or vulnerable populations (for example, children, seniors and the infirm).

Accordingly, the Contractor is required to review the Instructions found in the instructions and complete "Contractor and all persons subject to Disclosure Certification Forms" located at Forms Pages 11-13 as well as any other applicable criminal disclosure forms (i.e., Forms Pages 14 through 19," together with Forms Pages 11-13 collectively referred to as "Disclosure Forms").

However, the following Persons Subject to Disclosure are **exempt** from Executive Order 1-2008: (i) those persons for whom the County has already conducted a background check and issued a security clearance that is in full force and effect; or (ii) those persons for whom another state or federal agency having appropriate jurisdiction has conducted a security and/or background clearance or has implemented other protocols or criteria for this purpose that apply to the subject matter of this Contract that is in full force and effect.

If a Person Subject to Disclosure is exempt from the disclosure described in Executive Order 1-2008 because of either "i" or "ii" above, then the Contractor shall notify the Procuring Officer[1] in the respective Department of its claim of exemption and it shall be the responsibility of the Procuring Officer to verify each exemption. If the Procuring Officer determines that the Contractor is exempt under sections "i" or "ii" above, the Procuring Officer shall confirm same with the Contractor and maintain a written record including all supporting details of the verification of and acknowledgement of said exemption.

If the Procuring Officer determines that the Contractor is not exempt under sections "i" or "ii" above, the Procuring Officer shall notify the Contractor in writing, and the appropriate Disclosure Forms shall be required.

It shall be the Contractor's duty to disclose and to inquire of each and every Person Subject to Disclosure, whether they have been convicted of a crime or whether they are currently subject to pending criminal charges. It shall be the duty of the Contractor to submit a completed Certification Form "Forms Pages 11-13"annexed hereto as ," which certifies that the Contractor and every Person Subject to Disclosure has been asked whether they have been convicted of a crime or are currently subject to pending criminal charges.

Should the Contractor or any Person Subject to Disclosure (also referred to as "Person")

[1] "Procuring Officer" shall mean the head of the department or the individual(s) authorized by the head(s) of the department(s) undertaking the procurement and with respect to those matters delegated to the Bureau of Purchase and Supply pursuant to Section 161.11(a) of the Laws of Westchester County, the Purchasing Agent.

affirmatively advise that they have been convicted of a crime said Person shall be identified in Forms Page 14 entitled "Names And Titles Of Persons Subject To Disclosure That Answered Yes" to any questions on Forms Pages11-13 and shall complete Forms Pages 15-16 entitled, "Criminal Background Disclosure Form For Persons Who Have Been Convicted of A Crime."

Should the Contractor or any Person Subject to Disclosure advise that they are subject to pending criminal charges, said Person shall be identified in Forms Page 14 and shall complete the form annexed hereto as Forms Pages 17-18 entitled, "Criminal Background Disclosure Form For Persons Who Are Subject to Pending Criminal Charges."

Should the Contractor or any Person Subject to Disclosure refuse to answer whether they have been convicted of a crime or are currently subject to pending criminal charges, the name and title of said Person(s) shall be listed on Forms Page 19 entitled "Persons That refused To Answer".

It shall be the duty of the Contractor to submit to the Procuring Officer all of the attached applicable Disclosure Forms prior to the commencement of this Contract. It is the responsibility of each Contractor to assure that all of their proposed Subcontractors complete the criminal background and disclosure certification forms and submit the forms to the Procuring Officer before they will be approved to perform work on the contract.

Under no circumstances shall the existence of a language barrier serve as a basis for the waiver of or an exception to this obligation. If the Contractor needs to obtain translation services to fulfill this obligation, it shall be at the sole cost and expense of the Contractor.

The Contractor shall be required to make the same inquiry and forward updated Disclosure Forms to the Procuring Officer regarding additional Persons Subject to Disclosure in connection with this Contract during the term of this Contract. **NO NEW PERSON SUBJECT TO DISCLOSURE SHALL PERFORM WORK OR SERVICES OR ENTER ONTO COUNTY PREMISES UNTIL THE UPDATED DISCLOSURE FORMS ARE FILED WITH THE PROCURING OFFICER.**

THE CONTRACTOR HAS A CONTINUING OBLIGATION TO MAINTAIN THE ACCURACY OF THE DISCLOSURE FORMS FOR THE DURATION OF THIS CONTRACT, INCLUDING ANY AMENDMENTS OR EXTENSIONS THERETO AND SHALL PROVIDE ANY UPDATES TO THE PROCURING OFFICER AS NECESSARY TO COMPLY WITH THE DISCLOSURE REQUIREMENTS BY EXECUTIVE ORDER 1-2008.

Any failure by the Contractor to comply with the disclosure requirements of Executive Order 1–2008, absent proof of exemption deemed satisfactory by the County Procuring Officer, may be considered by the County, a material breach by the Contractor and may be grounds for immediate termination of this Agreement by the County.

44. MANDATORY OSHA CONSTRUCTION SAFETY AND HEALTH TRAINING

Pursuant to NYS Labor Law §220-h – On all public work projects of at least $250,000 all laborers, workers and mechanics employed, in the performance of the contract on the public work site, either by the contractor, sub-contractor or other person doing or contracting to do the

whole or a part of the work contemplated by the contract, are required to be certified as having successfully completed an OSHA construction safety and health course of at least 10 hours prior to performing any work on the project.

3. GENERAL CLAUSES

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

1. MATERIAL AND WORKMANSHIP

It is the intent of these specifications to require first-class work and new and best quality materials. For any unexpected features arising during the progress of the work and not fully covered herein the specifications shall be interpreted to require first-class work and materials, and such interpretations shall be binding upon the Contractor.

1) Upon award of the Contract, the Contractor shall furnish in writing to the Construction Administrator the sources of supply for concrete, and other materials that it proposes to use in the work, and material shall not be furnished from other sources of supply except after written approval by the Construction Administrator. The Contractor shall, before ordering equipment verify that Suppliers of equipment will provide the required warranties, guarantees, and maintenance services.

2. DEFINITIONS

COMMISSIONER - The head of the Department of Public Works of the County of Westchester.

CONSTRUCTION ADMINISTRATOR- The representative of the Commissioner of Public Works at the project site who, unless specifically designated otherwise in the Contract, shall in the first instance, make such determinations as are necessary for the expeditious completion of the Work, except for those determinations that are reserved to the Commissioner.

CONTRACT - Shall mean each of the various parts of these documents both as a whole or severally and except for titles, subtitles, headings and table of contents, shall include the Notice to Bidders, Information for Bidders, the Proposal, the Specifications, the Performance Bond, the Plans, the Contract Form, and all addenda and provisions required by law.

CONTRACTOR - Party of the second part to the Contract acting directly or through its agents, subcontractors, or employees, and who is responsible for all debts pertaining to and for the acceptable performance of the work for which it had contracted.

COUNTY - Party of the first part to the Contract as represented by the Board of Acquisition and Contract and the Commissioner of Public Works for the County of Westchester.

ENGINEER - An Engineer or Architect that designed the project and is serving as the duly authorized representative of the Commissioner of Public Works who, in addition to the duties set forth in the Contract, shall, in the first instance, make such determinations as are necessary to ensure the Contractor's compliance with its obligations for the preparation and submission of shop drawings and all other submittals required for the Work. If there is no Engineer the duties of the Engineer shall be performed by the Construction Administrator and all references in this

Agreement to the Engineer shall be deemed to mean the Construction Administrator.

MAJOR SUBCONTRACTOR- Subcontractors performing all or a portion of the work for Electrical; Heating, Ventilating and Air Conditioning; Fire Prevention; General Construction; and/or any Subcontractor whose subcontract price is equal to or greater than ten percent (10%) of the Contract Price.

OWNER - The County of Westchester.

PLANS - All official drawings or reproductions of drawings pertaining to the work or to any structure connected therewith.

SPECIFICATIONS - The body of directions, requirements, etc. contained in this present volume, together with all documents of any descriptions and agreements made (or to be made), pertaining to the methods(or manner) of performing the work or to the quantities and quality. Specifications shall also include the Notice to Contractors, Instructions to Bidders, Bond, Proposal and Contract Agreement.

SURETY - The corporate body, which is bound with and for the Contractor and which engages to be responsible for the faithful performance of the contract, and to indemnify the County against all claims for damages.

A.A.S.H.O. - American Association of State Highway Officials

A.R.E.A. - American Railway Engineering Association

A.S.T.M. - American Society for Testing Materials

A.W.W.A. - American Water Works Association

N.E.C. - National Electrical Code

N.E.M.A. - National Electric Manufacturers Association

3. BOUNDARIES OF WORK

The County will provide land or rights-of-way for the work specified in this Contract. Other contractors, employees or concessionaires of the county, may for all necessary purposes enter upon the work and premises used by the Contractor, and the Contractor shall give to other contractors and employees of the County all reasonable facilities and assistance for the completion of adjoining work.

4. OVERLAPPING WORK

The Contractor shall take notice that because of work on other contracts within and adjacent to the contract limits it may not have exclusive occupancy of the territory within or adjacent

to the contract limits, and that during the life of this contract the owners and operators of Public Utilities may make changes in their facilities.

The said changes may be made by utility employees or by contract within or adjacent to the contract limits and may be both temporary and permanent.

The Contractor shall cooperate with other Contractors and owners of various utilities and shall coordinate and arrange the sequence of its work to conform with the progressive operations of work already or to be put under contract. Cooperation with Contractors already or to be engaged upon the site is essential to properly coordinate the construction efforts of all Contractors, Utility Owners and Subcontractors engaged in work within and adjacent to the contract limits.

The Contractor shall coordinate the work of its various Subcontractors. Their respective operations shall be arranged and conducted so that delays are avoided. Where the work of the Contractor or Subcontractor overlaps or dovetails with that of other Contractors, materials shall be delivered and operations conducted so as to carry on the work continuously in an efficient and workmanlike manner. The Contractor shall coordinate its work to be done hereunder with the work of the other Contractor(s) and the Contractor shall fully cooperate with such other Contractor(s) and carefully fit its own work to that provided under other contracts as may be directed by the Construction Administrator. If the Construction Administrator shall determine that the Contractor is failing to coordinate its work with the work of the other Contractor(s) as the Construction Administrator has directed, then the Commissioner shall have the right, at its sole option, to withhold any payments otherwise due hereunder until the Construction Administrator's directions are complied with by the Contractor and/or deduct the costs incurred by the County due to the Contractor's failure or refusal to so cooperate. Delays or oversights on the part of the Contractor or Subcontractors or Utility Owners in performing their work in the proper manner thereby causing cutting, removing and replacing work already in place, shall not be the basis for a claim for extra compensation.

In the event of interference between operations of Utility Owners and other Contractors, or among the Contractors themselves, the Construction Administrator shall be the sole judge of the rights of each Contractor insofar as the sequence of work necessary to expedite the completion of the entire project, and in all cases its decision shall be final. The Contractor agrees that it has included in its unit prices bid for the various items of the contract the possible additional cost of performing the work under this contract because it may not have a clear site for its work and because of possible interference of roadway use, other Contractors and necessary utility work, and the necessity or desirability of opening certain sections of pavement to traffic before the entire work is completed. The County shall not be liable for any damages suffered by any Contractor by reason of another Contractor's failure to comply with the directions of the Construction Administrator, or by reason of another Contractor's default in performance or by any act or failure to act of any Utility Owner or anyone working on its behalf, it being understood that the County does not guarantee the responsibility or continued efficiency of any Contractor or Utility Owner and under no circumstances shall the County be liable to any Contractor or Utility Owner for any delays, interferences or any other impediment or hindrance to the Contractor's or Utility Owner's work .

Should the Contractor sustain any damage through any act or omission of any other contractor having a Contract with the County for the performance of work upon the site or of work which may be necessary to be performed for the proper prosecution of the work to be performed hereunder, or through any act or omission of a supplier or subcontractor of whatever tier of such contractor, the Contractor shall have no claim against the County for such damage, but shall have a right to recover such damage from the other contractor under the provision similar to the following provision that has been or will be inserted in the Contracts with such other contractors.

Should any other Contractor having or who shall hereafter have a Contract with the County for the performance of work upon the site sustain any damage through any act or omission of the Contractor hereunder or through the act or omission of any subcontractor of whatever tier of the Contractor, the Contractor agrees to reimburse such other Contractor for all such damages and to defend at his own expense any suit based upon such claim and if any judgment or claims against the County shall be allowed the Contractor shall pay or satisfy such judgment or claim and pay all costs and expenses, including attorney's fees, incurred by the County in connection therewith and to indemnify and hold the County harmless from all such claims.

The County's right to indemnification hereunder shall not be diminished or waived by its assessment against the Contractor of liquidated damages as may be provided elsewhere herein.

Delays in availability of any part of the site or any delays due to interference between the several Contractors and the Utility Owners shall be compensated for by the Construction Administrator solely through granting an extension of time in which to complete the work of the contract without assessment of Engineering charges. The Contractor in submitting its bid hereby agrees that it shall make no other claim against the County for any damages due to such delays or interference.

5. PROPER METHOD OF WORK AND PROPER MATERIALS

The Construction Administrator shall have the power in general to direct the order and sequence of the work, which will be such as to permit the entire work under this contract to be begun and to proceed as rapidly as possible, and such as to bring the several parts of the work to a successful completion at about the same time.

If at any time before the commencement or during the progress of the work the materials and appliances used or to be used appear to the Construction Administrator as insufficient or improper for securing the quality of work required, or the required rate of progress, he may order the Contractor to increase their efficiency or to improve their character, and the Contractor shall promptly conform to such order; but the failure of the Construction Administrator to demand any increase of such efficiency or improvement shall not release the Contractor from its obligation to secure the quality of work or the rate of progress specified.

6. CONTROL OF AREA

Unloading of materials and parking of equipment shall be subject to the orders of the Construction Administrator so far as he may find necessary for the protection and safety of the traveling public and the preservation of property.

7. PERMITS, FEES, ETC.

The County will obtain at its sole cost the necessary New York State Pollutant Discharge Elimination System ("SPDES") Permit and will sign the associated Notice of Intent ("NOI"). The Contractor and its subcontractors will sign the required Certification Statement (a copy of which is contained as Proposal Page) when it signs the contract.

All necessary permits from County, State or other concerned Public Authorities shall be secured at the cost and expense of the Contractor. It shall also give all notices required by law, ordinance, or the rules and regulations of the concerned Public Bureaus or Departments, and also as a part of the Contract, comply without extra charge or compensation with all State Laws and all other Ordinances or Regulations that may be applicable to this work. Contractor, however, shall first notify the Commissioner before proceeding with securing of all necessary permits and the giving of required notices.

8. TRAFFIC

The General Contractor shall be responsible for the Maintenance and Protection of traffic at all times until the date of completion and acceptance of its work.

During the whole course of the work the Contractor shall so conduct its work and operations so as to interfere with traffic passing the work as little as possible and effect by every reasonable means the safety and comfort of pedestrians, vehicles and vehicle passengers passing the work.

9. INSPECTION

The Contractor shall at all times provide convenient access and safe and proper facilities for the inspection of all parts of the work. No work, except such shop work as may be so permitted, shall be done except in the presence of the Construction Administrator or his/her assistants. No material of any kind shall be used upon the work until it has been inspected and accepted by the Construction Administrator. All materials rejected shall be immediately removed from the work and not again offered for inspection. Any materials or workmanship found at any time to be defective shall be remedied at once, regardless of previous inspection. The inspection and supervision of the work by the Construction Administrator is intended to aid the Contractor in supplying labor and materials in accordance with the specifications, but such inspection shall not operate to release the Contractor from any of its contract obligations.

10. STOPPING WORK

The Commissioner, Construction Administrator or Engineer may stop by written order any work or any part of the work under this contract if, in his/her opinion, the methods employed

or conditions are such that unsatisfactory work might result. When work is so stopped it shall not be resumed until the methods or conditions are revised to the satisfaction of the Commissioner, which must be signified in writing. The Contractor agrees to make no claim for increased costs arising from the issuance of any stop work order.

11. DIMENSIONS

Figured dimensions on the plans shall be given preference over scaled dimensions, but shall be checked by the Contractor before starting construction. Any errors, omissions or discrepancies shall be brought to the attention of the Engineer and his/her decision thereon shall be final.

12. PAYMENTS TO COUNTY

Wherever in the Contract Documents the Contractor is required to make a payment to the County, the Contractor agrees that the County has the option to withhold such sum(s) from payments otherwise due to the Contractor and that all such sums withheld shall be deemed not to be earned by the Contractor.

13. PROTECTION OF UTILITIES AND STRUCTURES

The Contractor shall be responsible for the preservation of all public and private underground and surface utilities/structures at or adjacent to the construction work; insofar as they may be endangered by the work. This shall hold true whether or not they are shown on the contract drawings. If they are shown on the drawings, the County does not guarantee their locations even though the information will be from the best available sources.

The Contractor shall give ample and reasonable notice to all private, corporate or municipal owners before work is done near their utility or structure; shall properly protect all utilities/structures encountered; shall at their expense repair/replace any items that are damaged; and shall proceed with caution to prevent undue interruptions to utility services.

Investigation and/or on-site mark-out, by the County, must be done prior to excavation work at the Valhalla Campus. This investigation/mark-out is to serve as a guide for the Contractor and does not absolve the Contractor from the responsibility to repair/replace identified or non-identified utilities/structures, at no cost to the County.

All excavation work performed at the Valhalla Campus requires the submission of a completed "Ground Penetration" form/sketch(es) will be distributed to the appropriate utility owners. Therefore, the Contractor should assume that no excavation work can be performed until approximately twenty (20) working days after submission of the form/sketch(es), but not prior to approval by the DPW-BO Superintendent of Buildings.

14. PROTECTION OF WATER RESOURCES & THE ENVIRONMENT

The Contractor is responsible to review the specifications and drawings as they relate to this Agreement to ascertain what procedures must be followed in order to comply with all applicable stormwater management, water quality control, erosion, and sediment control

laws, rules, regulations and permits. If the Contractor is of the opinion that any work required, necessitated, or contained in the specifications or otherwise ordered conflicts with the applicable stormwater management, water quality control, erosion, and sediment control laws, rules, regulations, procedures, and permits, including, without limitation, all applicable provisions of the New York State Stormwater Management Design Manual, and the New York Standards and Specifications for Erosion and Sediment Control as they may be amended from time to time, it must promptly notify the First Deputy Commissioner of the Department of Public Works in writing.

In addition to all other requirements contained in this Agreement, the Contractor recognizes and understands that it is an essential element of this Agreement that the Contractor complies with the County's policies to protect water resources and the environment. The Contractor must comply with all applicable stormwater management, water quality control, erosion, and sediment control laws, rules, regulations, permits, procedures and specifications, including, without limitation, all applicable provisions of the New York State Stormwater Management Design Manual,[1], the New York Standards and Specifications for Erosion and Sediment Control as they may be amended from time to time. All of these documents should be obtained from the New York State Department of Environmental Conservation to ensure that the Contractor has the latest version. It should be noted that the standards set forth in the New York State Stormwater Management Design Manual, and the New York Standards and Specifications for Erosion and Sediment Control apply to ALL work done for the County, regardless of the size of the project. In case of a conflict among the governmental regulations and standards, the most stringent regulation, standard or recommendation shall apply to the work done under this Agreement.

The Contractor and its subcontractors shall execute the required Stormwater Pollution Prevention Certification, which is located at Proposal Page 20. In addition, the Contractor acknowledges that if the work required under this Agreement requires that a State Pollutant Discharge Elimination System ("SPDES") permit be obtained from the New York State Department of Environmental Conservation, then the Contractor must comply with the terms and conditions of the SPDES permit for stormwater discharges from construction activities and the Contractor will not take any action or fail to take any necessary action that will result in the County being held to be in violation of said permit or any other permit. The Contractor shall cooperate with the County in obtaining the permit and comply with the SPDES permit and all other applicable laws, rules, regulations and permits.

The Contractor shall provide, as the Commissioner or his designee may request, proof of compliance with the County's policies to protect water resources and the environment, and all applicable stormwater management, water quality control, erosion and sediment control laws, rules, regulations, permits, procedures and specifications.

The Contractor is responsible to ascertain which of the laws, rules, regulations, permits and standards referenced above affect its construction activities, and the Contractor shall be solely responsible for all costs and expenses, including any penalties or fines, incurred by the County, due to the Contractor's failure to comply with such applicable laws, rules,

[1] available at http://www.dec.state.ny.us/website/dow/swmanual/swmanual.html - The location of this reference is provided to assist the Contractor; it does not relieve the Contractor from the obligation of obtaining and complying with the latest version of the document.

permits, regulations, standards and County policies. The Contractor shall be responsible to defend and indemnify the County from any and all claims resulting from the Contractor's failure to comply with the applicable laws, rules, regulations, permits, standards and County policies.

Failure of the Contractor to comply with the County's policies to protect water resources and the environment, and all applicable stormwater management, water quality control, erosion and sediment control laws, rules, regulations, permits, procedures and specifications may result in the withholding of progress payments to the Contractor by the County. Such withholding of progress payments shall not relieve the Contractor of any requirements of the Agreement including the completion of the work within the specified time, and any construction sequence requirement of the Agreement.

The Contractor acknowledges that its failure to comply with the County's policies to protect water resources and the environment, and all applicable stormwater management, water quality control, erosion and sediment control laws, rules, regulations, permits, procedures and specifications shall constitute a material breach under this contract. For the breach or violation of this provision, without limiting any other rights or remedies to which the County may be entitled, the County shall have the right, in its sole discretion to suspend, discontinue or terminate this Agreement immediately upon notice to the Contractor. In such event, the Contractor shall be liable to the County for any additional costs incurred by the County in the completion of the project.

The failure of the Contractor to comply with these requirements could lead to a determination that the Contractor is not a responsible bidder when the Contractor is bidding on other projects.

15. SANITARY REGULATIONS

The Contractor shall obey and enforce such sanitary regulations and orders and shall take such precautions against infectious diseases as may be deemed necessary. The building of shanties or other structures for housing the men, tools, machinery or supplies will be permitted only at approved places, and the sanitary condition of the grounds in and at such shanties or other structures must be at all times maintained in a satisfactory manner.

16. CLEANING UP

Upon completion of the work, the Contractor shall remove all equipment, rubbish, debris and surplus materials from the buildings, and grounds, and provide a suitable dumping place for such materials. The premises shall be left in a neat, clean and acceptable condition.

No litter, debris of any kind shall be allowed to accumulate for more than one day in any portion of the buildings or grounds, and must be removed from the area at the end of each workday.

17. PREVENTION OF DUST HAZARD

In accordance with the New York State Labor Law, Section 22a, in the event a silica or other harmful dust hazard is created due to construction operations under the contract, the Contractor shall install, maintain and keep in effective operation the appliances and methods

for the elimination of such silica dust or other harmful dust as have been recommended and approved by State and local authorities.

18. REPRESENTATIVE ALWAYS PRESENT

The Contractor in case of its absence from the work shall have a competent representative fluent in English or foreman present, who shall obey without delay, all instructions of the Construction Administrator in the prosecution and completion of the work in conformity with this contract, and shall have full authority to supply labor and material immediately.

19. WORK IN BAD WEATHER

During freezing, stormy or inclement weather, no work shall be done except such as can be done satisfactorily and in a manner to secure first-class construction throughout.

20. PROTECTION OF WORK UNTIL COMPLETION

The Contractor shall be responsible for the protection and maintenance of its work until the same has been accepted by the Owner and shall make good any damage to the work caused by floods, storms, settlements, accidents, or acts of negligence by its employees or others so that the complete work when turned over to the Owner will be in first-class condition and in accordance with the plans and specifications.

21. REMOVAL OF TEMPORARY STRUCTURES AND CLEANING UP

On or before the completion of the work the Contractor shall, without charge therefore, tear down and remove all buildings and other structures built by him for facilitating the carrying out of the work, shall remove all rubbish of all kinds from the grounds which he has occupied, shall do any small amount of additional trimming and grading and shall leave the entire work and premises clean, neat and in good condition. The Contractor shall provide at its own expense suitable dumping places for such material. When the necessity for protecting traffic ends, the Contractor shall remove all signs, lighting devices, barricades and temporary railings from the site of the work.

22. GROSS LOADS HAULED ON HIGHWAY

The Contractor shall at no time during the construction of this contract, haul gross loads exceeding the legal limit prescribed by the Highway Law over the highways of access to, or the highway included in this contract.

23. CONCRETE BATCH PROPORTIONS - YIELD

No Construction Administrator or Engineer is authorized to instruct or inform the Contractor, or any of its agents or employees, or its concrete supplier as to the weights of the ingredients to be used to produce a cubic yard of concrete or as to the yield to be used to produce a cubic yard of concrete or as to the yield to be expected from any batch. The Contractor shall make its own determination and give its own instructions to its agents, employees and concrete supplier as to the total quantity of ingredients to be purchased as a

cubic yard of concrete. The right is reserved to the Construction Administrator and Engineer, however, to verify yields after batch weights have been established by the Contractor and to order a reduction in total weight per load in the event his/her calculations show that the rated capacity of truck mixers, if approved for use, will be exceeded.

24. DAMAGE DUE TO CONTRACTOR'S OPERATIONS

In the event that damage is caused to structures, surfacing, pavement, shrubbery, trees or to grassed areas through trucking operations, delivery of materials, the actual performance of the work, or other causes, the Contractor shall fully restore the same to their original condition at its own expense. In the event that more than one contractor causes damages to any one area, the Director of Project Management will apportion the amount of repair work to be done by each contractor. The decision of the Director of Project Management shall be final and binding upon the Contractor(s) and may not be challenged except pursuant to a proceeding brought pursuant to Article 78 of the Civil Practice Law and Rules.

25. PROPERTY DAMAGE

The Contractor shall not enter upon nor make use of any private property along the line of work except when written permission is secured from the owner of that property. In case of any damage or injury done along the line of work in consequence of any act or omission on the part of the Contractor, or any one in its employ, in carrying out the contract, the Contractor shall at its own expense restore the same or make repairs as are necessary in consequence thereof in a manner satisfactory to the owner of the affected property; provided, however, that the obligation thus assumed by the Contractor shall not inure directly or indirectly to the benefit of any insurer of physical damage to property or loss of use, rents or profits of property regardless of whether the insurer has actually paid the claim or made only a loan to its insured, nor to the latter if it shall waive or abandon any claim against its insurer or insurers.

In case of failure on the part of the Contractor to restore or repair such property in a manner satisfactory to the owner of the affected property, the party of the first part may upon forty-eight hours notice to the Contractor proceed with such restoration or repair. The expense of such restoration or repair shall be deducted from any monies, which are due or may become due the Contractor under its contract. The Construction Administrator shall be the sole judge as to what constitutes failure to restore or repair as above stated and service of notice by mail addressed to the Contractor at the address stated in the proposal shall be sufficient.

26. CLAIMS FOR DAMAGES

The Contractor agrees that it will make no claim against the County or any of its representatives for damages for delay, interference or disruption of any kind in the performance of its Contract and further agrees that any such claim arising from acts or failure to act of the County or any of its representatives shall be fully and exclusively compensated for by an extension of time to complete the performance of the work as provided herein.

27. EXTENSIONS OF TIME

An extension or extensions of time may be granted only by the Commissioner and only upon a verified application therefore by the Contractor. Each application for an extension of time must set forth in detail the nature of each cause of delay in the completion of the work, the date upon which each such cause of delay began and ended, and the number of days attributable to each of such causes. If the schedule for this project is based upon the Critical Path Method, the Contractor must also demonstrate that the delay for which an extension of time is sought occurred on the critical path. A formal written notice of the Contractor's intent to apply for an extension of time must be submitted to the Commissioner within seven (7) calendar days of the start of the alleged delay. The formal application for the extension of time must be submitted to the Commissioner no later than ten (10) calendar days after the end of the delay, but in no event later than the Contractor's submittal of its application for its substantial completion payment. The failure of the Contractor to timely submit either its formal written notice of its intent to apply for an extension of time or the application thereof shall be deemed a waiver of any entitlement to any extension of time.

The Contractor shall be entitled to an extension of time for delay in completion of the work caused solely (1) by the acts or omissions of the County, its officers, agents or employees; or (2) by the acts or omissions of other Contractors on this project; or (3) by supervening conditions entirely beyond the control of either party hereto (such as, but not limited to, Acts of God, excessive inclement weather, war, or any other national emergency making performance temporarily impossible or illegal, or strikes or labor disputes not brought about by any act or omission of the Contractor).

The Contractor shall not be entitled to receive a separate extension of time for each of several causes of delay operating concurrently, but, if at all, only for the actual period of delay in completion of the work as determined by the Engineer or Commissioner. If one of multiple causes of delay operating concurrently results from any act or omission of the Contractor or of its subcontractors of whatever tier, and would of itself (irrespective of concurrent causes) have delayed the work, no extension of time will be allowed for the period of delay resulting from such act or omission and the Contractor shall re-arrange his Progress Schedule and operations so as to complete the Work within the time set forth in the Contract and minimize the impact of the Work on the other Prime Contractors.

The determination made by the Commissioner or Engineer on an application for an extension of time shall be binding and conclusive on the Contractor and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules.

Permitting the Contractor to continue with the work after the time fixed for its completion has expired, or after the time to which such completion may have been extended has expired, or the making of any payment to the Contractor after such time, shall not operate as waiver on the part of the County of any of its rights or remedies under this contract nor shall it relieve the Contractor from his obligation under the Contract, including without limitations its liability to the County for liquidated damages, engineering costs, delays, damages, and/or costs incurred by the County.

If the Commissioner deems it advisable and expedient to have the Contractor complete and furnish the Work after the expiration of the time of Completion of Work (see "Required

Time For Completion Of The Work" of the General Requirements) and in order that the County's fiscal officers may be permitted to make payment to the Contractor for Work performed beyond that date, the Commissioner may extend the Contract solely for the purpose of enabling the Contractor to be paid for Work performed. This extension shall in no way relieve the Contractor from his obligation under the Contract, including without limitations its liability to the County for liquidated damages, engineering costs, delays, damages, attorney's fees and/or costs incurred by the County, nor shall such extension of time be asserted by the Contractor in any action or proceeding as evidence that it completed its work in a timely manner.

The time necessary for review by the Engineer of all submittals including vendors, shop drawings, substitutions, etc., and delays incurred by normal seasonal and weather conditions should be anticipated and is neither compensatory nor eligible for Extensions of Time.

When the Work embraced in the Contract is not completed on or before the date specified herein, engineering and inspection expenses incurred by the County of Westchester upon the Work from the completion date originally fixed in the Contract to the final date of completion of the Work may be charged to the Contract and be deducted from the final monies due the Contractor.

28. REQUEST FOR APPROVAL OF EQUAL

A. GENERAL REQUIREMENTS

Wherever in the Contract Documents an article, material, apparatus, product or process is called for by trade name or catalog reference, or by the name of the patentee, manufacturer or dealer, it is understood that it constitutes the standard requirement to meet the contract specifications. Where two or more articles, materials, apparatus, products or processes are listed as acceptable by reference to trade name or otherwise, the choice of these will be optional to the bidder.

Bidders may base their bid on one of the specified items, or they may base their bid on an "equal". However, the bidder should be aware that the County makes the final determination as to what constitutes an equal.

If the Engineer shall reject the proposed equal as not being the equal of that specifically named in the contract, the successful bidder (Contractor) shall immediately proceed to furnish the designated article, material, apparatus, product or process as specified or an approved equal without additional cost or time delay to the County.

B. REVIEW PROCESS

1) Within fifteen (15) days from the Notice to Proceed, requests for approval of equals must be proposed to the Commissioner on the "Request For Approval Of Equal" form of the Sample Forms. This Period for submitting requests will be strictly enforced. Such requests shall conform to the requirements of this Article.

2) Requests for approval of equals will be received and considered from Prime Contractors only and not from manufacturers, suppliers, Subcontractors, or other third parties.

3) If the materials and equipment submitted are offered as equals to the Contract

Documents the Contractor shall advise the County and the Engineer of the requested equal and comply with the requirements hereinafter specified in this Article.

4) Where the acceptability of an equal is conditioned upon a record of satisfactory operation and the proposed equal does not fulfill this requirement, the Engineer, at his/her sole discretion, may accept the equal if the Contractor provides a bond or cash deposit which guarantees replacement at no cost to the County for any failure occurring within the specified time. The equal item must meet all other technical requirements contained in the Specification.

5) The successful bidder shall furnish such information as required by the Engineer to demonstrate that the equal article, material, apparatus, product or process is the equal of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended. The Contractor shall set forth the reasons for desiring to utilize the proposed equal.

6) Contractor shall submit:

   a. For each proposed request for approved equal sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed request for approved equal is equal, including manufacturer's brand or trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.

   b. Certified tests, where applicable, by an independent laboratory attesting that the proposed equal is equal.

   c. A list of installations where the proposed equal equipment or materials is performing under similar conditions as specified.

7) Requests for approval of equal after the period set forth in B. REVIEW PROCESS, Paragraph 1, above will not be accepted for evaluation except in case of strikes, discontinuance of manufacturer or other reason deemed valid by the Engineer whereby the specified products or those approved are unattainable. In such case the Contractor shall provide substantial proof that the acceptable products are unavailable.

8) Where the approval of an equal requires revision or redesign of any part of Work, including that of other Contracts, all such revision and redesign, and all new drawings and details required therefore, shall be provided by the Contractor at its own cost and expense, and shall be subject to the approval of the Commissioner.

9) In the event that the Engineer is required to provide additional engineering services, then the engineer's charges for such additional services shall be promptly paid by the Contractor to the County.

10) Any modifications in the Work required under other Contracts to accommodate the changed design will be incorporated in the appropriate Contracts and any resulting increases in Contract prices will be paid by the Contractor who initiated the

changed design to the County.

11) In all cases the Engineer shall be the judge as to whether a proposed equal is to be approved. The Contractor shall abide by his/her decision when proposed equal items are judged to be unacceptable and shall in such instances furnish the item specified or indicated. No equal items shall be used in the Work without written approval of the Engineer.

12) In making request for approval of equal, Contractor represents that:

    a. Contractor has investigated proposed equal, and determined that it is equal to or superior in all respects to the product, manufacturer or method specified.

    b. Contractor will provide the same or better warranties or bonds for proposed equal as for product, manufacturer or method specified.

    c. Contractor waives all claims for additional costs or extension of time related to proposed equal that subsequently may become apparent.

    d. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Engineer in considering an equal proposed by the Contractor or by reason of refusal of the Engineer to approve an equal proposed by the Contractor. Any delays arising out of consideration, approval, or utilization of an equal shall be the sole responsibility of the Contractor requesting the equal and it shall arrange its operations to make up the time lost.

13) Proposed Equal Will Not Be Accepted If:

    a. Acceptance will require substantial revision of Contract Documents.

    b. They will change design concepts or Technical Specifications.

    c. They will delay completion of the Work, or the Work of other Contractors.

    d. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for approval of equal from Contractor.

14) Only those products originally specified and/or added by approved requests for equals submitted in accordance with the preceding paragraphs may be used in the Work. Whenever requests for equals are approved, it shall be understood that such approval is conditional upon strict conformance with all requirements of the Contract and further subject to the following:

    a. Any material or article submitted for approval in accordance with the above procedure must be equal, in the sole opinion of the Engineer, to the material or article specified. It must be readily available in sufficient quantity to prevent delay of any Work; it must be available in an equivalent color, texture, dimension, gauge, type and finish as to the item or article specified; it must be equal to the specified item in strength, durability, efficiency, serviceability, compatibility with existing systems, ease and cost of maintenance; it must be compatible with the design and not necessitate substantial design modifications; it must be equal in warranties and guarantees; its use must not impose substantial additional Work, or require substantial changes in the Work of any

other Contractor. Availability of spare parts shall be assured for the useful life of the Project.

b. The Engineer reserves the right to disapprove, for aesthetic reasons, any material or equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.

c. All requests for approval of equals of materials or other changes from the contract requirements shall be accompanied by an itemized list of all other items affected. The Engineer shall have the right, if such is not done, to rescind any approvals for equals or changes and to order such Work removed and replaced with Work conforming to the specified requirements of the contract, all at the Contractor's expense, or to assess all additional costs resulting from the equal to the Contractor.

15) Approval of an equal will not relieve Contractor from the requirement to submit Shop Drawings or any of the provisions of the Contract Documents.

16) In the event that the Engineer is required to provide additional engineering services as a result of a request for approval of an equal of materials or equipment which are not "or equal" by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, or for evaluation of deviations from Contract Documents, then the Engineer's charges in connection with such additional services shall be paid by the Contractor to the County.

17) The Contractor shall respond to required submittals with complete information and with a degree of accuracy to achieve approvals within three (3) submissions. All costs to the Engineer involved with subsequent submissions requiring approval, will be paid by the Contractor to the County.

29. SUBSTITUTION

A. Should the Contractor desire to substitute other articles, materials, apparatus, products or processes than those specified or approved as equal, the Contractor shall apply to the Engineer in writing for approval of such substitution. It should be noted that the bid shall not be based on a substituted article, material, apparatus, product or process. With the application shall be furnished such information as required by the Engineer to demonstrate that the article, material, apparatus, product or process he wishes to use is the equivalent of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended. The Contractor shall set forth the reasons for desiring to make the substitution and shall further state what difference, if any, will be made in the construction schedule and the contract price for such substitution should it be accepted; it being the intent hereunder that any savings shall accrue to the benefit of the County.

B. If the Engineer shall reject any such desired substitution as not being the equivalent of that specifically named in the contract, or if it shall determine that the adjustment in price in favor of the County is insufficient, the Contractor shall immediately proceed to furnish the designated article, material, apparatus, product or process.

C. Request for substitutes must be proposed to the Commissioner on the "Request For Approval Of Substitution" form of the Sample Forms. Such requests shall conform to the requirements of this Article.

D. Requests for substitutions shall include full information concerning differences in cost, and any savings in cost resulting from such substitutions shall be passed on to the County.

E. Requests for utilization of substitutes will be reviewed during the course of the project. The impact on the project and the timeliness of submission will be of key consideration.

F. The approval of utilization of a substitute is subject to the sole and final discretion of the Engineer.

G. REVIEW PROCESS

1) Requests for approval of substitutions will be received and considered from Prime Contractors only and not from manufacturers, suppliers, Subcontractors, or other third parties.

2) If the materials and equipment submitted are offered as substitutions to the Contract Documents or approved equal the Contractor shall advise the County and the Engineer of the requested substitutions and comply with the requirements hereinafter specified in this Article.

3) Where the acceptability of substitution is conditioned upon a record of satisfactory operation and the proposed substitution does not fulfill this requirement, the Engineer, at his/her sole discretion, may accept the substitution if the Contractor provides a bond or cash deposit which guarantees replacement at no cost to the County for any failure occurring within the specified time. The substitution item must meet all other technical requirements contained in the Specification.

4) The Contractor shall furnish such information as required by the Engineer to demonstrate that the equal article, material, apparatus, product or process is the equivalent of that specified in quality, finish, design, efficiency and durability and has been elsewhere demonstrated to be equally serviceable for the purpose for which it is intended and/or that it offers substantial benefits to the County in saving of time and/or cost. The Contractor shall set forth the reasons for desiring to make this substitution.

5) Contractor shall submit:

a. For each proposed request for approved substitute sufficient details, complete descriptive literature and performance data together with samples of the materials, where feasible, to enable the Engineer to determine if the proposed request for approval should be granted, including manufacturer's brand or trade names, model numbers, description of specification of item, performance data, test reports, samples, history of service, and other data as applicable.

b. Certified tests, where applicable, by an independent laboratory attesting to the performance of the substitute.

c. A list of installations where the proposed substitute equipment or materials is performing under similar conditions as specified.

6) Where the approval of a substitute requires revision or redesign of any part of Work, including that of other Contracts, all such revision and redesign, and all new drawings and details required therefore, shall be provided by the Contractor at its own cost and expense, and shall be subject to the approval of the Engineer.

7) In the event that the Engineer is required to provide additional engineering services, then the engineer's charges for such additional services shall be paid by the Contractor to the County.

8) Any modifications in the Work required under other contracts to accommodate the changed design will be incorporated in the appropriate contracts and any resulting increases in contract prices will be charged to the Contractor by the County who initiated the changed design.

9) In all cases the Engineer shall be the judge as to whether a proposed substitute is to be approved. The Contractor shall be bound by his/her decision. No substitute items shall be used in the Work without written approval of the Engineer.

10) In making request for approval of substitute, Contractor represents that:

a. Contractor has investigated proposed substitute, and determined that it is equal to or superior in all respects to the product, manufacturer or method specified or offers other specified advantages to the County.

b. Contractor will provide the same or better warranties or bonds for proposed substitute as for product, manufacturer or method specified.

c. Contractor waives all claims for additional costs or extension of time related to proposed substitute that subsequently may become apparent.

d. Contractor shall have and make no claim for an extension of time or for damages by reason of the time taken by the Engineer in considering a substitute proposed by the Contractor or by reason of failure of the Engineer to approve a substitute proposed by the Contractor. Any delays arising out of consideration, approval, or utilization of a substitute shall be the sole responsibility of the Contractor requesting the substitute and it shall arrange its operations to make up the time lost.

11) Proposed substitute will not be accepted if:

a. Acceptance will require substantial revision of Contract Documents.

b. They will substantially change design concepts or Technical Specifications.

c. They will delay completion of the Work, or the Work of other Contractors.

d. They are indicated or implied on a Shop Drawing and are not accompanied by a formal request for approval of substitute from Contractor.

12) The Engineer reserves the right to disapprove, for aesthetic reasons, any material or

equipment on the basis of design or color considerations alone, without prejudice to the quality of the material or equipment, if the manufacturer cannot meet the required colors or design.

13) All requests for approval of substitutes of materials or other changes from the contract requirements, shall be accompanied by an itemized list of all other items affected by such substitution or change. The Engineer shall have the right, if such is not done, to rescind any approvals for substitutions and to order such Work removed and replaced with Work conforming to the specified requirements of the contract, all at the Contractor's expense, or to assess all additional costs resulting from the substitution to the Contractor.

14) Approval of a substitute will not relieve Contractor from the requirement to submit Shop Drawings or any of the provisions of the Contract Documents.

15) In the event that the Engineer is required to provide additional engineering services as a result of a request for approval of a substitute results in changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or as a result of Contractor's errors, omissions or failure to conform to the requirements of the Contract Documents or if the Engineer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, or for evaluation of deviations from Contract Documents, then the Engineer's charges in connection with such additional services shall be paid by the Contractor.

16) Structural design shown on the Drawing is based upon the configuration of and maximum loading for major items of equipment as indicated on the Drawings and as specified. If the substituted equipment furnished differs from said features, the Contractor shall pay to the County all costs of redesign and for any construction changes required to accommodate the equipment furnished, including the Engineer's charges in connection therewith.

17) The Contractor shall respond to required submittals with complete information and with a degree of accuracy to achieve approvals within two (2) submissions. All costs to the Engineer involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be paid by the Contractor to the County, by deducting such costs from payments due for Work completed. In the event an approved item is requested by the Contractor to be changed or substituted for, all costs involved in the reviewing and approval process will likewise be backcharged to the Contractor unless determined by the Engineer that the need for such substitution and/or deviation from Contract Documents is beyond the control of the Contractor.

30. EXTRA WORK: INCREASED COMPENSATION/DECREASED WORK: CREDIT TO THE OWNER

The Director of Project Management may, at any time, by a written order, and without notice to the sureties, require the performance of Extra Work or require or approve changes in the work, or Decreased Work ("work" to include but not be limited to specified methods of performing work) as he may deem necessary or desirable. The amount of compensation

to be paid to the Contractor for any Extra Work, as so ordered, or credit to the Owner for such decreased work, as so ordered or approved, shall be determined as follows:

1) **First**: By such applicable unit prices, if any, as set forth in the Contract; or

2) **Second**: If no such prices are so set forth, then by unit prices or by a lump sum, or sums, mutually agreed upon by the Director of Project Management and the Contractor; or

3) **Third**: If, in the opinion of the Director of Project Management, the aforesaid unit prices, under "First" above, are not applicable, or if the two parties hereto cannot reach agreement as to new unit prices or a lump sum, or sums, under "Second" above, then by the actual net cost in money to the Contractor of the materials and of the wages of applied labor (including cost of supplements provided and premiums for Workmen's Compensation Insurance, FICA, and Federal and State Unemployment Insurance) required for such Extra Work, plus twenty (20%) percent as compensation for all items of profit and costs or expenses including administration, overhead, superintendence, insurance (other than those specifically noted above) materials used in temporary structures, allowances made by the Contractor to subcontractors, including those made for overhead and profit, additional premiums upon the performance bond of the Contractor and the use of small tools and any and all other costs and expenses not enumerated above, plus such rental for plant and equipment (other than small tools) required and approved for such extra work. Where extra work is performed by a Subcontractor, the twenty percent stipulated above shall be divided between the Contractor and the Subcontractor as per their contractual agreement, or if not defined therein, then as the Contractor sees fit.

Rental rates for any power operated machinery, trucks or equipment, which it may be found necessary to use as in "Third" above, shall be reasonable and shall be based on those prevailing in the area of the County where such work is to be done, and they shall be agreed upon in writing before the work is begun.

In no case shall the rental rates submitted exceed the rates set up in the current edition of "Equipment Watch" plus the cost of fuel and lubricants.

These rates shall include all repairs, fuel, lubricants, applicable taxes, insurance, depreciation, storage and all attachments complete, ready to operate, but excluding operators. Operators shall be paid as stated here in above for labor.

For equipment, which is already on the project, the rental period shall start when ordered to work by the Construction Administrator, and shall continue until ordered to discontinue by him. The minimum payment for any one rental period shall be four hours, unless otherwise agreed upon between the Construction Administrator and the Contractor.

For equipment which has to be brought to the project, specifically for use as in "Third" above, the County will pay all loading and unloading costs, also all transportation costs will not be paid, if the equipment is used for work other than in "Third" above while on the project. The rental period shall begin at the time the equipment has been unloaded on the

project, and shall end on and include the day the order to discontinue the use of the equipment as in "Third" above is given to the Contractor by the Construction Administrator.

The daily rate shall apply for rental periods of four calendar days or less, the weekly rate shall apply for rental periods of more than four and not exceeding twenty-one calendar days, and the monthly rate shall apply for rental periods in excess of twenty-one calendar days. For fractional periods above the full unit rental period (day, week, month) reimbursement shall be proportioned on the basis of the applicable rental period. (Day-8 hrs.; Week-7 calendar days; Month-30 calendar days).

No percentage shall be added to the amounts of equipment rental prices agreed upon, but the price agreed upon shall be the total compensation allowed for the use of such equipment.

The provisions hereof shall not affect the power of the Contractor to act in case of emergency.

31. DISPUTED WORK - NOTICE OF CLAIMS FOR DAMAGES

If the Contractor is of the opinion that any work required, necessitated, or ordered violates or conflicts with or is not required by the terms and provisions of this Contract, it must promptly, within five (5) calendar days after being directed to perform such work, notify the Construction Administrator, in writing, of its contentions with respect thereto and request a final determination thereon. If the Construction Administrator determines that the work in question is contract and not extra work, or that the order complained of is proper, he will direct the Contractor in writing to proceed and the Contractor shall promptly comply. In order, however, to preserve its right to claim compensation for such work or damages resulting from such compliance, the Contractor must, within seven (7) calendar days after receiving notice of the Construction Administrator's determination and direction, notify the Construction Administrator, in writing that the work is being performed or that the determination and direction is being complied with, under protest. Failure of the Contractor to so notify shall be deemed as a waiver of claim for extra compensation or damages therefore.

While the Contractor is performing disputed work or complying with a determination or order under protest in accordance with this Article, in each such case the Contractor shall furnish the Construction Administrator daily with three copies of written statements signed by the Contractor’s representatives at the site showing:

1) the name of each worker employed on such work or engaged in complying with such determination or order, the number of hours employed thereon, and the character of the work each is doing; and

2) the nature and quantity of any materials, plant and equipment furnished or used in connection with the performance of such work or compliance with such order, and from whom purchased or rented.

It is expressly agreed that no dispute over the scope of the Contractor’s work or any portion thereof shall cause any delay or interruption to the Contractor’s work.

In addition to the foregoing statements, the Contractor shall, upon notice from the Board of Acquisition and Contract, produce for examination by the duly appointed representative of

the Board of Acquisition and Contract, all its books of accounts, bills, invoices, payrolls, subcontracts, time books, daily reports, bank deposit books, bank statements, check books and canceled checks, showing all of its acts and transactions in connection with or relating to or arising by reason of this contract, and submit itself, its agents, servants and employees for examination under oath by any duly appointed representative designated by the Board of Acquisition and Contract to investigate claims made against the County. Unless the aforesaid statements shall be made and filed within the time aforesaid and the aforesaid records submitted for examination and the Contractor, its agents, servants, and employees submit themselves for examination as aforesaid, the County shall be released from all claims arising under, relating to or by reason of this contract, except for the sums certified by the Construction Administrator to be due and agreed that no person has power to waive any of the foregoing provisions, and that in any action against the County to recover any sum in excess of the sums certified by the Construction Administrator to be due under or by reason of this contract, the Contractor must allege in its complaint and prove, at the trial, strict compliance with the provisions of this article.

Before final acceptance of the work by the County, all matters of dispute must be adjusted to the mutual satisfaction of the parties thereto. Determinations and decisions in case any question shall arise, shall constitute a condition precedent to the right of the Contractor to receive the money therefore, until the matter in question has been adjusted.

32. CONTRACTOR'S SUBCONTRACTS AND MATERIAL LISTS

Within fifteen (15) days after execution of the Contract, the successful bidder shall submit to the County for approval a list of the subcontractors, materialmen and materials that he/she plans to use in the performance of the work and statements of the work they are to perform. The format and content of the list shall be in accordance with directives from the Construction Administrator. He/sit shall also submit additional information regarding their qualifications as may be later requested by the County. No part of the work may be sublet until after the Contractor has received the County's approval.

The Contractor shall be fully responsible for all acts and omissions of its subcontractors and persons directly or indirectly employed by them, and the County's approval to sublet parts of the work will in no way relieve the Contractor of any of its obligations under the Contract. All dealings of the Construction Administrator with the subcontractors shall be through the Contractor, subcontractors being recognized by the County only as employees of the Contractor.

By executing the Agreement, the Contractor represents that the Contractor shall insert appropriate clauses in all subcontracts to bind the subcontractors to the Contractor by all applicable provisions of the Contract Documents executed between the Contract and the County, but this shall not be construed as creating any contractual relationships between subcontractors and the County. Prior to approval of the subcontractors, the County has the right to review and recommend changes in the subcontracts. The County reserves the right to reject any subcontractor proposed by the Contractor if in the reasonable opinion of the County such subcontractor lacks the experience, capability or integrity to perform its subcontract work or is otherwise non-responsible.

By executing the Agreement, the Contractor represents that the Contractor shall insert appropriate clauses in each subcontract that require that if the Contractor is terminated by the County either for default or convenience that at the sole option of the County the subcontract shall automatically attorn to the County and the subcontractor shall continue without delay or interruption to fully perform all of the obligations required by its subcontract.

Where the specifications permit the Contractor a choice of different materials or manufactured products, it shall state the choice he has made in making up its bid, with the understanding that all choices must subsequently be approved by the Commissioner, after award of the contract to the successful bidder. If the bidder wishes to propose utilization of materials or manufactured products other than those specified, it shall so state and submit the required information in accordance with Article "Request For Approval Of Equal" of the General Clauses."

33. ASSIGNMENT OF CONTRACT

The Contractor shall not assign, transfer, convey or otherwise dispose of the contract or any part of it or any monies due and payable under the contract, without prior written approval of the County. If such approvals are granted by the County, they shall in no way relieve the Contractor or from any obligations under the terms of this Contract.

All documents assigning the contract or any part of it or any monies due and payable under the contract shall contain a clause stating that all monies to be paid the assignee in accordance with the terms of the Contractor's contract with the County, are subject to a prior lien for services rendered or materials and equipment supplied, in favor of all persons, firms or corporations rendering such services or supplying such materials and equipment.

34. PAYMENT FOR GENERAL PROVISIONS

No direct payment will be made for work done or materials furnished in compliance with the General Provisions of the specifications, unless otherwise noted. All compensation to the Contractor for its performance of the requirements of any general provision shall be considered to have been included in the prices he has bid for the individual items if a unit price contract and/or for a lump sum price if a lump sum contract.

In the event the Contractor fails or refuses to proceed with its work and/or correct or repair deficient or defective work then without prejudice to any and all of the County's other rights and remedies, and upon three (3) days notice to Contractor, the County may perform and/or employ any other person or persons to correct and/or repair any or all such work. All costs incurred by the County pertaining thereto shall be paid forthwith by the Contractor to the County.

35. COSTS INCURRED BY COUNTY

Wherever in these Contract Documents the County is entitled to recover costs from the Contractor or charge the Contractor for the costs incurred for the correction, supervision or for any other reason related to the Contractor's work or arising from the Contractor's failure or refusal to proceed with its work in a timely manner, such costs and/or charges shall be

deemed to include, but not be limited to, the County's costs and fees for inspection(s), engineering, consultant(s) and attorneys.

36. GUARANTEE OF WORK

A. Except as otherwise specified, all work performed under the Contract shall be guaranteed by the Contractor against defects resulting from the use of inferior materials, equipment or workmanship for one year from the guarantee starting date (which shall be defined as the date of the County's approval of the final Certificate for Payment or the date of actual full occupancy of the building, whichever is earlier). The building, section thereof, or item of equipment, shall be occupied or put into actual use by the Owner only after judged completed by the Construction Administrator and Owner and approved by him as ready for occupancy.

B. If, within any guarantee period, repairs or changes are required in connection with guaranteed work, which in the opinion of the Construction Administrator or Owner is rendered necessary as a result of the materials, equipment or workmanship which are inferior, defective, or not in accordance with terms of the Contract, the Contractor shall promptly upon receipt of notice from the Construction Administrator or Owner and without expense to the Construction Administrator or Owner:

   1) Place in satisfactory condition, in every particular, all of such guaranteed work, correct all defects thereof, and

   2) Make good all damages to the building or site, or equipment or contents thereof, and

   3) Make good any work or material, or equipment and contents of said building or site disturbed in fulfilling any such guarantee.

C. In any case where in fulfilling requirements of the Contract or of any guarantee embraced in or required thereby the Contractor disturbs any work, it shall restore such disturbed work to a condition satisfactory to the Construction Administrator.

D. If the Contractor, after notice, fails to proceed promptly to comply with terms of its guarantee, the Owner may have the defects corrected and the Contractor shall be liable for all expenses incurred.

E. All special guarantees applicable to definite parts of the work that may be stipulated in the Specifications or other papers forming a part of the Contract shall be subject to the requirements and term of this article.

37. SEPARATE CONTRACTS

A. Contractor's attention is specifically directed to the fact that, because of the work of other contracts within and adjacent to the limits of this Contract they may not have exclusive occupancy of the territory within or adjacent to the limits of this Contract.

B. Contractor's attention is further directed to the fact that, during the life of this Contract the owners and operators of Public Utilities may make changes in their facilities. These changes may be made by the Utility employees or by contract within the limit or adjacent to these contracts and may be both temporary and permanent.

C. Contractor shall be required to cooperate with other contractors and the owners of the various utilities, and to coordinate and arrange the sequence of their work to conform to the progressive operations of the work already under contract and to be put under contract.

D. Contractor shall be responsible for the coordination of the work of their various subcontractors. Their respective operations shall be arranged and conducted so that delays will be avoided. Where the work of a subcontractor overlaps or dovetails with that of other subontractors, materials shall be delivered and operations conducted so as to carry on the work continuously in an efficient and workmanlike manner. Delays or oversights on the part of Contractor or its subcontractors or utility owners in getting any or all of their work done in the proper way thereby causing cutting, removing and replacing work already in place, shall not be the basis for claim for extra compensation.

E. In case of interference between the operations of the utility owners and different Contractors, the Construction Administrator will be the sole judge of the rights of each Contractor and the sequence of work necessary to expedite the completion of the entire project, and in all cases the Construction Administrators decision shall be accepted as final and may not be challenged except in a proceeding brought pursuant to Article 78 of the Civil Practice Law and Rules.

38. COOPERATION WITH OWNER

Each Contractor shall cooperate with the Owner as to parking of vehicles, availability of storage and working areas and confining of activities and personnel to same. **NO PARKING FOR CONTRACTOR'S EMPLOYEES**.

39. JOB MEETINGS & PROJECT SUPERINTENDANT

A. An officer of the Contractor, or its project manager or superintendent, who is fluent in English and authorized to make binding decision on behalf of the Contractor shall attend job meetings with the Commissioner and/or the Construction Administrator, and any subcontractors whom the Inspector may designate; for the purpose of discussing expedition, execution and coordination of the work.

B. Job meetings will be scheduled periodically (the first to be prior to commencement of construction) at a time and place designated by the Construction Administrator.

C. The Contractor shall not commence any work prior to the first (pre-construction) meeting between the Contractor, Commissioner and/or Construction Administrator, client, and other concerned governmental and utility company representatives.

D. At the pre-construction meeting, the scheduling of the work on an arrow-flow diagram (showing chronologically and in detail the sequence and methods that will be followed) will be provided, and details for the proper execution and special requirements of the work will be explained and discussed.

E. The Contractor shall be responsible for providing a detailed construction schedule that provides for a Critical Path Method (“CPM”) and which is compatible with any of the state of the art CPM Method scheduling software.

F. Updated coordinated arrow-flow diagrams or CPM schedules, as the case may be, will be provided by the Contractor, as above, on a monthly basis to the County.

The Contractor shall indicate on the construction schedules noted above, time for shop drawing preparation, approvals, fabrication and delivery of materials and equipment for major items. The County may request that additional important items be included on the schedule.

G. The Contractors hall ensure that its Project Superintendent shall be on site full time at all times when the Contractor's Work is being performed.

40. PATENT WARRANTY

A. Contractor expressly represents, warrants and agrees that he has the legal right to furnish and install and to authorize the County to purchase and use the equipment hereby offered and each and every one of its several parts and every feature thereof, under one or the other, or partly under one and partly under the other of the following representations.

1) That the Contractor possesses a valid patent(s) covering the equipment to be furnished hereunder or part or features thereof or has or will obtain permit(s) and license(s) authorizing the Contractor to furnish and install same and to authorize the purchase and use thereof by the County.

2) The Contractor is responsible before ordering material, equipment, parts, systems, etc, to verify that the suppliers of all such material, equipment, parts, systems, etc, will supply the required warranty, guarantee, O & P manual, and maintenance service schedule.

3) That the equipment offered or certain parts or features thereof are not covered by any valid patent(s) within the knowledge of the Contractor.

B. Contractor further warrants and agrees that if any patent(s) is hereafter issued to any person whatsoever with respect to the equipment or any part or features thereof, to be furnished and installed hereunder, the Contractor will obtain such permit(s) or license(s) from the Patentee as may be necessary to authorize the use of the equipment by the County.

C. Contractor further represents, warrants and agrees that he and its sureties shall hold themselves responsible for and defend any claims made against the County for any infringement of patents due to the purchase and use by the County of said equipment or any part or feature thereof; that they will indemnify and save harmless the County from all costs, expenses and damages which it shall be obliged to pay by reason of any such infringement of patent(s); that in case the use of any such equipment is enjoined, they will bear the expenses of removing same and replacing same with equipment which will satisfactorily perform the function without constituting an infringement of any patent(s); and in case the use of any equipment shall be enjoined, that they shall pay to the County the sum of $1,000.00 per day, as liquidated damages, for each and every day during which the County shall be enjoined from using the same up to the day on which such

equipment is replaced by other equipment which will satisfactorily perform the same function but which will not constitute an infringement of any other patent(s).

D. The Contractor further agrees in the event the use of any of the equipment is enjoined and the Contractor is unable within a reasonable time to devise other equipment which will satisfactorily perform the same functions without infringement on any patent(s), that he will remove the equipment and refund to the County the entire cost of its purchase and installation, plus the sum of $ 1,000.00 per day as liquidated damages for each and every day until the substitute equipment has been purchased and installed by the County, excepting however that such period shall not exceed three months.

E. The Contractor further agrees in the event that any claim or notice of claim for infringement of patent(s) are made or filed prior to the making of payment by the County for the equipment and/or material proposed to be furnished and installed hereunder, that the County may withhold any sum due to the Contractor for such equipment and/or material until such claims shall have been settled or adjudicated or until additional surety bonds or other guarantees of indemnification shall have been posted, if deemed necessary by the County for its protection.

41. MATERIALS

A. Quality

1) It is the intent of these Specifications to describe definitely and fully the character of materials and workmanship required with regard to all ordinary conditions of the work and to require first-class work and new and best quality materials in all particulars. For unexpected conditions arising during the progress of the work and not fully covered herein, the Specifications shall be interpreted by the Construction Administrator to require first-class work and materials and such interpretations shall be accepted by the Contractor.

2) The Contractor is responsible before ordering material, equipment, parts, systems, etc, to verify that the suppliers of all such material, equipment, parts, systems, etc, will supply the required warranty, guarantee, O & P manual, and maintenance service schedule.

3) Where materials or devices are specified in these documents by reference to government, manufacturer's association, or professional society standards, the pertinent sections of the latest edition of such standards shall have the same force and effect as if set forth in full in these Specifications. The following abbreviations shall be used as indicated for the principal societies:

AASHO	American Association of State Highway Officials
ACI	American Concrete Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute

ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWI	American Woodworking Institute
AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
CS	Commercial Standards
FS	Federal Specifications
IEEE	Institute of Electrical and Electronic Engineers
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
SDI	Steel Deck Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Incorporated
TCA	Tile Council of America, Incorporated
TMCA	Tile and Marble Contractors of America
UL	Underwriter's Laboratories, Incorporated

B. Delivery, Storage and Handling:

1) Materials shall be delivered in manufacturer's original sealed containers with complete identification of contents and manufacturer, and kept sealed in original containers until used. Labels shall not be removed until materials have been installed and inspected.

2) Materials shall be delivered, stored, and handled with proper equipment and in a manner to protect them from damage.

3) The Contractor shall make arrangements for the receipt of materials delivered to the construction site. No representative of the County will accept any materials ordered by the Contractor.

4) Finish materials shall be protected from dirt and damage, and perishable materials shall be stored within appropriate weatherproof enclosures.

5) Delivery of materials shall be coordinated with the Operations Schedule.

6) The Contractor shall confine the apparatus, the storage of materials and the operations of the workmen to the limits indicated by law, ordinances, permits, or directions of the Construction Administrator, and shall not encumber the premises beyond the contract limits.

7) The Contractor shall not load or permit any part of the structure to be loaded with a weight that will endanger its safety.

8) Whenever the Contract Documents require delivery by the Contractor of any materials, equipment, or other items, the term delivery shall be deemed to include unloading and storing with proper protection where directed.

C. Federal Regulations

1) Should the Federal Government, because of Declaration of an Emergency, or other cause, establish controls over the use of certain construction materials, then the Contractor, immediately after signing the Contract or immediately after Declaration of an Emergency, shall furnish the Commissioner with an itemized list of all critical materials required for use on the project. For each item, the quantity required and the approximate date on which delivery will be required shall be indicated.

D. Name Plates

1) Each piece of operable equipment to be furnished and installed by a Contractor under its Contract such as motors, pumps, heaters, fans, transformers, switch and fuse racks and other similar equipment shall be provided with a substantial name plate of non-corrodible metal securely fastened in place and clearly and permanently inscribed with the manufacturer's name, the model or type designation, the serial number, the principal rated capacities, the electrical or other power characteristics and other similar and appropriate information.

2) Manufacturer's identification shall be inconspicuous, but where nameplates contain information relative to characteristics or maintenance, they shall be clearly visible and located for easy access.

3) The nameplate of a subcontractor or a distributor will not be permitted.

E. Manufacturer's Certification

1) Prior to the delivery of any water or sewer pipe to the construction site, the Contractor shall furnish properly attested documents certifying as to the type, class, name of manufacturer and source of supply of the pipe. One copy of each document shall be forwarded to the Construction Administrator at the construction site and to the Director of Project Management care of the Engineering Division, Michaelian Office Building, White Plains, New York.

F. Samples

1) The Contractor shall furnish, for approval of the Engineer, any samples required by the specifications or that may be requested by the Owner, of all materials he proposes to use, and shall pay all shipping charges for the samples. The Contractor shall send all samples to the office of the Engineer, except when directed otherwise. The sample of approved material will remain on file in the Engineer's office. A disapproved sample will be returned to the Contractor.

2) No samples are to be submitted with bids.

3) No materials or equipment of which samples are required to be submitted for

approval shall be used on the work until such approval has been given by the Engineer or Construction Administrator, save only at the Contractor's risk and expense.

4) Each sample shall have a label indicating the material represented, its place of origin and the names of the producer, the Contractor and the Contract for which the material is intended.

5) Approval of any sample shall be only for characteristics or for uses named in such approval, and no other. No approval of a sample shall be taken in itself to change or modify any Contract requirement. When a material has been approved, no additional sample of that material will be considered and no change in brand or make will be permitted. Approved samples held by the Engineer will be returned to the Contractor upon completion of the work, if requested.

6) Transactions with manufacturers or subcontractors shall be through the Contractor.

G. Dissimilar Materials

1) Where metals are placed in contact with or fastened to dissimilar metals, concrete, masonry, wood or other absorptive materials subject to repeated wetting or wood treated with a preservative non-compatible with the metal or if drainage from dissimilar materials passes over the work; treat the contact surfaces with a heavy coat of approved alkali-resident bituminous paint.

2) Where one of the metals is aluminum, a coat of zinc-chromate primer shall be applied prior to the bituminous paint.

42. STANDARD OF QUALITY

Wherever in the contract documents an article, material, apparatus, device, product or process is called for by trade name or catalog reference, or by the name of the patentee, manufacturer or dealer, it shall be construed as establishing a standard of quality and not construed as limiting competition. In such instances, the Contractor may use any article, material, etc. which, in the judgment of the Engineer, expressed in writing, is equal to and acceptable for the intent specified.

43. PROPRIETARY ITEM

Whenever less than three names are used in proprietary item specifications, it has been determined that:

A. The use of trade names is necessary for effective and workable specifications for the item.

B. All manufacturers known by the individuals familiar with the trade involved have been listed.

C. Equal items may be approved in accordance with Article “Request For Approval Of Equal” of the General Clauses.

44. SHOP DRAWINGS

A. Shop Drawing Schedule

1) Within fifteen (15) days after the Notice to Proceed, the Contractor shall prepare and submit two (2) copies of its schedule of Shop Drawing submissions to the Engineer for review and approval. The schedule is to be submitted on the "Shop Drawing Schedule" form of the Sample Forms.

2) In order to maintain the construction schedule for this project the Contractor shall submit all Shop Drawings per approved schedule. The Contractor is expressly cautioned that its failure or refusal to timely submit a shop drawing schedule acceptable to the Engineer and/or any deviation from the approved shop drawing schedule shall be deemed a default under this Contract.

3) Shop Drawings shall be submitted without fail in time to permit correction, resubmission and final approval, as hereinafter specified, without causing any delay in the construction of any Work.

4) Samples and Shop Drawings, which are related to the same unit of Work or Specification Section, shall be submitted at the same time. If related Shop Drawings and Samples are submitted at different times, they cannot be reviewed until both are furnished to the Engineer.

5) The schedule shall be updated every four-(4) weeks or more frequently as required by the Engineer.

6) Two (2)-updated copies of the schedule shall be submitted to the Engineer with each application for Partial Payment.

7) Form of Schedule

Schedule shall be in tabular form with appropriate spaces to insert the following information for principal items of equipment and materials:

a. Date on which Shop Drawings are requested and received from the manufacturer.

b. Dates on which Shop Drawings are transmitted to the Engineer by the Contractor.

c. Dates on which Shop Drawings are returned by the Engineer for revisions.

d. Dates on which Shop Drawings are revised by manufacturer and resubmitted to the Engineer.

e. Date on which Shop Drawings are returned by Engineer annotated either "Approved" or "Approved as Noted".

f. Date on which accepted Shop Drawings are transmitted to manufacturer and Contractor's Invoice Number.

g. Date of manufacturer's scheduled delivery.

h. Date on which delivery is actually made.

i. Sample of schedule follows on next page.

B. Shop Drawing Requirements

1) Shop Drawings for the Work shall include working and setting drawings, schedules, shop details, wiring diagrams, manufacturer's catalog cuts and brochures and all other drawings, schedules and diagrams necessary for the proper correlation of the Work.

Insofar as it is practicable, all drawings shall be uniform in size. They shall be dated, numbered consecutively and shall be identified with the Contract Number and Title, a description of the material or equipment and the area of the work and where it is to be installed. Shop drawings shall accurately and clearly show sizes, work, erection dimensions, arrangement and sectional views, necessary details including information for making connection with the work of other items as may be required, materials and finishes, detailed parts lists, and performance characteristics and capacities as may be required.

2) All detailing for structural components shall be done in accordance with the provisions for design and workmanship in the latest additions of the publications listed below except as may be modified in the Contract Documents:

a. "Manual of Steel Construction" of the America Institute of Steel Construction.

b. "Building Code Requirements for Reinforced Concrete" and "Manual of Standard Practice for Detailing Reinforced Concrete Structures" of American Concrete Institute.

3) Detailing practices for other components shall be done to conform to the best trade practices.

4) Contractor Responsibilities

a. Before submitting Shop Drawings to the Engineer all submittals from its Subcontractors, manufacturers or suppliers shall be sent directly to the Contractor for preliminary review, coordination and checking.

Contractor shall be responsible for their submission at the proper time so as to prevent delays in delivery of material or equipment. Contractor shall thoroughly check all drawings for accuracy and conformance to the intent of the Contract Documents. Drawings found to be inaccurate or otherwise in error shall be returned to the Subcontractors, manufacturers, or suppliers by the Contractor for correction.

b. All submittals, including Shop Drawings prepared by or under the direction of the various Contractors, shall be thoroughly checked by the Contractor for accuracy and checked by the Contractor for accuracy and conformance to the intent of the Contract Documents before being submitted tot he Engineer and shall bear the Contractor's signature certifying that they have been so checked. Before submitting them to the Engineer, all submittals shall be properly labeled and consecutively numbered. In a clear space above the title block, the Contractor shall provide the "Shop Drawing ID" form of the Sample Forms, and enter the required information:

c. Shop Drawings shall be submitted as a single package including all associated drawings for any operating system and shall include all items of equipment and any mechanical units involved or necessary for the functioning of such system. Where applicable, the submittal shall include elementary wiring diagrams showing circuit functioning and necessary interconnecting wiring diagrams for construction.

d. If the submittals contain any departures from the Contract Documents, specific mention thereof shall be made in the Contractor's letter of transmittal. Otherwise, the review of such submittals shall not constitute approval of the departure. The Contractor shall also call the Engineer's attention to any changes by the use of larger letters of at least 1" in height on the Shop Drawings along with a letter by the Contractor advising the Engineer to the recommended change and the reason therefore. If this is not done, even if the Work is incorporated in the construction, it will not be accepted by the Engineer even if Shop Drawings are "Approved".

e. No materials or equipment shall be ordered, fabricated or shipped or any Work performed until the Engineer returns to the Contractor the submittals herein required, annotated "Approved".

f. Where errors, deviations, and/or omissions are discovered at a later date in any of the submittals, the Engineer's prior review of the submittals does not relieve the Contractor of the responsibility for correcting all errors, deviations and/or omissions.

g. Two (2) copies of Preliminary Operations and Maintenance Manuals shall be submitted with the final Shop Drawings for each item of equipment.

h. Submittals shall be transmitted in strict compliance with Special Clause 10. A.2 and in sufficient time to allow the Engineer adequate time for review and processing so as not to delay the Project per the approved Shop Drawing Schedule.

i. Contractor shall transmit five (5) prints of each submittal to the Engineer for review. Any submissions, which in the opinion of the Engineer, are not legible will not be reviewed and will be returned to the Contractor annotated "Disapproved".

j. Contract drawings are for engineering and general arrangement purposes only and are not to be used as Shop Drawings.

k. Shop Drawings shall accurately and clearly present the following:

- All working and installation dimensions.
- Arrangement and sectional views.
- Units of equipment in the proposed positions for installation, details of required attachments and connections, and dimensioned locations between units and in relation to the structures.
- Necessary details and information for making connections between the

various trades including, but not limited to, power supplies and interconnecting wiring between units, accessories, appurtenances, etc.

l. Structural and all other layout drawings prepared specifically for the Project shall have a plan scale of not less than 1/4-inch equal to 1 foot and they shall be not larger than the size of the Contract Drawings.

m. Where manufacturer's publications in the form of catalogs, brochures, illustrations, compliance certificates, or other data sheets are submitted in lieu of prepared Shop Drawings, such submissions shall specifically indicate the item for which approval is requested. Identification of items shall be made in ink, and submissions showing only general information are not acceptable.

n. The Contractor shall provide all required copies for the use of the various trades and at the Site, and one (1) copy of approved Shop Drawings shall be provided by the Contractor to each of the other Prime Contractors unless otherwise noted in writing by the Engineer.

o. The Contractor shall respond to required submittals with complete information and accuracy to achieve required approvals within three (3) submissions. All costs to the Owner involved with subsequent submissions of Shop Drawings, Samples or other items requiring approval, will be backcharged to the Contractor, at the rate of 3.0 times direct technical labor cost, by deducting such costs from payments due for Work completed. In the event an approved item is requested by the Contractor to be changed or substituted, all involved costs in the review process will likewise be paid by the Contractor to the County unless determined by the Director of Project Management or Commissioner that the need for such deviation is beyond the control of the Contractor. Contractor shall be responsible for coordinating its Work and submittals with its Subcontractors.. Should Contractor cause the need for additional submissions or reviews of previous submissions all involved costs will similarly be paid to the County.

5) Procedure for Review

a. Shop Drawings will be checked for design conformance with the Contract Documents and general arrangement only.

b. Submittals will be annotated by the Engineer in one of the following ways:

- "Approved" - no exceptions are taken.
- "Approved as Noted" - minor corrections are noted and shall be made and a resubmittal is required.
- "Disapproved because" - with specific deficiencies noted.
- "Disapproved" - based on the information submitted, the submission is not in conformance with the Contract Documents. The deviations from the Contract Documents are too numerous to list and a completely revised submission of the proposed equipment or a submission of other equipment is required.

c. One copy of the reviewed submittals will be returned to the Contractor. It is the Contractor's responsibility to provide copies to:

- Its Subcontractors.
- Its Materialmen and Suppliers.

unless notified otherwise in writing by the Engineer.

6) Disapproved drawings will be returned to the Contractor for correction and resubmission. After the Contractor has had the required corrections made on the original drawing, it shall again submit five copies for review by the Engineer.

7) The acceptance of Shop Drawings by the Engineer shall be only general in nature and shall not relieve the Contractor of any responsibility for the accuracy of the drawings, the proper fitting and construction of the Work or for the furnishing of materials or other Work required by the Contract Documents, but not shown on the Shop Drawings. Acceptance of Shop Drawings by the Engineer shall not be construed as approving departures from the Contract requirements unless specifically noted by the Engineer. Acceptance of Shop Drawings for one item shall not be construed as approval for other changes even if noted by the Contractor on the drawing.

8) Shop Drawings submitted other than in accordance with the outlined procedures will be returned to the Contractor for resubmission and the Contractor shall bear all expense and risk of all delays as if no Shop Drawings had been submitted.

9) No Work shall be performed until the Shop Drawings have been accepted by the Owner, and the Contractor shall be responsible for all costs and damages, which may result from proceeding prior to the approval of the Shop Drawings.

45. SEQUENCE OF CONSTRUCTION OPERATIONS

A. It is mandatory that the premises continue to be occupied and facilities therein shall continue to function during the performance of the construction work.

B. Detailed sequence of construction and availability of spaces in areas through which services must pass shall be coordinated between the Owner and the Contractor, before actual commencement of the Work.

1) To enable the Work to be laid out and prosecuted in an orderly and expeditious manner, Contractor shall provide a proposed Progress Schedule, within fifteen (15) days after the issuance of the Notice to Proceed of this Contract unless otherwise directed in writing by the Construction Administrator. The proposed Progress Schedule shall show the anticipated time of commencement and completion of each of the various operations to be performed under this Contract; together with all necessary and appropriate information regarding the sequence and correlation of Work; and the Schedule of Shop Drawings and delivery of all materials and equipment required for the Work. The Contractor shall prepare a Master Progress Schedule (Schedule) for the Work. Contractor as directed by the Construction Administrator shall revise the proposed Schedule until each activity is properly sequenced to provide that the Work will be completed in the proper order and

within the allotted Contract duration, without any conflicts. When the Construction Administrator has accepted the Schedule the Contractor will sign it. The Contractor shall then provide one (1) copy of such approved Schedule to each Subcontractor and two (2) copies to the Construction Administrator. Contractor shall afford its Subcontractors a reasonable opportunity for the introduction and storage of their materials and the execution of their Work and shall properly connect and coordinate its Work with others.

Contractor shall strictly adhere to the Schedule unless changed as provided for in the following paragraph.

2) Within five (5) days after receiving notice of any change in the Contract, or of any Extra Work to be performed, or of any suspension of the whole or any portion of the Work, or of any other conditions which are likely to cause or are actually causing delays, Contractor must notify the Construction Administrator in writing of the effect, if any, of such change or Extra Work or suspension or other condition upon the previously approved schedule, and must state in what respects, if any, the Schedule should be revised, with the reasons therefor. These proposed changes in the Schedule shall be reviewed and, if appropriate, approved, in writing, by the Construction Administrator. Contractor must strictly adhere to the revised Schedule. Distribution of the revised Schedule shall be as described in paragraph B-1 above. Contractor's compliance with the requirements of this paragraph is in addition to, and not in lieu of, compliance with other notice requirements pertaining to delays and extensions of time contained elsewhere in the contract.

3) The Schedule shall be reviewed by Contractor every two (2) weeks or as directed by the Construction Administrator.

4) If Contractor shall fail to adhere to the approved Schedule, or to the Schedule as revised, they must promptly adopt additional means and methods of construction with no additional cost to the County that will make up for the lost time and will assure completion in accordance with such Schedule. The proposed means and methods shall be described in writing to the County within two (2) days after the Contractor discovered or should have reasonably discovered that the Schedule would not be met as originally proposed. Failure to comply with this requirement may result in the County enforcing its rights under the Contract including, without limitation, default of the Contract.

C. From time to time as the Work progresses and in the sequence indicated by the approved Schedule, the Contractor must submit to the Construction Administrator a specific request in writing for each item of information or approval required. These requests shall be submitted sufficiently in advance of the date upon which the information or approval is actually required by the Contractor to allow for the time the Construction Administrator may reasonably take to act upon such submissions or resubmissions. The Contractor shall not have any right to an Extension of Time on account of delays due to its failure to timely submit requests for the information or approvals.

D. Certain construction work shall be required, which will be disruptive to the Owner's staff insofar as noise, dirt and dust is concerned. The Contractor, therefore, shall

perform such work during other than normal working hours. Subject to the requirements of law, the Owner imposes no limitation on the Contractor's working hours and whatever overtime work may be necessary or required shall be considered by the Contractor and reflected in its Bid Proposal without the benefit of extra compensation.

46. PROTECTION

A. The Contractor shall at all times exercise all necessary precautions for the safety of the public, employees performing the work and County personnel. The Contractor shall provide and maintain barricades, danger signals and other safeguards about the work and shall be held responsible for all accidents or damages to persons or property caused by failure to do so throughout the progress of the work, and shall comply with all applicable provisions of Federal, State and County Safety Laws.

B. The Contractor shall during the performance of its work, protect at all times all adjacent portions of the existing surfaces and existing equipment from damage due to the performance of the construction work.

C. The Contractor shall furnish temporary facilities and/or temporary dust-proof partitions separating all work areas and access routes from those areas not involved in active alterations, so that this work will not interfere with the Owner's access or normal use of areas not allocated to the Contractor, or any essential service to such areas, when ordered by the Construction Administrator.

47. CLEANUP AND REMOVAL OF DEBRIS

A. At the end of each working day, the Contractor shall sweep up and collect all the rubbish and place it in appropriate containers, furnished by the Contractor. Containers shall be kept at a location on, or adjacent to the work site, as designated by the Construction Administrator. Wood or cardboard crates and other debris of a similar nature shall be broken up, securely bundled and neatly stacked alongside the containers. Once each week and at the completion of the work, the Contractor shall remove all accumulated debris and rubbish.

B. At the completion of the work, the Contractor shall clean all equipment, fixtures, surfaces and accessories, removing all dust and other foreign matter, ready for use by the Owner.

48. TEMPORARY SERVICE

A. Sanitary facilities will be provided by the Owner for the Contractor and its personnel.

B. The Owner will supply and pay for the cost of all-temporary water and temporary electric power (120 volt, 60 hertz). The Contractor shall furnish and install all temporary electrical and water connections required for work under this Contract, at and to locations as designated by the Construction Administrator.

49. OPERATING TESTS

A. Where operating tests are specified the Contractor shall test the work as it progresses and shall make satisfactory preliminary tests in all cases before applying to the Engineer for official tests.

B. Official tests will be made in the manner specified for the different branches of the work, in the presence of the Construction Administrator or Engineer. Should defects appear they shall be corrected by the Contractor and the test repeated until the installation is acceptable to the Construction Administrator or Engineer and to any authorities having jurisdiction.

C. No work of any kind shall be covered or enclosed before it has been tested and approved.

D. The Contractor shall furnish all materials and apparatus, make connections and conduct tests, without extra compensation unless noted otherwise.

50. OPERATING INSTRUCTIONS AND PARTS LISTS

A. Where the Specifications require any Contractor to supply equipment operating and maintenance instructions and spare parts lists prior to the completion of the work it shall provide three copies of the publications for each piece of equipment he has furnished and installed under the Contract, upon receipt of the approved shop drawings.

B. Publications shall be prepared for the specific equipment furnished and installed, containing the following information, and shall not refer to other sizes, types or models of similar equipment:

1) Clear and concise instructions for the operation, adjustment, lubrication and other maintenance of the equipment, including a complete lubrication chart.

2) A complete listing of all parts for the equipment, with catalog numbers and other data necessary for ordering replacement parts.

C. Advertising literature will not be acceptable.

51. CUTTING AND PATCHING

Contract with Single Bid:

A. Where the project does not involve separate bids pursuant to the New York General Municipal Law the following will apply:

1) Where walls, floors, ceilings, roofs or other items require cutting for the installation of new work, all such cutting shall be done by the Contractor with the approval of the Construction Administrator; and the Contractor shall patch the opening to make the cut portions match the adjacent finished surfaces, unless otherwise indicated.

2) The Contractor shall not endanger any existing condition by its operations.

3) The cost of all cutting and patching caused by the Contractor's negligence shall be

borne by the Contractor.

Contract with Separate Bids:

B. If the project is one where separate bid specifications are required pursuant to the New York General Municipal Law the following will apply:

1) A sufficient time in advance of the construction of new floors, walls, ceilings, roofs, or other items, each Contractor shall be responsible for properly locating and providing in place all sleeves, inserts and forms required for their work, and shall furnish the Contractor for General Construction with complete information relative to exact locations and dimensions of all required openings in the General Contractor's work. Other Contractors shall periodically consult the Job Progress Chart of the General Contractor so that they will not be delayed by their work requirements, but the General Contractor shall be obliged to give all other Contractors at least seventy-two hours notice before commencing the previously mentioned new construction work.

2) The cost shall be borne by the responsible Contractor for all cutting, patching, re-waterproofing and re-caulking of new work necessary for reception of the work of a Contractor, caused by the Contractor's failure to timely or properly locate and provide in place all sleeves, inserts and forms required for its own work, or by a Contractor's failure to inform the General Contractor of required openings. The General Contractor shall do all cutting, patching, re-waterproofing and re-caulking of all new work no matter how or by whom such work was caused and shall be reimbursed for such extra work by the responsible Contractor, in accordance with the terms of the Contract. All cutting and patching shall have prior approval of the Construction Administrator.

3) Where sleeves, inserts, forms or openings are required in existing walls, floors, ceilings roofs, or other existing items, all necessary cutting, patching, re-waterproofing and re-caulking required shall be done by the individual responsible Contractor, except for finished surfaces. The responsible Contractor shall do all rough patching to bring the cut areas to the proper surface ready to receive the finished surface. All finishing work required to make the cut portions match the adjacent finished surfaces shall be performed by the General Contractor.

4) Each Contractor shall be responsible for coordinating their work with the work of all other Contractors engaged on the project. If directed, Contractors shall submit coordinated shop drawings showing how the fitting of the various parts of the work will be accomplished, for the Construction Administrator’s acceptance.

5) All cutting and patching shall be governed by the applicable divisions of the Specifications with regard to workmanship, materials and methods.

6) No Contractor shall endanger any work by unauthorized cutting, excavating, or other alteration of the work, unless previously authorized by the Construction Administrator.

52. CONFLICTS AMONG CONTRACT DOCUMENTS

In the event of any conflict among the Contract Documents, the Contractor shall notify the Commissioner and comply with the Commissioner's interpretation, according to the following priorities:

Priority Order	Document
1…….	Modification issued after execution of Agreement
2…….	Agreement between Owner and Contractor
3…….	Addenda issued prior to the execution of the Agreement (Later date to take precedence)
4…….	Special Notices
5…….	Technical Specifications
6…….	Construction Drawings:
6A……..	Schedule on Construction Drawings
6B……..	Notes on Construction Drawings
6C……..	Large Scale Details on Construction Drawings
6D……..	Small Scale Details on Construction Drawings
7…….	General Requirements
8…….	Special Clauses
9…….	Information for Bidders and General Clauses

53. RECORD DRAWINGS

A. The Owner shall furnish, at the first job meeting, one set of "paper" copies of the contract drawing(s) - this is in addition to the five sets of contract drawings as described in the Article "Contract Drawings" of the General Requirements; for the Contractor's use to indicate change(s) as they occur for the duration of the construction work. Upon request from the Contractor, the County will supply the Contractor a copy of the original Contract Drawings in AutoCAD format.

B. The Contractor shall record neatly and legibly, using reasonable drafting care, all approved change(s) (including minor revisions or corrections of pipes, ducts, electric outlets, circuit panels and other features, as well as invert elevations and locations of underground lines).

C. When all approved changes are recorded and clearly identified, the Contractor shall prepare a set of "as-built" (record) drawings, in the latest version of AutoCAD, using the approved County format and associated CAD layering guidelines, with 24" x 36" drawing sizes, showing the project as built including all changes in the work made during construction based on marked-up prints, drawings, and other data. These drawings shall be filed on a CD and submitted to the Construction Administrator.

D. All additional "paper" or reproducible drawings are to be obtained by the Contractor at their own expense.

54. TIME

A. All time limits (see Article "Required Time For Completion Of The Work" of the General Requirements, and, Article "Time Of Starting" of the Information For Bidders) stated in the specifications are of the essence of the Contract.

B. The Contractor may perform all necessary labor during other than normal working hours. The Owner imposes no limitation of the Contractor's working hours and whatever overtime work may be necessary or required shall be considered by the Contractor and reflected in its Bid Proposal without the benefit or extra compensation. The Contractor must give a minimum of four (4) hours notice to the Construction Administrator when overtime Work is necessary. The Contractor shall promptly pay to the County the additional cost of the Engineer and Construction Administrator for inspection services during the overtime Work.

55. ACCELERATION OF THE WORK

The Owner may, at its sole discretion and for any reason, require the Contractor to accelerate the schedule of performance by providing overtime, extended day, extra crews, Saturday, Sunday and/or holiday work and/or by having all or any subcontractors designated by the Owner provide overtime, extended day, extra crews, Saturday, Sunday or holiday work by the Contractor's or his subcontractor's own forces, and such requirements is independent of and not related in any way to any apparent inability of the Contractor to comply with the schedule(s), Milestone(s) and/or completion date requirements, the Owner, pursuant to a written change order as signed by the Commissioner shall reimburse the Contractor for the direct cost to the Contractor of the premium time for the labor utilized by the Contractor in such overtime, extended day, extra crews, Saturday, Sunday or holiday work(but not for the straight time costs of such labor) together with any social security and state or federal unemployment insurance taxes in connection with such premium time. However, no overhead, supervision costs, commissions, profit or other costs and expenses of any nature whatsoever, including impact costs or costs associated with lost efficiency or productivity, shall be payable in connection therewith. Anything to the foregoing notwithstanding, in the event that the Contractor has fallen behind schedule or in the Owner's judgment appears likely to fall behind schedule, Owner shall have the absolute right to direct the Contractor to accelerate the performance of its work, including that of its subcontractors, and the full costs for such acceleration shall be borne solely by the Contractor.

56. ULTRA LOW SULFUR DIESEL FUEL

A. Contractors and Subcontractors operating onroad and nonroad vehicles to perform County work must power those vehicles with ultra low sulfur diesel fuel. Ultra low sulfur diesel fuel is any diesel fuel that has a sulfur content of no more than fifteen parts per million.

B. In addition, all onroad and nonroad diesel vehicles used to perform County work and equipped with a model year 2003 or older engine shall utilize the best available

technology[2] in accordance with the following schedule:

a) effective September 1, 2007 - 35% of all such motor vehicles used on this project;
b) effective September 1, 2008 - 65% of all such motor vehicles used on this project;
c) effective September 1, 2009 - 100% of all such motor vehicles used on this project.

C. All onroad and nonroad diesel vehicles to perform County work having a gross vehicle weight rating of more than 14,000 pounds shall utilize the best available technology or be equipped with an engine certified to the applicable 2007 United States Environmental Protection Agency ("EPA") standard for particulate matter as set forth in Section 86.007-11 of Title 40 of the Code of Federal Regulations or to any subsequent EPA standard for such pollutant that is at least as stringent, in accordance with the following schedule:

a) by September 1, 2007 - 35% of all such motor vehicles;
b) by September 1, 2008 - 65% of all such motor vehicles;
c) by September 1, 2009 - 100% of all such motor vehicles

D. Any contractor who violates any provision of Section 873.1329 shall be liable for a civil penalty not to exceed ten thousand dollars plus twice the amount of money saved by such contractor for failure to comply with this section.

E. Any contractor who makes a false claim may be liable for a civil penalty not to exceed twenty thousand dollars, in addition to twice the amount of money saved by such contractor as a result of having made such false claim.

F. Nothing in this section shall be construed to limit the County's authority to cancel or terminate a contract, deny or withdraw approval to perform a subcontract or provide supplies, issue a non-responsibility finding, issue a non-responsiveness finding, deny a person or entity pre-qualification as a vendor, or otherwise deny a person or entity public entity business.

G. If sufficient quantities of ultra low sulfur diesel fuel are not available to meet the needs of a contractor to fulfill the requirements of this contract, the Contractor may submit a written request to the Commissioner to use diesel fuel with a sulfur content of no more than thirty parts per million as long as the contractor shall use whatever quantity of ultra low sulfur diesel fuel that is available. Such determination shall be made in writing on a case by case basis upon written application to the Commissioner. If the Commissioner grants such authority it shall expire sixty days thereafter and may be renewed upon written request for additional periods of sixty days.

[2] Best Available Technology means a system for reducing the emission of pollutants which is based on technology verified by the U.S. Environmental protection Agency or the California Air Resources Board or which has been identified pursuant to NYC's Department of Environmental Protection that (1) reduces diesel particulate matter emissions by at least 85 percent, as compared to a similar engine operating on traditional diesel fuel without emission control technology, or reduces engine emissions to 0.01 grams diesel particulate matter per brake horsepower per hour or less; and 2) achieves the greatest reduction in emissions of nitrogen oxides at a reasonable cost and in no case produces a net increase in nitrogen oxides in excess of 10%.

H. The Contractor, in order to comply with Subsections B & C above, must retrofit its vehicles to include both of the following in order to comply with the Best Available Technology Requirements:

- Diesel Oxidation Catalysts (DOC)
- Crankcase Vent Filters (CVF)

If the Contractor wants to propose an alternative technology it must submit a written request to the Commissioner with sufficient detail to enable the Commissioner to make a determination as to whether to accept the alternative technology. Any approval of alternative technology must be in writing.

57. QUALIFIED TRANSPORTATION FRINGE PROGRAM

EXECUTIVE ORDER NO. 7-2005

Requires that contractors, concessionaires and vendors doing business with the County enroll in a Qualified Transportation Fringe Program as defined in §132(f)(1) of the IRS Tax Code for all contracts for goods or services of $100,000 or more in any twelve month period during the contract term if such contractor, concessionaire or vendor employs more than 25 individuals who utilize public transportation and/or pay for commuter parking at least 1 day per week regardless of whether those employees are engaged in work pursuant to the contract.

Bidders shall submit the signed statement on Proposal Page 34. Notwithstanding the above, a Bidder may submit a Waiver Application on Proposal Page 35 to the Commissioner.

58. USE OF FLUORESCENT LIGHT BULBS & ENERGY EFFICIENT BULBS

The use of incandescent light bulbs is prohibited in County-owned buildings and facilities. Only fluorescent light bulbs may be installed in County buildings and facilities. Exterior lights must utilize energy-efficient bulbs. For further details see Article 58 of the General Clauses.

59. COUNTY OF WESTCHESTER PHOSPHORUS-FREE LAWN FERTILIZER POLICY

Executive Order 8-2007 limits the use of lawn fertilizers containing phosphorous and other compounds containing phosphorous, such as phosphate on County owned property.

EXECUTIVE ORDER NO.8 OF 2007

WHEREAS, the New York City water supply watershed is a critical drinking water source for approximately eight million New York City consumers and approximately one million upstate consumers. Over eighty-five percent (85%) of Westchester County's residents consume water from the New York City water supply system; and

WHEREAS, eutrophication is a natural aging process of lakes or streams brought on by

nutrient enrichment. Eutrophication can be greatly accelerated by human activities that increase the rate at which nutrients and organic substances enter aquatic ecosystems from their surrounding watersheds; and

WHEREAS, as a result of accelerated eutrophication, enhanced plant growth reduces dissolved oxygen in the water creating severely impaired water bodies with unpleasant water taste and odor, discoloration, release of toxins and increased turbidity that interferes with the health and diversity of indigenous fish, plant, and animal populations and with the recreational use of rivers, lakes and wetlands. Consequently, eutrophication restricts water use for fisheries, recreation, industry, and drinking due to the increased growth of undesirable algae and aquatic weeds and the oxygen shortages caused by their death and decomposition; and

WHEREAS, nutrient pollution due to human activities is one of the leading causes of eutrophication in the NYC Watershed, and is specifically accelerated by the introduction of excessive phosphorus into the environment. In fact, most reservoirs in the East of Hudson portion of the New York City Watershed (5 of the 7 located in Westchester County) are designated as phosphorous-restricted basins in accordance with the New York City Watershed Rules & Regulations due to excessive phosphorous volumes which have not been reduced despite phosphorous reductions mandated by the New York State Department of Environmental Conservation (NYSDEC); and

WHEREAS, one unnecessary source of phosphorus pollution in the watershed is the many pounds oflawn fertilizer applied by residents and businesses in the County of Westchester each year; and

WHEREAS, when phosphorus fertilizer is applied to phosphorus-rich lawns, much of the excess simply runs off of the lawn into the storm drainage systems where it can be carried into rivers, lakes, streams, and wetlands, causing eutrophication; and

WHEREAS, soil tests conducted pursuant to a six-year study by the Cornell Cooperative Extension, an extension of the State's designated Land-Grant University, have shown that approximately 90% of the lawns in Westchester County have medium-to-high levels of phosphorus; and

WHEREAS, the New York City Watershed Pesticide and Fertilizer Technical Working Group, established by the New York City Watershed Memorandum of Agreement, issued a report in 2000, noting the high percentage of phosphorus in regional soils and recommending that phosphorus-based lawn fertilizers be added only when a soil analysis identifies phosphorus deficiencies.

WHEREAS, the proposed Stormwater Phase II regulations recently issued by the New York State Department of Environmental Conservation, and which are expected to go into effect in January of2008, will allow the use of phosphorus-based lawn fertilizers on municipally-owned land only where soil testing indicates that phosphorus concentrations are inadequate, in order to ensure that municipalities in the New York City Watershed are

taking satisfactory steps to achieve the above-referenced mandatory phosphorous reductions.

WHEREAS, the United States Environmental Protection Agency has also determined that a Nonpoint Source Implementation Plan was necessary in the Croton Watershed because the phosphorus reductions necessary to meet the targeted applicable water quality standards could not be achieved by wastewater treatment plant upgrades alone; and

WHEREAS, Section 110.11 of the Laws of Westchester County places the responsibility to supervise, direct and control, subject to law, the administrative services and departments of the county, upon the County Executive; and

WHEREAS, I have determined that restricting the application and use of lawn fertilizer containing phosphorus on all County-owned property will address one source of unnecessary and preventable phosphorus pollution and will improve water quality in the County; and

WHEREAS, the Department of Planning, after review of the applicable regulations under the State Environmental Quality Review Act, has advised that this Executive Order has been classified as a Type II action, pursuant to 6 N.Y.C.R.R. § 617.5(c)(20), "routine or continuing agency administration and management, not including new programs or major reordering of priorities that may affect the environment," and 6 N.Y.C.R.R. § 617.5(c)(27), "adoption o fregulations, policies, procedures and local legislative decisions in connection with any action on this list." As such, no further environmental review is required.

NOW THEREFORE, I, , County Executive of the County of Westchester, in light of the aforementioned, do hereby order and direct each and every department, board, agency, and commission of the County of Westchester under my jurisdiction to ensure that the policies and procedures set forth in the following Phosphorus-Free Lawn Fertilizer Policy are complied with.

COUNTY OF WESTCHESTER
PHOSPHORUS- FREE LAWN FERTILIZER POLICY

I. Definitions:

(1) "Certified laboratory" means any laboratory certified by the New York State Department of Health pursuant to section five hundred two of the New York State Public Health Law to conduct soil analysis.

(2) "Commercial fertilizer" means any substances containing one or more recognized plant nutrients which is used for its plant nutrient content, and which is designed for use or claimed to have value in promoting plant growth, except unmanipulated animal or vegetable manures, agricultural liming material, wood ashes, gypsum and other products exempted by regulation of the New York State Commissioner of Agriculture and Markets.

(3) "Lawn fertilizer" means a commercial fertilizer distributed primarily for non-farm use, such as lawns, shrubbery, flowers, golf courses, municipal parks, cemeteries, greenhouses and nurseries, and such other use as the commissioner may define by regulation. Lawn fertilizer does not include fertilizer products intended primarily for garden and indoor plant application.

II. Use and Application of Lawn Fertilizer:

(1) Any lawn fertilizer that is labeled as containing more than 0% phosphorus or other compound containing phosphorus, such as phosphate, shall not be applied upon any County-owned property, except as provided in section III. Of this Executive Order.

(2) No lawn fertilizer shall be applied upon County-owned property when the ground is frozen.

(3) Lawn fertilizer shall not be applied to any impervious surface upon County-owned property, including parking lots, roadways, and sidewalks. If such application occurs, the fertilizer must be immediately contained and either applied to turf in a manner consistent with this Executive Order or placed in an appropriate container.

III. Exemptions:

The prohibition against the use of lawn fertilizer under section II of this Executive Order shall not apply to:

(1) Newly established turf or lawn areas during their first growing season.

(2) Turf or lawn areas that soil tests, performed within the past three years by a certified laboratory or by the Cornell University Cooperative Extension of Westchester County, confirm the need for additional phosphorus application in accordance with the phosphorus levels established by the Cornell University Cooperative Extension of Westchester County. The lawn fertilizer application shall not contain an amount of phosphorus exceeding the amount and rate of application recommended in the soil test evaluation.

(3) Agricultural uses, vegetable and flower gardens, or application to trees or shrubs.

IV. The transition to phosphorus-free lawn fertilizer shall occur as soon as possible in a manner that avoids wasting of existing inventories; accommodates establishment of supply chains for new products; enables the training of County employees and licensees in appropriate work methods; and allows the phase-out of products and practices inconsistent with this Executive Order. However, in no event shall lawn fertilizer containing phosphorus (i.e., labeled as containing more than 0% phosphorus or other compound containing phosphorus, such as phosphate) be applied upon County-owned property after January 1,2009, unless an exemption set forth in Section III of this Executive Order applies.

V. This Executive Order shall take effect on the date hereof, and shall remain in effect until otherwise superseded, repealed, modified or revoked.

SAMPLE FORMS

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

AFFIRMATIVE ACTION PROGRAM REQUIREMENT- SUBCONTRACTOR(S)

County of Westchester, Department of Public Works

(To Be Completed By Subcontractor and Submitted with Request to Utilize Subcontractor)

Affirmative Action Program

An approved Affirmative Action Plan shall be required for all Subcontractors for public work where the subcontracted work exceeds $50,000 or more than fourteen (14) persons are employed by the Subcontractor.

Does the Subcontractor participate in an approved Affirmative Action Program? Yes [ ] No [ ]

If Yes, give name of Program: _____

_____

If No, how many employees will the Subcontractor employ on this project? _____

An approved Affirmative Action Program shall mean a plan approved or adopted by Westchester County including but not limited to, the Home-Town Plan, the Recruitment Training Program or any other program approved or meeting the requirements of the State or Federal government.

The "Monthly Employment Utilization Report" of the Sample Forms, shall be filled out by the Contractor and/or Subcontractor(s) who are required to have an Affirmative Action Program, prior to the start of the work.

CONTRACTOR'S REPORT OF EMPLOYMENT AND WEEKLY AFFIDAVIT

County of Westchester, Department of Public Works

Contract No._____

Report No._____

Week(s) ending_____

Title of Contract and Location _____

Contractor or Subcontractor _____

Address _____

_____

_____

STATE OF)
COUNTY OF) SS.:

I,_____, being duly sworn, depose and say:

1. I pay or supervise the payment of the persons employed by_____
(Contractor or Subcontractor)
in connection with the above referenced contract;

2. During the payment period commencing on the ____ day of _____,

20____ and ending on the _____ day of _____, 20___, all persons employed by

_____ in connection with such contract have been paid in full
(Contractor or Subcontractor)
weekly wages and supplements earned by such persons except the following: (strikeout, if not applicable)

3. Such persons have been paid the prevailing rate of wages and the supplements as determined and required by Section 220 of the New York State Labor Law.

4. No rebates or deductions have been deducted from such wages and supplements except as authorized or required by applicable statutes or regulations of the Federal, State and County Governments.

5. The following is a true and accurate summary of wages and supplements paid:

_____During the week_____Total to date

Number of names on payroll _____

Hours worked _____

Total wages earned_____

6. I have read the foregoing statement of wages and supplement, know the contents thereof, and the same is true to my own knowledge.

_____

(Signature)

STATE OF NEW YORK)
COUNTY OF WESTCHESTER) ss.:

On this _____ day of _____, 20___, before me personally came _____ to me known, and known to me to be the person who executed the above instrument, and who being duly sworn did say that he executed the same.

Sworn to before me
this _____ day of _____

_____

License No.

_____

Notary Public - State of New York

MONTHLY EMPLOYMENT UTILIZATION REPORT

County of Westchester, Department of Public Works

MONTHLY EMPLOYMENT UTILIZATION REPORT	JOB TITLE:	CONTRACT NO.:
WESTCHESTER COUNTY DEPARTMENT OF PUBLIC WORKS DIVISION OF ENGINEERING	NAME AND LOCATION OF CONTRACTOR:	REPORTING PERIOD: FROM: _____ TO: _____

CONSTRUCTION TRADE	CLASSIFICATION	WORK HOURS OF EMPLOYMENT												MINORITY PERCENTAGE %	FEMALE PERCENTAGE %	TOTAL NUMBER OF EMPLOYEES		TOTAL NUMBER OF MINORITY EMPLOYEES	
		TOTAL ALL EMPLOYEES BY TRADE				BLACK (NOT HISPANIC ORIGNAL)		HISPANIC		ASIAN OR PACIFIC ISLANDERS		AMERICAN INDIAN OR ALASKAN NATIVE							
		M	HRS	F	HRS	M	F	M	F	M	F	M	F			M	F	M	F
	JOURNEY WORKER																		
	APPRENTICE																		
	TRAINEE																		
	SUB-TOTAL																		
	JOURNEY WORKER																		
	APPRENTICE																		
	TRAINEE																		
	SUB-TOTAL																		
	JOURNEY WORKER																		
	APPRENTICE																		
	TRAINEE																		
	SUB-TOTAL																		
	JOURNEY WORKER																		
	APPRENTICE																		
	TRAINEE																		
	SUB-TOTAL																		
TOTAL JOURNEY WORKER																			
TOTAL APPRENTICES																			
TOTAL TRAINEES																			
GRAND TOTAL (#HRS & #EMPL)																			

COMPANY OFFICAL'S SIGNATURE AND TITLE:	TELEPHONE NUMBER (Include Area Code):	DATE SIGNED:	PAGE: _____ OF _____

This report must be filled out by all contractors (both prime and sub) who are required to have an Affirmative Action Program, and must be filed with the Engineer by the 5th day of each month during the term of the Contract, and shall include the total work hours of each employee classification in each trade in the covered area for the Monthly Reporting Period. The Prime Contractor shall submit a report for its Aggregate Work Force and collect and submit reports for each subcontractor's Aggregate Work Force to the Engineer.

SHOP DRAWING SCHEDULE

County of Westchester, Department of Public Works

SHOP DRAWING SCHEDULE											
SPECIFICATION NUMBER	DESCRIPTION OF ITEM/MODEL #	SUBMISSION	REQUEST FROM CONTRACTOR TO MANUFACTURER	RECEIVED BY CONTRACTOR FROM MANUFACTURER	RECEIVED BY COUNTY FROM CONTRACTOR	RETURNED BY COUNTY TO CONTRACTOR	RETURNED BY CONTRACTOR TO MANUFACTURER	APPROVED BY COUNTY	APPROVED SHOP DRAWINGS TO MANUFACTURER FROM CONTRACTOR	INVOICE NO. AND SCHEDULED DELIVERY DATE	ACTUAL DELIVERY DATE
		ORIGINAL									
		2									
		3									
		4									
		ORIGINAL									
		2									
		3									
		4									
		ORIGINAL									
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		4									
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		4									
		ORIGINAL									
		2									
		3									
		4									
		ORIGINAL									
		2									
		3									
		4									

SHOP DRAWING ID

County of Westchester, Department of Public Works

WESTCHESTER COUNTY DRAWING _____ OF _____

NAME OF PROJECT

_____

Date _____

Contract No. _____

Item/Model No. _____

Manufacturer _____

Contract Drawing No. _____

Specification Section _____

This document has been reviewed, coordinated and checked for accuracy of content and for compliance with the Contract Documents. The information contained herein has been coordinated with all other Contract Work.

Contractor _____

Signed _____

REQUEST FOR APPROVAL OF EQUAL

County of Westchester, Department of Public Works

SPECIFICATION NO.	ITEM	EQUAL

Attach a separate sheet here if more space is required.

REQUEST FOR APPROVAL OF SUBSTITUTIONS

County of Westchester, Department of Public Works

ITEM NO.	ITEM	SUBSTITUTION	COST OF SPECIFIED ITEM	COST OF SUBSTITUTED ITEM	SAVINGS TO COUNTY

Attach a separate sheet here if more space is required.

CONTRACTOR'S ULTRA LOW SULFUR DIESEL FUEL AFFIDAVIT

County of Westchester, Department of Public Works

Contract No. _____Period Included in this Report:_____, 20__ to _____, 20__

Title of Contract and Location_____
_____

Contractor _____
Address_____

Subcontractor _____
Address_____

STATE OF) ss.:
COUNTY OF)

I, _____being duly sworn, depose and say:
(print name) (print title)

1. I certify under penalty of perjury that I agree to comply with the requirements of Chapter 878, Article XIII, Section 873.13.29 of the Laws of Westchester County.
2. During the period _____ through _____, all diesel-powered vehicles, used in the performance of Contract No._____, were powered by ultra low sulfur diesel fuel (15 ppm Sulfur Maximum).
3. No fuel other than Ultra Low Sulfur Diesel Fuel (15 ppm Sulfur Maximum) was utilized on this project for the above described vehicles.
4. The annexed Ultra Low Sulfur Diesel Fuel Log is a true and accurate summary of the low sulfur diesel fuel (15 ppm Sulfur Maximum) purchased and utilized in the performance of this project.
5. I have read the foregoing statement, have full knowledge of the contents thereof, and it is my intent that the County of Westchester will rely on the statements contained herein.

_____
(Signature)

STATE OF) ss.:
COUNTY OF)

On this _____ day of _____, 20__, before me personally came _____ to me known, and known to me to be the person who executed the above instrument, and who being duly sworn did say that he/she executed the same.

Sworn to before me this

_____day of _____, 20__.

_____

Notary Public

The Ultra Low Sulfur Diesel Fuel-Log must be attached.

This Certification also has to be submitted by your subcontractor(s). *Additional copies of this form can be acquired from the Department of Public Work.*

ULTRA LOW SULFUR DIESEL FUEL (15 ppm Sulfur Maximum) – LOG

Period of Log: _____ through _____

Contract No. _____

Title of Contract and Location_____
_____

Contractor or Subcontractor_____
Address_____

Date of Purchase	Name and Address of Vendor (Print)	Gallons Purchased

A Separate Copy of this Certification will also have to be signed by each of your subcontractors that utilize diesel powered vehicles, fifty horsepower or greater, on the above project. *Additional copies of this form can be acquired from the Department of Public Works.*

Westchester gov.com

Westchester County • Department of Finance • Treasury Division

Electronic Funds Transfer (EFT) Vendor Direct Payment Authorization Form

Authorization is: *(check one)*
- ❒ New
- ❒ Change
- ❒ No Change

INSTRUCTIONS: Please complete both sections of this Authorization form and attach a voided check. See the reverse for more information and instructions (Forms Page 21). If you previously submitted this form and there is no change to the information previously submitted, ONLY complete lines 1 through 6 of section 1.

Section I - Vendor Information

1. Vendor Name:

2. Taxpayer ID Number or Social Security Number:

3. Vendor Primary Address

4. Contact Person Name: | Contact Person Telephone Number:

5. Vendor E-Mail Addresses for Remittance Notification:

6. Vendor Certification: *I have read and understand the Vendor Direct Payment Program and hereby authorize payments to be received by electronic funds transfer into the bank that I designate in Section II. I further understand that in the event that an erroneous electronic payment is sent, Westchester County reserves the right to reverse the electronic payment. In the event that a reversal cannot be implemented, Westchester County will utilize any other lawful means to retrieve payments to which the payee was not entitled.*

Authorized Signature | Print Name/Title | Date

Section II- Financial Institution Information

7. Bank Name:

8. Bank Address:

9. Routing Transit Number:

10. Account Type: (check one) ❒ Checking ❒ Savings

11. Bank Account Number: | 12. Bank Account Title:

13. Bank Contact Person Name: | Telephone Number:

14. FINANCIAL INSTITUTION CERTIFICATION (required **ONLY** if directing funds into a Savings Account **OR** if a voided check is not attached to this form): *I certify that the account number and type of account is maintained in the name of the vendor named above. As a representative of the named financial Institution, I certify that this financial Institution is ACH capable and agrees to receive and deposit payments to the account shown.*

Authorized Signature | Print Name / Title | Date

(Leave Blank - to be completed by Westchester County) - Vendor number assigned

Electronic Funds Transfer (EFT)
Vendor Direct Payment Authorization Form

GENERAL INSTRUCTIONS

Please complete both sections of the Vendor Direct Payment Authorization Form and forward the completed form (along with a voided check for the account to which you want your payments credited) to: Westchester County Board of Acquisition and Contract, 148 Martine Ave, Room 104, White Plains, NY 10601, Attention: Vendor Direct. Please see item 14 below regarding attachment of a voided check.

Section I - VENDOR INFORMATION

1. Provide the name of the vendor as it appears on the W-9 form.
2. Enter the vendor's Taxpayer ID number or Social Security Number as it appears on the W-9 form.
3. Enter the vendor's complete primary address (not a P.O. Box).
4. Provide the name and telephone number of the vendor's contact person.
5. Enter the business e-mail address for the remittance notification. THIS IS VERY IMPORTANT. This is the e-mail address that we will use to send you notification and remittance information two days prior to the payment being credited to your bank account. We suggest that you provide a group mailbox (if applicable) for your e-mail address. You may also designate multiple e-mail addresses.
6. Please have an authorized Payee/Company official sign and date the form and include his/her title.

Section II - FINANCIAL INSTITUTION INFORMATION

7. Provide bank's name.
8. Provide the complete address of your bank.
9. Enter your bank's 9 digit routing transit number.
10. Indicate the type of account (check one box only).
11. Enter the vendor's bank account number.
12. Enter the title of the vendor's account.
13. Provide the name and telephone number of your bank contact person.
14. If you are directing your payments to a Savings Account OR you can not attach a voided check for your checking account, this line needs to be completed and signed by an authorized bank official. IF YOU DO ATTACH A VOIDED CHECK FOR A CHECKING ACCOUNT, YOU MAY LEAVE THIS LINE BLANK.

DPW 10/08

SAMPLE FORMS

SUBCONTRACTOR
APPRENTICESHIP AGREEMENT REQUIREMENT

(To be Completed by Subcontractor and submitted by Contractor **within 90 days of Award** of the Construction Contract)

In accordance with Chapter 309 of the Laws of Westchester County, the Subcontractor shall complete this form.

Questions the Subcontractor shall answer:

(1) Is the Subcontractor engaged in an occupation which is registered as apprenticeable by the New York State Commissioner of Labor?	Yes [ ] No [ ]
(2) Is the total number of persons employed by the Subcontractor more than 14?	Yes [ ] No [ ]

If the Subcontractor answered "No" to Questions (1), the Subcontractor can stop here and must sign this form below before a notary public.

If the Subcontractor answered "No" to Question (2) above, the Subcontractor must complete the following verification and sign this form below before a notary public:

VERIFICATION AS TO NUMBER OF PERSONS EMPLOYED
I hereby verify on behalf of the Subcontractor and under penalty of perjury that the total number of persons employed by the Subcontractor is 14 or fewer.
Signature of Subcontractor:_____ Print Name: Print Title:

If Subcontractor answered "Yes" to Questions (1) and (2) above, the Subcontractor hereby certifies to the following:

1. The Subcontractor has submitted to the Contractor who has or will submit to the Commissioner pursuant to Chapter 309 proof of an Apprenticeship Agreement appropriate for the type and scope of work to be performed and registered with the New York State Commissioner of Labor pursuant to the requirements found in Article 23 of the New York State Labor law.
2. The Subcontractor has submitted to the Contractor who has or will submit to the Commissioner pursuant to Chapter 309 either:
    a. proof of 30% apprentice completion rate for the applicable registered apprenticeship program by the submission of the most recently available certificates of completion, which show that each of the Subcontractor's applicable registered apprenticeship programs has an apprentice completion rate of at least thirty percent (30%) as determined by the New York State Department of Law,
    or

SAMPLE FORMS

SUBCONTRACTOR
APPRENTICESHIP AGREEMENT REQUIREMENT

b. proof of exemption from the 30% apprenticeship completion rate (See § 309.41(C) of the Local Law) by the submission of a copy of the relevant fully executed program registration agreement or proof of the New York State Department of Labor's provisional approval of the apprenticeship program.

SIGNATURE

I hereby verify on behalf of the Subcontractor and under penalty of perjury that the above statements are true.

Name of Subcontractor:_____
Signature:_____
Print Name:
Print Title:

NOTARY PUBLIC

STATE OF _____)
SS:
COUNTY OF _____)

_____, being duly sworn, deposes and says that he/she is the _____ of the Bidder described herein and who executed the foregoing verification, that he/she has read the same and knows the contents thereof, and that the statements contained herein are true.

Sworn to before me this ____ day of _____, 202___.

_____
Notary Public

SAMPLE CONTRACT AND BOND

FOR CONSTRUCTION

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

SAMPLE CONTRACT AND BOND

FOR CONSTRUCTION

SAMPLE

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

(WC DPW E Version 1/10)

COUNTY OF WESTCHESTER

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

COUNTY OFFICE BUILDING/ROOM 500
WHITE PLAINS, NEW YORK

CONTRACT AND BOND

FOR:

CONTRACT NO. XX XXX

John Nonna
County Attorney

SAMPLE

CONTRACT NO.: _____ **Amount of Contract: $_____**

THIS AGREEMENT made this ____ day of _____, **20___**, by and between the **COUNTY OF WESTCHESTER**, a municipal corporation of the State of New York, hereinafter, "County", and

_____
_____
_____

hereinafter called the "Contractor", WITNESSETH as follows:

WHEREAS, the Commissioner of Public Works and Transportation, hereinafter called "Commissioner", by virtue of the power and authority in him vested did advertise for proposals and bids for:

_____
_____
_____,

Westchester County, New York, to furnish all labor, tools, implements and materials that may be requisite and necessary to the execution and completion of the work according to the plans, specifications, profiles and other drawings relating to such work, as approved by the County of Westchester and now on file in the Office of the Commissioner, and

WHEREAS, the Contractor did bid for said work in the manner and form as required by said plans and specifications and, being the lowest responsible bidder therefore, was duly awarded the Contract for such work at prices named in the itemized proposal by a resolution of the Board of Acquisition and Contract of the said County of Westchester.

NOW THEREFORE, the Contractor, in consideration of the prices so named for the various items of work to be paid for as hereinafter provided, does for itself, its representatives, agents, executors, administrators, successors or assigns, covenant and agree with the County that it, the said Contractor, shall and will at its own proper costs and charges and in conformity with said plans and specifications which are made a part of this Contract without setting forth same herein, provide all manner and kind of materials, molds, models, cartage, appliances and appurtenances required and of every description necessary for the due and proper performance of this Contract and the completion of said work to be done under the supervision and direction of the Commissioner, in a good workmanlike manner and in conformity with said plans and specifications without any alteration, deviation, additions, or omissions therefrom except upon due request and under the written direction of said Commissioner.

The Contractor acknowledges receipt of the Notice to Contractors, Special Notices, General Requirements and Proposals, Information for Bidders, General and Special Clauses, Technical Specifications, the Plans, and Specifications relating to this Contract, as well as all issued Addenda thereto (collectively, the "Bid Documents"), all of which are expressly incorporated in this Contract as if fully set forth herein.

SAMPLE

IT IS FURTHER UNDERSTOOD AND AGREED by and between the parties to this Contract that if in the opinion of the said Commissioner of the County of Westchester it shall become necessary to make any change in the work called by the plans and specifications which are a part of this Contract, whereby, consistent with the Information for Bidders, the work contemplated by said plans and specifications is modified and reduced and the costs and expenses of such work lessened, that then and in that event the Contractor will do the work as changed and modified and the said Commissioner shall estimate the difference between the original estimate of quantities therefor and the amount that should be paid by reason of the modification and change and the difference shall be deducted from the original estimate of quantities therefore of said Contract and said Contractor shall be paid accordingly. The estimate of said Commissioner shall be final and conclusive upon the parties hereto and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules. Any changes, modifications or deductions shall in no way invalidate this Contract and said Contractor agrees that in the event of any such change or modification reducing the original, estimated quantities therefore, it will not make any claim for any profit, or loss of profit by reason thereof. Notwithstanding any dispute or disagreement arising hereunder, Contractor agrees that the Work shall not be delayed nor disrupted by reason thereof.

The County hereby covenants and agrees with the said Contractor, in consideration of the covenants and agreements herein being strictly and in all respects complied with by the said Contractor as specified, that it will well and truly pay unto the said Contractor the unit prices set forth in the Proposal for the various items included in the Contract.

All partial payments will be made in accordance with the provisions set forth in the Information for Bidders and especially that part thereof which relates to "Estimates and Payments".

Furthermore, all partial payments will be made on the claim voucher and verified certificate of the Commissioner, both of which shall be filed in the Office of the Commissioner of Finance of the County of Westchester. The said claim voucher shall show the value of the work completed and the verified certificate shall show the said work was done in accordance with the plans and specifications.

With the final estimate the Contractor shall furnish to the Construction Administrator a sworn statement listing all unpaid bills and liabilities incurred under this Contract up to and including the date of the estimate. Where there are any bills or liabilities in excess of moneys due under any estimate under this Contract, the Construction Administrator may withhold payment of the estimate pending a satisfactory proof of settlement or adjustment of any excess claims. No final estimate will be approved or passed for payment unless and until the Contractor furnishes satisfactory proof that all bills and liabilities incurred under the Contract are paid in full and complies with the requirements of Section 220-a of the Labor Law.

Acceptance shall be effected as follows: whenever, in the opinion of the Commissioner, the Contractor shall have completely performed the Contract on his part to be performed, the Commissioner shall so certify in writing to the Board of Acquisition and Contract of the County and file such certificate with the said Board, stating therein, in substance that the work has been duly examined by him and that the same has been fully performed and completed in accordance with the terms of the Contract therefor, and recommending the acceptance thereof. When the Board of Acquisition and Contract by resolution duly adopts, approves and ratifies, the said acceptance shall be complete. No final payment shall be made under this Contract until such certificate of completion and recommendation of acceptance have been approved and ratified by a resolution of said Board of Acquisition and Contract.

Unless otherwise provided for in the contract documents, the Commissioner may take over, use, occupy or operate any part of the Work at any time prior to Final Acceptance upon written notification to the Contractor. The Engineer shall inspect the part of the Work to be taken over, used, occupied or operated, and will furnish the Contractor with a written statement of the Work, if any, that remains to be performed on such part. The Contractor shall not object to, nor interfere with, the Commissioner's decision to exercise the rights granted herein. In the event the Commissioner takes over, uses, occupies or operates any part of the work: (i) the Commissioner shall issue a written determination of Substantial Completion with respect to such part of the Work; and (ii) the Contractor shall be relieved of its absolute obligation to protect such part of the unfinished work in accordance with Article 19 of the General Clauses.

The Commissioner will approve a final estimate for final payment consistent with the authorization of final acceptance from the Board of Acquisition and Contract less previous payments and any and all deductions authorized to be made by the Commissioner under the Contract or law. Payment pursuant to such final estimate less any additional deductions authorized to be made by the Commissioner of Finance under the Contract or law shall constitute the final payment and shall be made by the Commissioner of Finance. If the contract is terminated prior to final acceptance the Commissioner is authorized to prepare a final payment as otherwise authorized by the Board of Acquisition and Contract subject to the above noted adjustments.

Upon the completion and acceptance of this Contract by the Board of Acquisition and Contract, as aforesaid, the Commissioner shall proceed with all reasonable diligence to ascertain from actual measurements the whole amount of work done by the Contractor, and also the value of such work under and according to the terms of this Contract, and thereupon make out in writing a final estimate therefor.

After the completion and acceptance as herein above-mentioned, the Commissioner of Public Works and Transportation shall file with the Commissioner of Finance of the County of Westchester the original verified certificate, claim voucher and the certification required by Section 220-a of the Labor Law, together with a certified copy of the resolution of approval and ratification of the Board of Acquisition and Contract of the said verified certificate and claim voucher and the resolution of acceptance of completion.

IT IS FURTHER UNDERSTOOD AND AGREED by and between the parties to this Contract that the Contractor will accept the unit prices named in the proposal for all additions to or deductions from the original quantities as given in the specifications. It is agreed that the Commissioner will make estimates of the value for the work completed as provided in the specifications and the final estimate will be made accordingly.

The Contractor further agrees that if at any time before or within thirty days after the whole of the work herein agreed to be performed has been completed and accepted any person or persons claiming to have performed any labor or furnished any material towards the performance and completion of this contract shall file with the proper officials any such notice as is described in the Lien Law, or any other act of the Legislature of the State of New York, the Contractor shall cause such Lien to be discharged of record. Otherwise and in every case and until the Lien is discharge of record the County shall retain, anything herein to the contrary notwithstanding, from the moneys under its control and due or to grow due under this Contract the sum of one hundred fifty (150%) percent of the amount of such Lien, unless otherwise authorized to withhold a larger amount. The Contractor further agrees to pay the County upon

demand the costs, including but not limited to attorney's fees, incurred by the County in any action(s) brought to foreclose or otherwise enforce said Lien.

The term of this Agreement shall commence on _____ and shall terminate on _____. It is recognized and understood by the parties that the above Agreement termination date is solely for accounting purposes to allow for final closeout of this Agreement. Accordingly, the Contractor covenants and agrees to commence the work embraced in this Agreement on the Agreement commencement date and to complete said work in all respects on or before the work completion date set forth the General Requirements section of this Agreement.

It is further understood and agreed by the parties hereto that the time of completion is of the essence of this Contract.

It is further understood and agreed by the Contractor that before entering upon the performance of this Contract it shall have approved by the County Attorney the Bond required to be furnished by it in the sum of --- _____ **DOLLARS-00/100--** **[$_____]**-conditioned for the faithful performance of the work.

The Contractor agrees to procure and maintain the insurance naming the County as additional insured, as provided and described in the Bid Documents. In addition to, and not in limitation of the insurance provisions in the Bid Documents, the Contractor agrees:

(a) that except for the amount, if any, of damage contributed to, caused by or resulting from the sole negligence of the County, the Contractor shall indemnify and hold harmless the County, its officers, employees, agents and elected officials from and against any and all liability, damage, claims, demands, costs, judgments, fees, attorneys' fees or loss arising directly or indirectly out of the acts or omissions hereunder by the Contractor or third parties under the direction or control of the Contractor; and

(b) to provide defense for and defend, at its sole expense, any and all claims, demands or causes of action directly or indirectly arising out of this Agreement and to bear all other costs and expenses related thereto.

(c) In the event the Contractor does not provide the above defense and indemnification to the County, and such refusal or denial to provide the above defense and indemnification is found to be in breach of this provision, then the Contractor shall reimburse the County's reasonable attorney's fees incurred in connection with the defense of any action, and in connection with enforcing this provision of the Agreement.

The Contractor hereby covenants and agrees to observe the plans, specifications and directions of the Commissioner in the doing of the work provided for under this Contract and to furnish the necessary materials and implements required therefore and to remove condemned material and rubbish as provided by plans and specifications and to employ a competent and sufficient force of workmen to complete the work of this improvement within the time specified. Should the Contractor at any time become insolvent, make an assignment for the benefit of creditors, abandon the Work, reduce its working force to a number which, if maintained, would be insufficient, in the sole opinion of the Commissioner, to complete the Work in accordance with the approved progress schedule; sublet, assign or otherwise dispose of this Contract other than as permitted elsewhere herein, refuse or neglect to supply a sufficiency of properly skilled workmen, or of material of the proper quantity or fail in any respect to prosecute the work with promptness and diligence, or fail in any other way in the performance of any of the agreements herein

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contained; all the foregoing being deemed acts of default, and such default being certified by the Commissioner, the County of Westchester, acting by the Board of Acquisition and Contract, shall be at liberty after five days written notice to the Contractor to provide any such labor or materials, use any and all sums due or to become due to the Contractor under this Contract, to pay for such labor and material, and if the Commissioner shall certify that such default is sufficient ground for such action, the County of Westchester acting by the Board of Acquisition and Contract, shall also be at liberty to terminate the employment of the Contractor for the said work and to enter upon the premises and take possession for the purpose of completing the work included under this Contract of all materials, tools and appliances thereon and to employ any other person or persons to finish the work and provide the materials therefore. Upon the Contractor's receipt of a notice from the County the Contractor shall immediately discontinue all further operations under this Contract. In case of such termination, the Contractor shall not be entitled to receive any further payment under this Contract until the said work shall be wholly finished, at which time if the unpaid balance of the amount to be paid under this Contract shall exceed the reasonable value of the work performed and the material furnished or the total costs therefor, whichever is greater, in finishing the work, such excess shall be paid by the County of Westchester to the Contractor, but if such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the County.

The expense incurred by the County and the total costs as herein provided either for furnishing materials or for finishing the work and any damage incurred through such default shall be certified by the Commissioner whose certificate thereof shall be final and conclusive upon the parties and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules.

In case the County shall declare the Contractor in default as to a part of the work only, the Contractor shall immediately discontinue such part, shall continue performing the remainder of the Work in strict conformity with the terms of the Contract.

In completing the whole or any part of the Work under the provisions of this Contract, the Commissioner shall have the power to depart from or change or vary the terms and provisions of this Contract. Such departure, change or variation, even to the extent of accepting a lesser or different performance, shall not affect the conclusiveness of the Commissioner's certification of the cost of completion referred to above, nor shall it constitute a defense to an action to recover the amount by which such certificate exceeds the amount which would have been payable to the Contractor hereunder but for his default or partial default.

In addition to termination as provided for above, the County may terminate this Contract for the convenience of the County by written notice to the Contractor from the Commissioner. In such event and upon receipt of such notice the Contractor shall stop work on the date specified in the notice; take such actions as may be necessary to protect and preserve the County's materials and property; cancel all cancelable orders for material and equipment; assign to the County and deliver to the jobsite or any other location designated by the Commissioner any non-cancelable orders for material and equipment that is not capable of use except in the performance of this Contract and which has been specifically fabricated for the sole purpose of this Contract and not incorporated in the Work; and take no action that will increase the amounts payable by the County under this Contract.

In the event the contract is cancelled for the convenience of the County the following provisions shall apply:

(a) For Work completed prior to the notice of termination, the Contractor shall be paid the fair and reasonable value of its work determined by the pro rata portion of the lump sum bid amount based upon the percent completion of the

Work as of the date of termination as determined by the Commissioner, plus work completed pursuant to approved change orders, less amounts previously paid. For purposes of determining the pro rata portion of the lump sum bid amount to which the Contractor is entitled, the Contractor's approved bid breakdown pursuant to Article 21 of the Information for Bidders shall be considered but shall not be dispositive as to the fair and reasonable value.

(b) For non-cancelable material and equipment that is not capable of use except in the performance of this Contract and which has been specifically fabricated for the sole purpose of this Contract, but not yet incorporated in the Work, the Contractor shall be paid the fair and reasonable value thereof as determined by the Commissioner, but not more than the Contractor's cost for such material and equipment, plus an additional sum of two (2%) percent of such fair and reasonable value.

(c) In the event the County terminates a lump sum Contract for convenience within thirty (30) days after the Contractor has received the Notice of Award from the County, the Contractor shall be paid one (1%) percent of the difference between the total lump sum bid amount and the total of all payments made prior to the notice of termination plus all payments allowed pursuant to (a) and (b).

(d) On all unit price Contracts, or on unit price items in a Contract, the County will pay the Contractor the sum of (e) and (f) below, less all payments previously made pursuant to this Contract:

(e) For all completed units, the unit price stated in the Contract, and

(f) For units that have been ordered but are only partially completed, the Contractor will be paid (i) a pro rata portion of the unit price as stated in the Contract based upon the percent completion of the unit as determined by the Commissioner and (ii) for non-cancelable material and equipment, payment will be made pursuant to (b), above.

(g) The Commissioner's determination(s) hereunder shall be final, binding and conclusive and subject to review only pursuant to Article 78 of the New York Civil Practice Law and Rules.

(h) The County shall not be liable to the Contractor for any payment or claim if the termination for convenience results in a reduction of thirty (30%) percent or less of the original contract price as bid.

On all Contracts or items in a Contract where time and material records are specified as the basis for payment of the Work, the Contractor shall be paid in accordance with Article 29 of the General Clauses, less all payments previously made pursuant to this Contract.

In no event shall any payments made pursuant to a termination for convenience exceed the Contract price for such items, either individually or collectively.

All payments made pursuant to a termination for convenience shall be in the nature of liquidated damages and shall be accepted by the Contractor in full satisfaction of all claims against the County.

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The County may deduct or set off against any sums due and payable arising from a termination for convenience, any claims it may have against the Contractor.

In the event the County terminates the Contractor for default and it is subsequently determined that the Contractor was not in default, said termination shall automatically be converted for all purposes into a termination for convenience.

It is further understood and agreed between the parties hereto that no certificate given or payment made under this Contract, except the final certificate or final payment shall be conclusive evidence of the performance of this Contract either wholly or in part and that no payment shall be construed to be an acceptance of defective work or improper materials. If the Contractor shall fail to replace any defective work or materials, the County may cause such defective materials to be removed and defective work to be replaced and the expense thereof shall be deducted from the amount to be paid the Contractor.

Anything to the contrary in the preceding paragraph notwithstanding, the Contractor is responsible for the repair of defects in materials and workmanship for a period of one year from the date of final acceptance of the work by the Board of Acquisition and Contract, unless a longer term is specified in the specifications.

The Contractor further agrees not to assign, transfer, convey, sublet or otherwise dispose of this Contract, or its right, title or interest in or to the same, or any part hereof without the previous consent in writing of the Board of Acquisition and Contract of the County. Before a Subcontractor shall proceed with any work, the Commissioner must first recommend and the Board of Acquisition and Contract must approve the use of the Subcontractor on this Contract. If a Subcontractor is not approved it may not work on this Contract. The Contractor specifically waives any claim due to the failure or refusal of the Commissioner or the Board of Acquisition and Contract to approve said Subcontractor.

The Contractor agrees to hold himself responsible for any claims made against the County for any infringement of patents by the use of patented articles in the construction and completion of the work or any process connected with the work agreed to be performed under this Contract or of any material used upon the said work, and shall indemnify and save harmless the County for the costs, expenses and damages which the County may be obligated to pay by reason of any infringement of patents used in the construction and completion of the work.

The parties hereto agree that no laborer, workman or mechanic in the employ of the Contractor, Subcontractor or other person doing or contracting to do the whole or part of the work contemplated by the Contract shall be permitted or required to work more than eight hours in any one calendar day or more than five days in any one week except in cases of extraordinary emergency including fire, flood or danger to life or property. No such person shall be so employed more than eight hours in any day or more than five days in any one week except in such emergency. Time lost in any week because of inclement weather by employees engaged in the construction, reconstruction and maintenance of highways outside of the limits of cities and villages may be made up during that week and/or the succeeding three weeks.

The Contractor further agrees to erect and maintain during construction all necessary guards, rails and signals to prevent accidents to persons, vehicles or to the adjoining property and also agrees to use all necessary precautions in blasting and that he will indemnify and save the County of Westchester harmless from all suits and actions of any kind and nature whatsoever from or on account of the construction of said work.

It is further understood and agreed by the parties hereto that should any dispute arise respecting the true construction, interpretation or meaning of the Contract plans, specifications or conditions herein,

or the measurements for the payment thereunder, same shall be referred to and decided by the said Commissioner and his decision thereon shall be final and conclusive upon the parties thereto and may not be challenged except in a proceeding commenced pursuant to Article 78 of the Civil Practice Law and Rules. This provision shall also apply to the true value of and duly authorized extra work or any work permitted by agreement in case any work shall be ordered performed, or any work called for shall be so omitted under and upon the direction of said Commissioner.

The Contractor by the submitting of bids and execution of this Contract hereby covenants and agrees that he has examined the plans, specifications and the site work, as to local conditions, difficulties and accuracy of approximate estimate of quantities and does hereby further covenant and agree that he will not make any claim for damages by reason of any such local conditions, difficulties or variation of approximate estimate of quantities.

The Contractor represents and warrants to the County with the knowledge and expectation that this warranty will be relied upon by the County that it is not now participating and has not at any time participated, either directly or through any substantially owned or affiliated person, firm, partnership or corporation, in an international boycott in violation of the provisions of United States Export Administration Act of 1969, 50 USC 2401 et seq. or the regulations promulgated thereunder.

The Contractor further warrants and represents that it is financially solvent, and sufficiently experienced and competent to perform the work and that the facts provided by it to the County in its bid and supporting documents, and contract documents are true and correct in all respects.

This Contract shall become void and any rights of the Contractor hereunder shall be forfeited if, subsequent to the execution hereof, the Contractor is convicted of a violation of the provision of the United States Export Administration Act of 1969, 50 USC 2401 et seq. as amended or has been found upon the final determination of the United States Commerce Department or any other appropriate agency of the United States or the State of New York to have violated such act or regulations.

If the Contractor, any officer, director, or any party holding a controlling interest (defined as five (5%) percent or more, or in the case of a corporation, any stockholder owning five (5%) percent or more of the outstanding shares) is convicted of a crime (excluding Class B and Unclassified Misdemeanors as defined under the New York State Penal Law and their equivalent in any city, state or under Federal law related to the type of services or activities which are the subject matter of this Contract) or if a related or affiliated company, partnership or corporation is convicted of a crime (excluding Class B and Unclassified Misdemeanors as defined above) after this Contract is fully executed, the County shall have the right to terminate this Agreement immediately and without penalty. An "affiliated company" as used herein means any affiliate which is a partnership, corporation, proprietorship, association or other entity (i) in which a 50% or greater ownership interest (as defined below) is directly or indirectly held by the Contractor or any of its management personnel (as defined below) or directors, (ii) which directly or indirectly holds 50% or more of the ownership interest in the Contractor, (iii) in which an aggregate 20% or greater ownership interest is directly or indirectly held by one or more shareholders (or partners or proprietors, in the case of a partnership or proprietorship) which or who in the aggregate hold a 20% or greater ownership interest in the Contractor, or (iv) which, whether by Contract or otherwise, directly or indirectly controls, is controlled by or is under common control with the Contractor. An "ownership interest" means the ownership, whether legally or beneficially, of the stock of or assets employed by a corporation, of a partnership interest in or assets employed by a partnership or of a similar interest in or assets employed by any other entity. "Management personnel" means executive officers and all other

persons, whether or not officers or employees, who perform policy-making functions similar to those of executive officers.

The Contractor represents that at the time of execution of this Contract, no individual or entity, as described above, has been convicted of a crime during the five (5) year period preceding the execution of this Contract.

Pursuant to Chapter 308 of the Laws of Westchester County (Local Law 18-1997), it is the goal of the County to use its best efforts to encourage, promote and increase participation of business enterprises that are owned and controlled by persons of color or women in contracts and projects funded by the County, and to monitor such participation. The parties agree that the Contractor has completed the questionnaire contained in the bid specifications attached hereto as part of this Agreement.

The County believes it is a laudable goal to provide business opportunities to veterans who were disabled while serving our country, and wants to encourage the participation in County contracts of certified business enterprises owned and controlled by service-disabled veterans. As part of the County's program to encourage the participation of such business enterprises in County contracts, and in furtherance of Article 17-B of the New York State Executive Law, the parties agree that the Contractor has completed the questionnaire entitled Questionnaire Regarding Business Enterprises Owned and Controlled by Service-Disabled Veterans contained in the bid specifications attached hereto as part of this Agreement.

Westchester County Local Law Intro No. 144-2026, which added Chapter 309 to the Laws of Westchester ("Chapter 309"), is attached hereto and made a part hereof as Appendix "A". The Contractor shall comply with Chapter 309, as applicable. Any failure to strictly comply with the provisions of Chapter 309 shall constitute a material default hereunder.

It is recognized and understood by the parties that this Contract is subject to appropriation by the Westchester County Board of Legislators. The County shall have no liability under this Contract beyond the funds, if any, that are appropriated and available for payment of the amounts due under this Contract. Notwithstanding the foregoing, the County will do all things lawfully within its power to obtain, maintain and properly request and pursue funds from which payments under this Contract may be made.

The parties hereto for themselves, their legal representatives, successors and assigns, expressly agree that any legal action or proceeding that may arise out of or relating to this Contract shall be brought and maintained only in the courts of the State of New York ("New York State Court") located in the County of Westchester. With respect to any action between the County and Contractor in New York State Court, the Contractor hereby expressly waives and relinquishes any rights it may otherwise have (i) to move to dismiss on grounds of forum *non conveniens*; (ii) to remove to Federal Court; and (iii) to move for a change of venue to a New York State Court outside of Westchester County.

The Contractor for itself, its legal representatives, successors or assigns expressly agrees that no legal action or proceeding shall lie or be maintained against the County upon any claims based upon or arising out of this Contract unless such action or proceeding shall be commenced within six (6) months of final acceptance of the work by the Board of Acquisition and Contract, or within six (6) months after the termination of this Contract, whichever first occurs.

This Contract and its terms, covenants, obligations, conditions and provisions shall be binding upon all the parties hereto, their legal representatives, successors and assigns.

This Contract shall not be enforceable until it is signed by all parties and approved by the Office of the County Attorney.

[Intentionally Left Blank.
Signatures to Follow.]

SAMPLE

IN WITNESS WHEREOF, the parties hereto have executed this agreement, THE COUNTY OF WESTCHESTER pursuant to law by:

Hugh J. Greechan, Jr., P.E. its **Commissioner**

and the **CONTRACTOR:** _____

BY_____ its _____
(Type or Print Name) **(Type or Print Title)**

THE COUNTY OF WESTCHESTER:

BY:_____
Commissioner

CONTRACTOR:

(SEAL)

_____

BY:_____ **ATTEST**
(Signature) **BY:** _____
(Signature)

Recommended:

_____
Department of Public Works and Transportation

Approved:

_____
County Attorney

SAMPLE

CONTRACTOR'S ACKNOWLEDGMENT
(Corporation)

STATE OF NEW YORK)
ss:
COUNTY OF)

On this _____ day of _____, 20___, before me personally came _____ known to me to be _____ of _____, the corporation described in and which executed the within instrument, who being by me duly sworn did depose and say that the said _____ resides at _____ and that he/she is _____ of said corporation and that he/she signed his/her name thereto by order of the Board of Directors of said corporation and, if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the Secretary of State of the State of New York.

_____
NOTARY

CONTRACTOR'S ACKNOWLEDGMENT
(Individual)

STATE OF NEW YORK)
ss:
COUNTY OF)

On this _____ day of _____, 20___, before me personally came _____ known to me to be the same person described in and who executed the within instrument and duly acknowledged to me that he/she executed the same for the purpose herein mentioned and, if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the County Clerk of Westchester County.

_____
NOTARY

CONTRACTOR'S ACKNOWLEDGMENT
(Co-Partnership)

STATE OF NEW YORK)
ss:
COUNTY OF)

On this _____ day of _____, 20___, before me personally came _____ known to me to be a member of the firm of _____ and the person described in, and who executed the within instrument in behalf of said firm, and he acknowledged to me that he executed the same in behalf of, and as the act of said firm for the purposes herein mentioned and, if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed with the County Clerk of Westchester County.

_____
NOTARY

SAMPLE

LIMITED LIABILITY COMPANY ACKNOWLEDGEMENT

STATE OF NEW YORK)
)ss:
COUNTY OF)

On this_____day of _____,20___, before me personally came_____to me known to be the individual who executed the foregoing instrument, and who being duly sworn by me, did depose and say that he/she is (are) _____of_____
(Member/Manager) (Limited Liability Company)

a Limited Liability Company, and that he/she has authority to sign the same, and acknowledge that he/she executed the same as the act and deed of said Limited Liability Company.

_____
(*Signature*)

Sworn to before me this_____day of_____, 20___.

_____
Notary

SAMPLE

CERTIFICATE OF AUTHORITY
(CORPORATION)

I, _____
(Officer OTHER THAN officer signing contract)

certify that I am _____ of
(Title)

_____
(Name of Corporation)

a corporation duly organized and in good standing under the _____

_____
(Law under which organized, e.g., the New York Business Corporation Law) named in the foregoing agreement; that

_____
(Person executing Agreement)

who signed said Agreement on behalf of the _____
(Name of Corporation)

was at the time of execution _____ of the Corporation and
(Title of such person)

that said agreement was duly signed for and on behalf of said Corporation by authority of its Board of Directors, thereunto duly authorized and that such authority is in full force and effect at the date of hereof.

_____
(*Signature*)

STATE OF NEW YORK)
)ss:
COUNTY OF)

On the _____ day of _____, in the year 20___, before me, the undersigned, a Notary Public in and for said State, _____ personally appeared, personally known to me or proved to me on the basis of satisfactory evidence to be the officer described in and who executed the above certificate, who being by me duly sworn did depose and say that he/she resides at _____ and he/she is an officer of said corporation; that he/she is duly authorized to execute said certificate on behalf of said corporation, and that he/she signed his/her name thereto pursuant to such authority.

_____
Notary

Date: _____

SAMPLE

CERTIFICATE OF AUTHORITY
LIMITED LIABILITY COMPANY

I_____
(Member/Manager OTHER THAN person executing Agreement)

certify that I am a_____of the
Member/Manager
_____(the "LLC") duly
(Limited Liability Company)

organized under the Laws of the State of_____; that

_____who signed said agreement on behalf
(Person Executing Agreement)

of the LLC was, at the time of execution, a Member/Manager of the LLC; that said Agreement was duly signed for and on behalf of said LLC and as the act of said LLC for the purposes therein mentioned.

_____
(Signature)

STATE OF NEW YORK)
)ss:
COUNTY OF)

On the_____day of _____, 20___, before me the undersigned, a Notary Public in and for said State,_____personally appeared, personally known to me or proved to me on the basis of satisfactory evidence to be the Member/Manager described in and who executed the above certificate, who being by me duly sworn did depose and say that he/she resides at

_____
and he/she is a Member/Manager of LLC; that he/she is duly authorized to execute said certificate on behalf of said LLC, and that he/she signed his/her name thereto pursuant to such authority.

_____
Notary

Date:_____

CORPORATE SOLE OFFICER ACKNOWLEDGEMENT

SAMPLE

STATE OF NEW YORK)
)ss:
COUNTY OF)

On this _____day of _____, 20___, before me the undersigned, personally appeared_____ personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is (are) subscribed to the within instrument and acknowledged to me that he/she executed the same in his/her capacity as President and Sole Officer and Director of

_____ the corporation described in and which
(Name of Corporation)

executed the within instrument, and acknowledged that he/she owns all the issued and outstanding capital stock of said corporation, and that by he/she signed the within instrument on behalf of said corporation.

_____
Notary

SAMPLE

APPENDIX "A"

LOCAL LAW INTRO. NO. 144-2026

A Local Law adding a new Chapter 309 to the Laws of Westchester County to require that County contractors and subcontractors have in place apprenticeship agreements appropriate for the type and scope of work to be performed, that have been registered with the New York Stace Commissioner of Labor.

BE IT ENACTED by the County Board of the County of Westchester as follows:

Section 1. Chapter 309 of the Laws of Westchester County is hereby added to read as follows:

CHAPTER309

APPRENTICESHIP AGREEMENTS REQUIRED FOR COUNTY CONSTRUCTION CONTRACTS

§309.01	Legislative Intent
§309.11	Definitions
§309.21	Requirement of Apprenticeship Agreements for Construction Contracts.
§309.31	Additional Considerations Permissible
§309.41	Proof of Participation and Apprentice Completion Rates
§309.51	Certified Payrolls
§309.61	Applicability
§309.71	Sanctions and Remedies
§309.81	Copy of Law Provided
§309.91	Severability

§ 309.01. Legislative Intent.

The County Board of Legislators recognizes that the New York State Legislature has declared it the public policy of the State of New York to develop sound apprenticeship training standards and to encourage labor and industry to participate in apprenticeship programs. Section 816-b of the New York State Labor Law authorizes governmental entities like the County that are direct or indirect parties to a construction contract to require contractors and subcontractors to have apprenticeship agreements in place

SAMPLE

that are appropriate for the type and scope of work to be performed, and that have been registered with by the New York State Commissioner of Labor pursuant to Article 23 of the Labor Law.

The County Board finds that New York State registered apprenticeship programs provide valuable educational and training tools for County residents, and may facilitate the ability of County residents to obtain skilled jobs. The County Board finds that it would be valuable to encourage local businesses to participate in such state registered apprenticeship programs, in order to meet the need for skilled trade persons, while providing residents with the means to earn a better living. New York State-approved apprenticeship programs also encourage equal opportunity for apprentices and applicants for apprenticeship, consistent with state and federal regulations, in order to enhance workforce development and diversification, and to prevent exclusionary practices. *See* 12 N.Y.C.R.R. 600.4; *see also* 29 C.F.R. pt. 30.

§ 309.11. Definitions.

A. "Apprenticeship Agreement" means: (1) an individual written agreement between an employer and an apprentice; (2) a written agreement between an employer or an association of employers, and an organization of employees describing conditions of employment for apprentices; or (3) a written statement describing conditions of employment for apprentices in a plant or plants where there is no bona fide employee organization.

B. "Commissioner" means the Commissioner of the Department of Public Works and Transportation.

C. "Construction Contract" means any contract to which the County or and of its departments or agencies may be a direct or indirect party which involves the construction, reconstruction, improvement, rehabilitation, repair. furnishing. equipping of or otherwise providing for and building facility, or physical structure in excess of S250,000. A public entity need not be part:)' to the Construction Contract. A Construction Contract includes: projects that Westchester County funds directly; projects that Westchester County funds indirectly by providing funds to a separate entity· to perform the construction-type activity: privately financed construction projects specifically built with the intent of leasing the entire property to any agency or department of Westchester County government; and construction projects built under Westchester County's direction and later paid for with Westchester County· funds.

D. "Contractor" means any bidder for, or awardee of, a Construction Contract, as defined in this section, obtained through competitive bidding procedures.

E. "Date of Award of the Construction Contract" means the date that the Construction Contract has been approved by the Board of Acquisition and Contract.

F. "Subcontract" means any agreement between Contractors or any agreement between a Contractor and an}' person or entity under which any portion of the Contractor's obligation is performed, undertaken or assumed.

G. "Subcontractor" means an individual, sole proprietorship, partnership, joint venture or corporation which is engaged by a Contractor or another subcontractor pursuant to a Construction Contract.

SAMPLE

§ 309.21. Requirement of Apprenticeship Agreements for Construction Contracts.

A. A Contractor shall have in place at the time of submission of a bid for a Construction Contract an Apprenticeship Agreement appropriate for the type and scope of work to be performed. Such Apprenticeship Agreement shall be registered with the New York State Commissioner of Labor pursuant to the requirements found in Article 23 of the New York State Labor Law.

B. A Contractor shall provide each Subcontractor with notice of the requirements for Apprenticeship Agreements as appropriate, and a copy of this Local Law, at the time of the execution of each respective Subcontract.

C. A Subcontractor shall have in place within ninety (90) days of the Date of the Award of a Construction Contract an Apprenticeship Agreement appropriate for the type and scope of work to be performed. Such Apprenticeship Agreement shall be registered with the New York State Commissioner of Labor pursuant to the requirements found in Article 23 of the New York State Labor Law.

D. This provision shall not apply to Contractors or Subcontractors engaged in occupations which are not registered as apprenticeable by the New York State Commissioner of Labor.

E. This provision shall not apply to emergency procurements entered into pursuant to section 103 of the New York State General Municipal Law and section 167.171 of the Laws of Westchester County.

F. The Commissioner is authorized to enact rules and regulations as may be deemed necessary for the implementation of this Chapter. This authority shall not include providing any further exemptions to the requirements of this Chapter, which are not already stated herein.

§ 309.31. Additional Considerations Permissible.

The County, in addition to whatever considerations are required by law, may consider the degree to which career opportunities in apprenticeship training programs approved by the New York State Commissioner of Labor may be provided.

§ 309.41. Proof of Participation and Apprentice Completion Rates.

A. Any prospective Contractor shall submit with their Construction Contract bid:
   1. proof of an Apprenticeship Agreement;
   2. most recently available certificates of completion. which show that each of the Contractor's applicable registered apprenticeship programs has an apprentice completion rate of at least thirty percent (30%) as determined by the New York State Department of Labor; and
   3. a certification that it shall fulfill its obligations under Section 309.21(a) of this Chapter.

B. Within ninety (90) days of the Date of the Award of the Construction Contract, the Contractor shall submit to the Commissioner, for all Subcontractors under the Construction Contract:
   1. proof of each Subcontractor's Apprenticeship Agreement(s); and
   2. certificates of completion, which show that each of the Subcontractor's applicable

registered apprenticeship programs has an apprentice completion rate of at least thirty percent (30%) as determined by the New York State Department of Labor.

C. Completion Rate Exemptions.

1. A registered apprenticeship program, under which any Apprenticeship Agreement is executed, shall be exempt from the completion rate requirements of § 309.41(A)(2) and§ 309.41(B)(2) where that apprenticeship program:
   i. is still in its probation period with the State Department of Labor, consistent with 12 N.Y.C.R.R. ch. IX, pt. 601: or
   ii. is within one year of the projected completion date of its first apprentice(s) eligible to be included in the completion rate calculation.
2. For the exemption to appl}', the Contractor shall submit to the Commissioner. On behalf of the Contractor and/or any Subcontractors, a copy of the relevant fully executed program registration agreement or proof of the State Department of Labor's provisional approval of the apprenticeship program.

§ 309.51. Certified Payroll.

The Contractor shall provide the Commissioner with a certified monthly payroll, which shall include the following information for each person employed to work on the Construction Contract by the Contractor and/or any Subcontractor: worker's name, address, last four digits of Social Security Number, classification(s) in which the worker was employed, hourly wage rate(s) paid, supplements paid or provided, and daily and weekly number of hours worked in each classification.

§ 309.61. Applicability.

A. This Chapter shall apply to Construction Contracts and Subcontracts entered on or after the effective date of the law, but shall not apply to extensions or renewals that were authorized pursuant to a provision contained in a Construction Contract or Subcontract that was executed prior to the effective date of the law. Nothing herein shall impair existing Construction Contracts or Subcontracts.

B. The requirements of Sections 309.21 and 309.41 of this Chapter, although recommended, shall not apply to a Contractor or Subcontractor upon receipt of a verified written statement that the total number of persons employed by such Contractor or Subcontractor is 14 or fewer.

§ 309.71. Sanctions and Remedies.

A. The failure of a prospective Contractor to provide the following may result in the determination that the bid is non-responsive:
   1. proof of an Apprenticeship Agreement for such Contractor as required by Section 309.21(A) or a verified written statement that the total number of persons employed by such Contractor is 14 or fewer; and/or
   2. a certification that a copy of this Local Law and notice of the requirements therein shall be provided to each Subcontractor. as required by Section 309.41(A)(3).

B. The County may withdraw or suspend its approval of one or more Subcontractors on any Construction Contract, or any portion thereof, in the event that it is established that a Subcontractor failed to comply with the requirements of this Chapter.

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§ 309.81. Copy of Law Provided.

A. The Commissioner shall cause a copy of this Local Law to be provided with the bid specifications for each bid for a Construction Contract.

B. This Local Law shall be included as an Appendix to each Construction Contract.

§ 309.91. Severability.

If any clause. sentence. paragraph. section. or part of this local law shall be adjudged by any court of competent jurisdiction to be invalid. such judgment shall not affect. impair. or invalidate the remainder thereof. but shall be confined in its operation to the clause, sentence, paragraph, section, or part thereof directly involved in the controversy in which such judgment shall have been rendered.

Section 2.

The Clerk of the Board shall cause a notice of this Local Law to be published at least once a week for two successive weeks, the first publication of which shall be had within ten days after such local law is adopted, in the official newspapers published in the County of Westchester. said notice to contain the number, date of adoption and a true cop}' of the Local Law, and a statement chat this Local Law changes a provision of law relating to public bidding and/or contracts, and is therefore subject to the provisions of Sections 209.171(2) and 209.181 of the Laws of Westchester County, providing for a permissive referendum.

Section 3.

This Local Law shall take effect ninety (90) days after its adoption, subject to the provisions of Section 209.181 of the Laws of Westchester County.

SAMPLE

PERFORMANCE AND PAYMENT BOND
Bond No._____

KNOW ALL BY THESE PRESENT,

that we, _____,
(Insert legal name and address of Contractor)

as Principal (hereinafter, together with its successors, assigns, subcontractors, administrators, executors or any other designees or transferees, collectively the "Principal"), and

_____,
(Insert legal name and address of Surety)

as Surety (hereinafter, together with its successors, assigns, subcontractors, administrators, executors or any other designees or transferees, collectively the "Surety"), are held and firmly bound along with our heirs, executors, administrators, successors and assigns, jointly and severally, unto **THE COUNTY OF WESTCHESTER, 148 Martine Avenue, White Plains, New York 10601**, as Obligee, (hereinafter "Obligee") for payment of the penal sum of _____ **DOLLARS ($ _____)**.

(hereinafter the "Penal Sum"), in lawful money of the United States, as more particularly set forth herein.

Said Penal Sum shall apply separately and independently, in its total amount, to the payment provision and the performance provision of this bond and shall not reduce or limit the right of the Obligee or any other claimant to recover under the other said provision.

THE CONDITION OF THIS OBLIGATION IS SUCH THAT:

WHEREAS, the Obligee, by resolution of its Board of Acquisition and Contract, has authorized the award of an agreement to the Principal for the work (the "Work") commonly described as:

Contract # _____,

WHEREAS, the Principal has entered into an agreement with the Obligee for performance of the Work in strict accordance with the agreement, its attachments and specifications contained therein; (the agreement with all attachments is hereinafter collectively referred to as the "Contract" and are incorporated herein and made a part hereof by reference); and

WHEREAS, by the terms of the Contract, the Principal is required to furnish a bond ensuring the Principal's prompt, full and faithful performance of the Contract.

NOW THEREFORE, if the Principal shall

(1) promptly, fully and faithfully perform the Work and each and all of the terms and obligations to be carried out and performed by the Principal in strict accordance with the terms, conditions and covenants of the Contract as it may be modified or amended from time to time; and if the Principal shall indemnify and save harmless the Obligee and all of its officers, agents and employees from any and all losses, liability and damages, claims, judgments, liens, costs, and fees of every description, which may be incurred by the Obligee by reason of a default or failure on the part of the Principal in the strict performance of any or all of the terms or obligations of the Contract, including all modifications, and amendments, thereto, and any warranties or guarantees required thereunder; and

(2) also promptly make payment of all wages, labor, services, supplies and material rendered or reasonably required for use in the performance of the Contract, of all persons and firms engaged in the Work provided for in the Contract, whether such persons are agents, servants or employees of the Principal, or any subcontractor or of any assignee or designee thereof, regardless of any contractual relationship between the Principal, or any subcontractor or any designee thereof, and further, shall pay or cause to be paid all lawful claims of subcontractors, materialmen and other third persons in connection with the work, labor, services, supplies and material furnished in and about the performance of the Contract, then this obligation shall be void; otherwise, it shall be, and remain, in full force and effect.

PROVIDED, however, that this bond is subject to the following additional terms and conditions:

The Surety, for value received, hereby stipulates and agrees that no change, adjustment of the time for performance of the Contract, any extension of time, adjustment of the Contract's not-to-exceed amount, any payment whether or not before the time required, any waiver of any provision, or by an assignment, subletting or other transfer of any of the Work, or of payment or non-payment of any moneys due or to become due under the Contract, any alterations, deletions, additions, or any other modifications to the terms of the Contract, the Work to be performed, or to the Contract specifications shall limit, restrict or otherwise impair Surety's obligations or Obligee's rights hereunder; The Surety hereby waives notice of any and all of such changes, modifications to the Contract, including but not limited to extensions of time for performance, adjustments of the Contract not-to-exceed amount, modifications, changes in the Work to be performed, alterations, deletions, omissions, additions, changes, payments, waivers, any changes in time, assignments, subcontracts and transfers; And the Surety hereby stipulates and agrees that any and all actions performed or omitted by and in relation to executors, administrators, successors, assigns, Subcontractors, and other designees, shall have the same effect as to said Surety as though done or omitted to be done by and in relation to said Principal.

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In the event of a failure of strict performance of the Contract by the Principal, which shall include, but not be limited to, any breach or default of the Contract by the Principal, and within fifteen (15) days after written notice from the Obligee to the Surety of the Principal's breach or default of the Contract, the Surety shall provide Obligee with written notice of its assumption of all obligations hereunder and request Obligee's approval of its proposed election ("Notice of Assumption and Election") to either: a) remedy or cause to be remedied the default or breach of the Principal Contract and cause the Principal to immediately commence and timely complete the Contract; or b) to take charge of the Work of the Contract and immediately commence and timely complete the Work at its own expense itself, through its agents or independent qualified contractors proposed by the Surety and acceptable to Obligee; provided, however, that the Surety hereby stipulates and agrees that both its proposed remedy procedure ("a" and "b" above) and proposed independent contractor, if any, in Surety's Notice of Assumption and Election shall be subject to the prior written approval of the Obligee, which approval shall be granted or withheld in the Obligee's sole discretion, and subject to Obligee's receipt of any and all necessary legal approvals. Surety shall, within five (5) days after written approval from the Obligee of Surety's Notice of Assumption and Election, commence or cause to be commenced the completion of the Work in strict accordance with its Notice of Assumption and Election and the terms, conditions and covenants of the Contract as they may be modified or amended from time to time, time being of the essence for the performance of the Work and this bond. The Surety shall not assert solvency/insolvency of the Principal or the Principal's denial of default as justification for its failure to give the Notice of Assumption and Election, or for its failure to promptly remedy the failure of performance or default of the Principal, or to complete the Work.

In the event the Surety shall fail to issue the Notice of Assumption and Election to Obligee and/or Surety fails to commence completion of the Work within the time periods provided above, the Obligee may thereafter cause the cure or remedy of the Principal's failure of performance or default, or complete the Work. The Principal and the Surety shall be each jointly and severally liable to the Obligee for all damages and costs sustained by the Obligee as a result of the Principal's failure of performance under the Contract or default in its performance of obligations thereunder, including without limitation the costs of cure or completion exceeding the then remaining balance of the Contract Price, and any other remedy available to Obligee; provided that the Surety's liability hereunder for the costs of performance, damages and other costs sustained by the Obligee upon the Principal's failure of performance under or default under the Contract shall be limited to the Penal Sum hereof, which shall be deemed to include the costs or value of any modifications to the Work which increases the Contract Price, plus the amount of costs, expenses and fees, including reasonable attorneys' fees in connection with any suit or other proceeding brought upon this bond by the Obligee, as more particularly set forth herein.

All persons who have performed labor or rendered services, as aforesaid, all subcontractors, and all persons, firms, corporations, including materialmen and third persons, as aforesaid, furnishing work, labor, services, supplies and material under or in connection with said Contract or in or about the performance and completion thereof, shall have a direct right of action (subject to the prior right of the Obligee under any claim which it may assert against the Principal and/or the Surety) against the Principal on this bond, upon first furnishing the Obligee with a Bond of Indemnity for costs in an amount satisfactory to the Obligee, which right of action shall be asserted in proceedings instituted in the State in which such work, labor, services, supplies or material was performed, rendered or furnished or where work, labor, services, supplies or material

has been performed, rendered or furnished, as aforesaid, in more than one State, than in any such State, no later than one (1) year after the complete performance of said Contract and final settlement thereof.

The Surety shall not be liable hereunder for any damages or compensation recoverable under any worker's compensation or employer's liability statute.

In no event shall the Surety be liable under the foregoing clauses for a greater sum than the Penal Sum of this bond, plus the amount of costs, expenses and fees, including reasonable attorneys' fees in connection with any suit or other proceeding brought upon this bond by the Obligee, as more particularly set forth herein, provided; however, that said Penal Sum is separately and independently applicable, in its total amount to the payment provision and the performance provision of this bond, and shall not reduce or limit the right of the Obligee to recover under the other said provision, or reduce or limit any suit, action or proceeding hereon that is instituted by any person, firm or corporation under the provisions of the payment provision of this bond. The Principal and the Surety do hereby expressly waive any objections that might be interposed as to the right of the Obligee to require a bond containing the foregoing provisions, and they do hereby further expressly waive any defense which they or either of them might interpose to an action brought hereon by any person, firm or corporation, including Subcontractors, materialmen, and third persons, for work, labor, services, supplies or material performed, rendered or furnished as aforesaid, upon the ground that there is no law authorizing the said Obligee to require the foregoing provision to be placed in this Bond.

Notices to the Surety, Principal and Obligee shall be mailed via certified mail, return receipt requested, or delivered to the addresses shown in the preamble. Notice shall be effective on the date of receipt.

The Penal Sum of this bond is in addition to any other bond furnished by the Principal to the Obligee and in no way shall be impaired or affected by any other bond.

In the event that any suit or other proceeding is brought upon this bond by the Obligee, the Surety shall pay to the Obligee all costs, expenses and fees incurred by the Obligee in connection therewith, including without limitation, attorneys' fees.

[NO FURTHER TEXT ON THIS PAGE. SIGNATURE PAGE FOLLOWS.]

SAMPLE

IN WITNESS WHEREOF, the Principal and Surety have executed this Performance and Payment Bond this _____ day of _____, 20__, by their duly authorized agents or representatives.

PRINCIPAL:
(Corporate Seal)

_____
Principal Name and Title

_____
Principal Signature

SURETY:

(Corporate Seal)

_____
Surety Name

_____
Surety Signature

(Attach Attorney-in-Fact Certificate)

If the Contractor (Principal) is a partnership, the Bond should be signed by each of the individuals who are partners.

If the Contractor (Principal) is a Corporation, the Bond should be signed in its correct corporate name by a duly authorized officer, agent, or attorney-in-fact.

There should be executed an appropriate number of counterparts of the Bond corresponding to the number of counterparts of the Contract.

Each executed Bond should be accompanied by:

(a) appropriate acknowledgments of the respective parties;

(b) appropriate duly certified copy of Power of Attorney or other Certificate of Authority where the Bond is executed by agent, officer or other representative of Principal or Surety;

(c) a duly certified extract from By-laws or resolutions of Surety under which Power of Attorney or other Certificate of Authority of its agent, officer or representative was issued, and

(d) duly certified copy of latest published financial statement of assets and liabilities of Surety.

SAMPLE

SCHEDULE OF HOURLY RATES

AND SUPPLEMENTS

DEPARTMENT OF PUBLIC WORKS

Division of Engineering

Kathy Hochul, Governor

Roberta Reardon, Commissioner

Westchester County DPWT

Yolanda Spraggins, Administrative Assistant
Michaelian Office Building
148 Martine Avenue, Room 518
White Plains NY 10601

Schedule Year	2026 through 2027
Date Requested	08/05/2026
PRC#	2026023440

Location	Westchester County Airport
Project ID#	25-532
Project Type	Rehabilitation of Building 1 to a safe, usable condition through critical system upgrades including roof and exterior repairs, new heating/plumbing/electrical/lighting systems, installation of modern

PREVAILING WAGE SCHEDULE FOR ARTICLE 8 PUBLIC WORK PROJECT

Attached is the current schedule(s) of the prevailing wage rates and prevailing hourly supplements for the project referenced above. A unique Prevailing Rate Case Number (PRC#) has been assigned to the schedule(s) for your project.

The schedule is effective from July 2026 through June 2027. All updates, corrections, posted on the 1st business day of each month, and future copies of the annual determination are available on the Department's website www.labor.ny.gov. Updated PDF copies of your schedule can be accessed by entering your assigned PRC# at the proper location on the website.

It is the responsibility of the contracting agency or its agent to annex and make part, the attached schedule, to the specifications for this project, when it is advertised for bids and /or to forward said schedules to the successful bidder(s), immediately upon receipt, in order to insure the proper payment of wages.

Please refer to the "General Provisions of Laws Covering Workers on Public Work Contracts" provided with this schedule, for the specific details relating to other responsibilities of the Department of Jurisdiction.

Upon completion or cancellation of this project, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

NOTICE OF COMPLETION / CANCELLATION OF PROJECT

Date Completed: _____ Date Cancelled: _____

Name & Title of Representative: _____

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12240

General Provisions of Laws Covering Workers on Article 8 Public Work Contracts

Introduction

The Labor Law requires public work contractors and subcontractors to pay laborers, workers, or mechanics employed in the performance of a public work contract not less than the prevailing rate of wage and supplements (fringe benefits) in the locality where the work is performed.

Contractor Registry

Effective December 30, 2024 all contractors and subcontractors submitting bids or performing construction work on public work projects, or private projects covered by Article 8 of the Labor Law, are required to register with the New York State Department of Labor (NYSDOL) under Labor Law Section 220-i. To register, contractors and subcontractors must submit an application through NYSDOL's Contractor Registry portal which is available through the agency's Management System for Protecting Worker Rights (MPWR) https://mpwr-public.labor.ny.gov/en/login.

For additional information, please visit online.

Responsibilities of the Department of Jurisdiction

A Department of Jurisdiction (Contracting Agency) includes a state department, agency, board or commission: a county, city, town or village; a school district, board of education or board of cooperative educational services; a sewer, water, fire, improvement and other district corporation; a public benefit corporation; and a public authority awarding a public work contract.

The Department of Jurisdiction (Contracting Agency) awarding a public work contract MUST obtain a Prevailing Rate Schedule listing the hourly rates of wages and supplements due the workers to be employed on a public work project. This schedule may be obtained by completing and forwarding a "Request for wage and Supplement Information" form (PW 39) to the Bureau of Public Work. The Prevailing Rate Schedule MUST be included in the specifications for the contract to be awarded and is deemed part of the public work contract.

Upon the awarding of the contract, the law requires that the Department of Jurisdiction (Contracting Agency) furnish the following information to the Bureau: the name and address of the contractor, the date the contract was let and the approximate dollar value of the contract. To facilitate compliance with this provision of the Labor Law, a copy of the Department's "Notice of Contract Award" form (PW 16) is provided with the original Prevailing Rate Schedule.

The Department of Jurisdiction (Contracting Agency) is required to notify the Bureau of the completion or cancellation of any public work project. The Department's PW 200 form is provided for that purpose.

Both the PW 16 and PW 200 forms are available for completion online.

Hours

No laborer, worker, or mechanic in the employ of a contractor or subcontractor engaged in the performance of any public work project shall be permitted to work more than eight hours in any day or more than five days in any week, except in cases of extraordinary emergency. The contractor and the Department of Jurisdiction (Contracting Agency) may apply to the Bureau of Public Work for a dispensation permitting workers to work additional hours or days per week on a particular public work project.

Wages and Supplements

The wages and supplements to be paid and/or provided to laborers, workers, and mechanics employed on a public work project shall be not less than those listed in the current Prevailing Rate Schedule for the locality where the work is performed. If a prime contractor on a public work project has not been provided with a Prevailing Rate Schedule, the contractor must notify the Department of Jurisdiction (Contracting Agency) who in turn must request an original Prevailing Rate Schedule form the Bureau of Public Work. Requests may be submitted by: mail to NYSDOL, Bureau of Public Work, State Office Bldg. Campus, Bldg. 12, Rm. 130, Albany, NY 12226; Fax to Bureau of Public Work (518) 485-1870; or electronically at the NYSDOL website www.labor.ny.gov.

Upon receiving the original schedule, the Department of Jurisdiction (Contracting Agency) is REQUIRED to provide complete copies to all prime contractors who in turn MUST, by law, provide copies of all applicable county schedules to each subcontractor and obtain from each subcontractor, an affidavit certifying such schedules were received. If the original schedule expired, the contractor may obtain a copy of the new annual determination from the NYSDOL website www.labor.ny.gov.

The Commissioner of Labor makes an annual determination of the prevailing rates. This determination is in effect from July 1st through June 30th of the following year. The annual determination is available on the NYSDOL website

www.labor.ny.gov.

Payrolls and Payroll Records

Every contractor and subcontractor MUST keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. As per Article 6 of the Labor law, contractors and subcontractors are required to establish, maintain, and preserve for not less than six (6) years, contemperaneous, true, and accurate payroll records. At a minimum, payrolls must show the following information for each person employed on a public work project: Name, Address, Last 4 Digits of Social Security Number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

The filing of payrolls to the Department of Jurisdiction is a condition of payment.Every contractor and subcontractor shall submit to the Department of Jurisdiction (Contracting Agency), within thirty (30) days after issuance of its first payroll and every thirty (30) days thereafter, a transcript of the original payrolls, subscribed and affirmed as true under penalty of perjury. The Department of Jurisdiction (Contracting Agency) shall collect, review for facial validity, and maintain such payrolls.

In addition, the Commissioner of Labor may require contractors to furnish, with ten (10) days of a request, payroll records sworn to as their validity and accuracy for public work and private work. Payroll records include, but are not limited to time cards, work description sheets, proof that supplements were provided, cancelled payroll checks and payrolls. Failure to provide the requested information within the allotted ten (10) days will result in the withholding of up to 25% of the contract, not to exceed $100,000.00. If the contractor or subcontractor does not maintain a place of business in New York State and the amount of the contract exceeds $25,000.00, payroll records and certifications must be kept on the project worksite.

The prime contractor is responsible for any underpayments of prevailing wages or supplements by any subcontractor.

All contractors or their subcontractors shall provide to their subcontractors a copy of the Prevailing Rate Schedule specified in the public work contract as well as any subsequently issued schedules. A failure to provide these schedules by a contractor or subcontractor is a violation of Article 8, Section 220-a of the Labor Law.

All subcontractors engaged by a public work project contractor or its subcontractor, upon receipt of the original schedule and any subsequently issued schedules, shall provide to such contractor a verified statement attesting that the subcontractor has received the Prevailing Rate Schedule and will pay or provide the applicable rates of wages and supplements specified therein. (See NYS Labor Laws, Article 8 . Section 220-a).

Determination of Prevailing Wage and Supplement Rate Updates Applicable to All Counties

The wages and supplements contained in the annual determination become effective July 1st whether or not the new determination has been received by a given contractor. Care should be taken to review the rates for obvious errors. Any corrections should be brought to the Department's attention immediately. It is the responsibility of the public work contractor to use the proper rates. If there is a question on the proper classification to be used, please call the district office located nearest the project. Any errors in the annual determination will be corrected and posted to the NYSDOL website on the first business day of each month. Contractors are responsible for paying these updated rates as well, retroactive to July 1st.

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. To the extent possible, the Department posts rates in its possession that cover periods of time beyond the July 1st to June 30th time frame covered by a particular annual determination. Rates that extend beyond that instant time period are informational ONLY and may be updated in future annual determinations that actually cover the then appropriate July 1st to June 30th time period.

Withholding of Payments

When a complaint is filed with the Commissioner of Labor alleging the failure of a contractor or subcontractor to pay or provide the prevailing wages or supplements, or when the Commissioner of Labor believes that unpaid wages or supplements may be due, payments on the public work contract shall be withheld from the prime contractor in a sufficient amount to satisfy the alleged unpaid wages and supplements, including interest and civil penalty, pending a final determination.

When the Bureau of Public Work finds that a contractor or subcontractor on a public work project failed to pay or provide the requisite prevailing wages or supplements, the Bureau is authorized by Sections 220-b and 235.2 of the Labor Law to so notify the financial officer of the Department of Jurisdiction (Contracting Agency) that awarded the public work contract. Such officer MUST then withhold or cause to be withheld from any payment due the prime contractor on account of such contract the amount indicated by the Bureau as sufficient to satisfy the unpaid wages and supplements, including interest and any civil penalty that may be assessed by the Commissioner of Labor. The withholding continues until there is a final determination of the underpayment by the Commissioner of Labor or by the court in the event a legal proceeding is instituted for review of the determination of the Commissioner of Labor.

The Department of Jurisdiction (Contracting Agency) shall comply with this order of the Commissioner of Labor or of the court with respect to the release of the funds so withheld.

Summary of Notice Posting Requirements

The current Prevailing Rate Schedule must be posted in a prominent and accessible place on the site of the public work project. The prevailing wage schedule must be encased in, or constructed of, materials capable of withstanding adverse weather conditions and be titled "PREVAILING RATE OF WAGES" in letters no smaller than two (2) inches by two (2) inches.

The "Public Work Project" notice must be posted at the beginning of the performance of every public work contract, on each job site.

Every employer providing workers. compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers. Compensation Board in a conspicuous place on the jobsite.

Every employer subject to the NYS Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers, notices furnished by the State Division of Human Rights.

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the NYS Department of Labor.

Apprentices

Employees cannot be paid apprentice rates unless they are individually registered in a program registered with the NYS Commissioner of Labor. The allowable ratio of apprentices to journeyworkers in any craft classification can be no greater than the statewide building trade ratios promulgated by the Department of Labor and included with the Prevailing Rate Schedule. An employee listed on a payroll as an apprentice who is not registered as above or is performing work outside the classification of work for which the apprentice is indentured, must be paid the prevailing journeyworker's wage rate for the classification of work the employee is actually performing.

NYSDOL Labor Law, Article 8, Section 220-3, require that only apprentices individually registered with the NYS Department of Labor may be paid apprenticeship rates on a public work project. No other Federal or State Agency of office registers apprentices in New York State.

Persons wishing to verify the apprentice registration of any person must do so in writing by mail, to the NYSDOL Office of Employability Development / Apprenticeship Training, State Office Bldg. Campus, Bldg. 12, Albany, NY 12226 or by Fax to NYSDOL Apprenticeship Training (518) 457-7154. All requests for verification must include the name and social security number of the person for whom the information is requested.

The only conclusive proof of individual apprentice registration is written verification from the NYSDOL Apprenticeship Training Albany Central office. Neither Federal nor State Apprenticeship Training offices outside of Albany can provide conclusive registration information.

It should be noted that the existence of a registered apprenticeship program is not conclusive proof that any person is registered in that program. Furthermore, the existence or possession of wallet cards, identification cards, or copies of state forms is not conclusive proof of the registration of any person as an apprentice.

Interest and Penalties

In the event that an underpayment of wages and/or supplements is found:

- Interest shall be assessed at the rate then in effect as prescribed by the Superintendent of Banks pursuant to section 14-a of the Banking Law, per annum from the date of underpayment to the date restitution is made.
- A Civil Penalty may also be assessed, not to exceed 25% of the total of wages, supplements, and interest due.

Debarment

Any contractor or subcontractor and/or its successor shall be ineligible to submit a bid on or be awarded any public work contract or subcontract with any state, municipal corporation or public body for a period of five (5) years when:

- Two (2) willful determinations have been rendered against that contractor or subcontractor and/or its successor within any consecutive six (6) year period.
- There is any willful determination that involves the falsification of payroll records or the kickback of wages or supplements.

Criminal Sanctions

Willful violations of the Prevailing Wage Law (Article 8 of the Labor Law) may be a felony punishable by fine or imprisonment of up to 15 years, or both.

Discrimination

No employee or applicant for employment may be discriminated against on account of age, race, creed, color, national origin, sex, disability or marital status.

No contractor, subcontractor nor any person acting on its behalf, shall by reason of race, creed, color, disability, sex or national origin discriminate against any citizen of the State of New York who is qualified and available to perform the work to which the employment relates (NYS Labor Law, Article 8, Section 220-e(a)).

No contractor, subcontractor, nor any person acting on its behalf, shall in any manner, discriminate against or intimidate any employee on account of race, creed, color, disability, sex, or national origin (NYS Labor Law, Article 8, Section 220-e(b)).

The Human Rights Law also prohibits discrimination in employment because of age, marital status, or religion.

There may be deducted from the amount payable to the contractor under the contract a penalty of $50.00 for each calendar day during which such person was discriminated against or intimidated in violation of the provision of the contract (NYS Labor Law, Article 8, Section 220-e(c)).

The contract may be cancelled or terminated by the State or municipality. All monies due or to become due thereunder may be forfeited for a second or any subsequent violation of the terms or conditions of the anti-discrimination sections of the contract (NYS Labor Law, Article 8, Section 220-e(d)).

Every employer subject to the New York State Human Rights Law must conspicuously post at its offices, places of employment, or employment training centers notices furnished by the State Division of Human Rights.

Workers' Compensation

In accordance with Section 142 of the State Finance Law, the contractor shall maintain coverage during the life of the contract for the benefit of such employees as required by the provisions of the New York State Workers' Compensation Law.

A contractor who is awarded a public work contract must provide proof of workers' compensation coverage prior to being allowed to begin work.

The insurance policy must be issued by a company authorized to provide workers' compensation coverage in New York State. Proof of coverage must be on form C-105.2 (Certificate of Workers' Compensation Insurance) and must name this agency as a certificate holder.

If New York State coverage is added to an existing out-of-state policy, it can only be added to a policy from a company authorized to write workers' compensation coverage in this state. The coverage must be listed under item 3A of the information page.

The contractor must maintain proof that subcontractors doing work covered under this contract secured and maintained a workers' compensation policy for all employees working in New York State.

Every employer providing worker's compensation insurance and disability benefits must post notices of such coverage in the format prescribed by the Workers' Compensation Board in a conspicuous place on the jobsite.

Unemployment Insurance

Employers liable for contributions under the Unemployment Insurance Law must conspicuously post on the jobsite notices furnished by the New York State Department of Labor.

Kathy Hochul, Governor

Roberta Reardon, Commissioner

Westchester County DPWT

Yolanda Spraggins, Administrative Assistant
Michaelian Office Building
148 Martine Avenue, Room 518
White Plains NY 10601

Schedule Year 2026 through 2027
Date Requested 08/05/2026
PRC# 2026023440

Location Westchester County Airport
Project ID# 25-532
Project Type Rehabilitation of Building 1 to a safe, usable condition through critical system upgrades including roof and exterior repairs, new heating/plumbing/electrical/lighting systems, installation of modern

Notice of Contract Award

New York State Labor Law, Article 8, Section 220.3a requires that certain information regarding the awarding of public work contracts, be furnished to the Commissioner of Labor. One "Notice of Contract Award" (PW 16, which may be photocopied), **MUST** be completed for **EACH** prime contractor on the above referenced project.

Upon notifying the successful bidder(s) of this contract, enter the required information and mail **OR** fax this form to the office shown at the bottom of this notice, **OR** fill out the electronic version via the NYSDOL website.

Contractor Information
All information must be supplied

Federal Employer Identification Number: _____

Name: _____

Address: _____

_____

City: _____ State: _____ Zip: _____

Amount of Contract: $_____

Approximate Starting Date: ____/____/____

Approximate Completion Date: ____/____/____

Contract Type:
[ ] (01) General Construction
[ ] (02) Heating/Ventilation
[ ] (03) Electrical
[ ] (04) Plumbing
[ ] (05) Other : _____

Phone: (518) 457-5589 Fax: (518) 485-1870
W. Averell Harriman State Office Campus, Bldg. 12, Room 130, Albany, NY 12226

Social Security Numbers on Certified Payrolls:

The Department of Labor is cognizant of the concerns of the potential for misuse or inadvertent disclosure of social security numbers. Identity theft is a growing problem and we are sympathetic to contractors' concern regarding inclusion of this information on payrolls if another identifier will suffice.

For these reasons, the substitution of the use of the last four digits of the social security number on certified payrolls submitted to contracting agencies on public work projects is now acceptable to the Department of Labor. This change does not affect the Department's ability to request and receive the entire social security number from employers during its public work/ prevailing wage investigations.

Construction Industry Fair Play Act: Required Posting for Labor Law Article 25-B § 861-d

Construction industry employers must post the "Construction Industry Fair Play Act" notice in a prominent and accessible place on the job site. Failure to post the notice can result in penalties of up to $1,500 for a first offense and up to $5,000 for a second offense. The posting is included as part of this wage schedule. Additional copies may be obtained from the NYS DOL website, https://dol.ny.gov/public-work-and-prevailing-wage
If you have any questions concerning the Fair Play Act, please call the State Labor Department toll-free at 1-866-435-1499 or email us at: dol.misclassified@labor.ny.gov .

Worker Notification: (Labor Law §220, paragraph a of subdivision 3-a)

Effective June 23, 2020

This provision is an addition to the existing wage rate law, Labor Law §220, paragraph a of subdivision 3-a. It requires contractors and subcontractors to provide written notice to all laborers, workers or mechanics of the *prevailing wage and supplement rate* for their particular job classification *on each pay stub**. It also requires contractors and subcontractors to *post a notice* at the beginning of the performance of every public work contract *on each job site* that includes the telephone number and address for the Department of Labor and a statement informing laborers, workers or mechanics of their right to contact the Department of Labor if he/she is not receiving the proper prevailing rate of wages and/or supplements for his/her job classification. The required notification will be provided with each wage schedule, may be downloaded from our website *www.labor.ny.gov* or be made available upon request by contacting the Bureau of Public Work at 518-457-5589. *In the event the required information will not fit on the pay stub, an accompanying sheet or attachment of the information will suffice.

(12.20)

To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND

Budget Policy & Reporting Manual

B-610

Public Work Enforcement Fund

effective date December 7, 2005

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1. Purpose and Scope:

This Item describes the Public Work Enforcement Fund (the Fund, PWEF) and its relevance to State agencies and public benefit corporations engaged in construction or reconstruction contracts, maintenance and repair, and announces the recently-enacted increase to the percentage of the dollar value of such contracts that must be deposited into the Fund. This item also describes the roles of the following entities with respect to the Fund:

- New York State Department of Labor (DOL),
- The Office of the State of Comptroller (OSC), and
- State agencies and public benefit corporations.

2. Background and Statutory References:

DOL uses the Fund to enforce the State's Labor Law as it relates to contracts for construction or reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law. State agencies and public benefit corporations participating in such contracts are required to make payments to the Fund.

Chapter 511 of the Laws of 1995 (as amended by Chapter 513 of the Laws of 1997, Chapter 655 of the Laws of 1999, Chapter 376 of the Laws of 2003 and Chapter 407 of the Laws of 2005) established the Fund.

3. Procedures and Agency Responsibilities:

The Fund is supported by transfers and deposits based on the value of contracts for construction and reconstruction, maintenance and repair, as defined in subdivision two of Section 220 of the Labor Law, into which all State agencies and public benefit corporations enter.

Chapter 407 of the Laws of 2005 increased the amount required to be provided to this fund to .10 of one-percent of the total cost of each such contract, to be calculated at the time agencies or public benefit corporations enter into a new contract or if a contract is amended. The provisions of this bill became effective August 2, 2005.

To all State Departments, Agency Heads and Public Benefit Corporations
IMPORTANT NOTICE REGARDING PUBLIC WORK ENFORCEMENT FUND

OSC will report to DOL on all construction-related ("D") contracts approved during the month, including contract amendments, and then DOL will bill agencies the appropriate assessment monthly. An agency may then make a determination if any of the billed contracts are exempt and so note on the bill submitted back to DOL. For any instance where an agency is unsure if a contract is or is not exempt, they can call the Bureau of Public Work at the number noted below for a determination. Payment by check or journal voucher is due to DOL within thirty days from the date of the billing. DOL will verify the amounts and forward them to OSC for processing.

For those contracts which are not approved or administered by the Comptroller, monthly reports and payments for deposit into the Public Work Enforcement Fund must be provided to the Administrative Finance Bureau at the DOL within 30 days of the end of each month or on a payment schedule mutually agreed upon with DOL.

Reports should contain the following information:

- Name and billing address of State agency or public benefit corporation;
- State agency or public benefit corporation contact and phone number;
- Name and address of contractor receiving the award;
- Contract number and effective dates;
- Contract amount and PWEF assessment charge (if contract amount has been amended, reflect increase or decrease to original contract and the adjustment in the PWEF charge); and
- Brief description of the work to be performed under each contract.

Checks and Journal Vouchers, payable to the "New York State Department of Labor" should be sent to:

Department of Labor
Administrative Finance Bureau-PWEF Unit
Building 12, Room 464
State Office Campus
Albany, NY 12226

Any questions regarding billing should be directed to NYSDOL's Administrative Finance Bureau-PWEF Unit at (518) 457-3624 and any questions regarding Public Work Contracts should be directed to the Bureau of Public Work at (518) 457-5589.

NEW YORK STATE OF OPPORTUNITY. Department of Labor

Required Notice under Article 25-B of the Labor Law

Attention All Employees, Contractors and Subcontractors: You are Covered by the Construction Industry Fair Play Act

The law says that you are an employee unless:

- You are free from direction and control in performing your job, **and**
- You perform work that is not part of the usual work done by the business that hired you, **and**
- You have an independently established business.

Your employer cannot consider you to be an independent contractor unless all three of these facts apply to your work.

It is against the law for an employer to misclassify employees as independent contractors or pay employees off the books.

Employee Rights: If you are an employee, you are entitled to state and federal worker protections. These include:

- Unemployment Insurance benefits, if you are unemployed through no fault of your own, able to work, and otherwise qualified,
- Workers' compensation benefits for on-the-job injuries,
- Payment for wages earned, minimum wage, and overtime (under certain conditions),
- Prevailing wages on public work projects,
- The provisions of the National Labor Relations Act, and
- A safe work environment.

It is a violation of this law for employers to retaliate against anyone who asserts their rights under the law. Retaliation subjects an employer to civil penalties, a private lawsuit or both.

Independent Contractors: If you are an independent contractor**, you must pay all taxes and Unemployment Insurance contributions required by New York State and Federal Law.**

Penalties for paying workers off the books or improperly treating employees as independent contractors:

• **Civil Penalty**	First offense: Up to $2,500 per employee Subsequent offense(s): Up to $5,000 per employee
• **Criminal Penalty**	First offense: Misdemeanor - up to 30 days in jail, up to a $25,000 fine and debarment from performing public work for up to one year. Subsequent offense(s): Misdemeanor - up to 60 days in jail or up to a $50,000 fine and debarment from performing public work for up to 5 years.

If you have questions about your employment status or believe that your employer may have violated your rights and you want to file a complaint, call the Department of Labor at (866) 435-1499 or send an email to dol.misclassified@labor.ny.gov. All complaints of fraud and violations are taken seriously. You can remain anonymous.

Employer Name:

IA 999 (09/16)

WE ARE YOUR DOL

NEW YORK STATE Department of Labor

New York State Department of Labor
Bureau of Public Work

Attention Employees

THIS IS A:

PUBLIC WORK PROJECT

If you are employed on this project as a **worker, laborer, or mechanic** you are entitled to receive the **prevailing wage and supplements rate** for the classification at which you are working.

Your pay stub and wage notice received upon hire must clearly state your wage rate and supplement rate.

Chapter 629 of the Labor Laws of 2007:

These wages are set by law and must be posted at the work site. They can also be found at: https://dol.ny.gov/bureau-public-work

If you feel that you have not received proper wages or benefits, please call our nearest office.*

Albany	(518) 457-2744	Patchogue	(631) 687-4882
Binghamton	(607) 721-8005	Rochester	(585) 258-4505
Buffalo	(716) 847-7159	Syracuse	(315) 428-4056
Garden City	(516) 228-3915	Utica	(315) 793-2314
New York City	(212) 932-2419	White Plains	(914) 997-9507
Newburgh	(845) 568-5287		

* For New York City government agency construction projects, please contact the Office of the NYC Comptroller at (212) 669-4443, or www.comptroller.nyc.gov – click on Bureau of Labor Law.

Contractor Name: _____

Project Location: _____

Requirements for OSHA 10 Compliance

Article 8 §220-h requires that when the advertised specifications, for every contract for public work, is $250,000.00 or more the contract must contain a provision requiring that every worker employed in the performance of a public work contract shall be certified as having completed an OSHA 10 safety training course. The clear intent of this provision is to require that all employees of public work contractors, required to be paid prevailing rates, receive such training “prior to the performing any work on the project.”

The Bureau will enforce the statute as follows:

All contractors and sub contractors must attach a copy of proof of completion of the OSHA 10 course to the first certified payroll submitted to the contracting agency and on each succeeding payroll where any new or additional employee is first listed.

Proof of completion may include but is not limited to:

- Copies of bona fide course completion card (*Note: Completion cards do not have an expiration date.)*
- Training roster, attendance record of other documentation from the certified trainer pending the issuance of the card.
- Other valid proof

**A certification by the employer attesting that all employees have completed such a course is not sufficient proof that the course has been completed.

Any questions regarding this statute may be directed to the New York State Department of Labor, Bureau of Public Work at 518-457-5589.

WICKS

Public work projects are subject to the Wicks Law requiring separate specifications and bidding for the plumbing, heating and electrical work, when the total project's threshold is $3 million in Bronx, Kings, New York, Queens and, Richmond counties; $1.5 million in Nassau, Suffolk and Westchester counties; and $500,000 in all other counties.

For projects below the monetary threshold, bidders must submit a sealed list naming each subcontractor for the plumbing, HVAC and electrical and the amount to be paid to each. The list may not be changed unless the public owner finds a legitimate construction need, including a change in specifications or costs or the use of a Project Labor Agreement (PLA), and must be open to public inspection.

Allows the state and local agencies and authorities to waive the Wicks Law and use a PLA if it will provide the best work at the lowest possible price. If a PLA is used, all contractors shall participate in apprentice training programs in the trades of work it employs that have been approved by the Department of Labor (DOL) for not less than three years. They shall also have at least one graduate in the last three years and use affirmative efforts to retain minority apprentices. PLA's would be exempt from Wicks, but deemed to be public work subject to prevailing wage enforcement.

The Commissioner of Labor shall have the power to enforce separate specification requirement s on projects, and may issue stop-bid orders against public owners for non-compliance.

Other new monetary thresholds, and similar sealed bidding for non-Wicks projects, would apply to certain public authorities including municipal housing authorities, NYC Construction Fund, Yonkers Educational Construction Fund, NYC Municipal Water Finance Authority, Buffalo Municipal Water Finance Authority, Westchester County Health Care Association, Nassau County Health Care Corp., Clifton-Fine Health Care Corp., Erie County Medical Center Corp., NYC Solid Waste Management Facilities, and the Dormitory Authority.

Contractors must pay subcontractors within a 7 days period.

(07.19)

Introduction to the Prevailing Rate Schedule

Information About Prevailing Rate Schedule

This information is provided to assist you in the interpretation of particular requirements for each classification of worker contained in the attached Schedule of Prevailing Rates.

Classification

It is the duty of the Commissioner of Labor to make the proper classification of workers taking into account whether the work is heavy and highway, building, sewer and water, tunnel work, or residential, and to make a determination of wages and supplements to be paid or provided. It is the responsibility of the public work contractor to use the proper rate. If there is a question on the proper classification to be used, please call the district office located nearest the project. District office locations and phone numbers are listed below.
Prevailing Wage Schedules are issued separately for "General Construction Projects" and "Residential Construction Projects" on a county-by-county basis.

General Construction Rates apply to projects such as: Buildings, Heavy & Highway, and Tunnel and Water & Sewer rates.
Residential Construction Rates generally apply to construction, reconstruction, repair, alteration, or demolition of one family, two family, row housing, or rental type units intended for residential use.
Some rates listed in the Residential Construction Rate Schedule have a very limited applicability listed along with the rate. Rates for occupations or locations not shown on the residential schedule must be obtained from the General Construction Rate Schedule. Please contact the local Bureau of Public Work office before using Residential Rate Schedules, to ensure that the project meets the required criteria.

*Contractor Registry (LL 220-I):
Labor Law Section 220-i requires that contractors obtain a Contractor Registry certificate of registration prior to bidding on or commencing work on a public or private project subject to prevailing wage requirements. Subcontractors also are prohibited from commencing work on covered employment unless they have received a Contractor Registry certificate. Contractors are required to submit their Certificate of Registration with their bid materials. A public database is available online to confirm registration at data.ny.gov to confirm registration validity. For additional information on how to register and the requirements, visit https://dol.ny.gov/public-work-contractor-and-subcontractorregistry-
landing.

Payrolls and Payroll Records

Every contractor and subcontractor MUST keep original payrolls or transcripts subscribed and affirmed as true under penalty of perjury. Payrolls must be maintained for at least three (3) years from the projects date of completion. Additionally, as per Article 6 of the Labor Law, contractors and subcontractors are required to establish, maintain, and preserve for not less that six (6) years, contemporaneous, true, and accurate payroll records.

At a minimum, payrolls must show the following information for each person employed on a public work project: Name; Address, Last 4 Digits of Social Security number, Classification(s) in which the worker was employed, Hourly wage rate(s) paid, Supplements paid or provided, and Daily and weekly number of hours worked in each classification.

Payroll records and transcripts are required to be kept on site during all the time that work under that contract is being performed.

NOTE: *For more detailed information regarding Article 9 prevailing wage contracts, please refer to "General Provisions of Laws Covering Workers on Article 9 Public Work Building Service Contracts".*

If you have any questions concerning the attached schedule or would like additional information, please write to:

New York State Department of Labor
Bureau of Public Work
State Office Campus, Bldg. 12
Albany, NY 12240

OR

Contact the nearest BUREAU of PUBLIC WORK District Office

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518

Bureau of Public Work - Newburgh	845-568-5287	845-568-5332
Bureau of Public Work - New York City	212-932-2419	212-775-3579
Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Paid Holidays

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

Overtime

At a minimum, all work performed on a public work project in excess of eight hours in any one day or more than five days in any workweek is overtime. The specific overtime requirements for each trade or occupation on a public work project may differ. Specific overtime requirements for each trade or occupation are contained in the prevailing rate schedules.

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays.

The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Supplemental Benefits

Particular attention should be given to the supplemental benefit requirements. Although in most cases the payment or provision of supplements is straight time for all hours worked, some classifications require the payment or provision of supplements, or a portion of the supplements, to be paid or provided at a premium rate for premium hours worked. Supplements may also be required to be paid or provided on paid holidays, regardless of whether the day is worked. The Overtime Codes and Notes listed on the particular wage classification will indicate these conditions as required.

Effective Dates

When you review the schedule for a particular occupation, your attention should be directed to the dates above the column of rates. These are the dates for which a given set of rates is effective. The rate listed is valid until the next effective rate change or until the new annual determination which takes effect on July 1 of each year. Please Note: Updates to the Wage Schedule shall be made on a quarterly basis.

All contractors and subcontractors are required to pay the current prevailing rates of wages and supplements. If you have any questions please contact the Bureau of Public Work or visit the New York State Department of Labor website (www.labor.ny.gov) for current wage rate information.

Shift Work

If the timeline of the contract requires shift work be performed to meet deadlines, the BPWE will enforce the shift work rate as the required rate on the project whether or not shift work is specifically addressed in the contract.

Paid Prenatal Leave

Every employer shall be required to provide to its employees twenty hours of paid prenatal personal leave during any fifty-two week calendar period. Paid prenatal personal leave shall mean leave taken for the health care services received by an employee during their pregnancy or related to such pregnancy, including physical examinations, medical procedures, monitoring and testing, and discussions with a healthcare provider related to the pregnancy. Paid prenatal personal leave may be taken in hourly increments. Benefits for paid prenatal personal leave shall be paid in hourly installments. Employees shall receive compensation at the employee's regular rate of pay, or the applicable minimum wage established by the labor law, whichever is greater, for the use of Paid Prenatal leave.

Apprentice Training Ratios

The following are the allowable ratios of registered Apprentices to Journey-workers.

For example, the ratio 1:1,1:3 indicates the allowable initial ratio is one Apprentice to one Journeyworker. The Journeyworker must be in place on the project before an Apprentice is allowed. Then three additional Journeyworkers are needed before a second Apprentice is allowed. The last ratio repeats indefinitely. Therefore, three more Journeyworkers must be present before a third Apprentice can be hired, and so on.

Please call Apprentice Training Central Office at (518) 457-6820 if you have any questions.

Title (Trade)	Ratio
Boilermaker (Construction)	1:1,1:4

Boilermaker (Shop)	1:1,1:3
Carpenter (Bldg.,H&H, Pile Driver/Dockbuilder)	1:1,1:4
Carpenter (Residential)	1:1,1:3
Electrical (Outside) Lineman	1:1,1:2
Electrician (Inside)	1:1,1:3
Elevator/Escalator Construction & Modernizer	1:1,1:2
Glazier	1:1,1:3
Insulation & Asbestos Worker	1:1,1:3
Iron Worker	1:1,1:4
Laborer	1:1,1:3
Mason	1:1,1:4
Millwright	1:1,1:4
Op Engineer	1:1,1:5
Painter	1:1,1:3
Plumber & Steamfitter	1:1,1:3
Roofer	1:1,1:2
Sheet Metal Worker	1:1,1:3
Sprinkler Fitter	1:1,1:2

If you have any questions concerning the attached schedule or would like additional information, please contact the nearest BUREAU of PUBLIC WORK District Office or write to:

New York State Department of Labor
Bureau of Public Work
State Office Campus, Bldg. 12
Albany, NY 12226

District Office Locations:	Telephone #	FAX #
Bureau of Public Work - Albany	518-457-2744	518-485-0240
Bureau of Public Work - Binghamton	607-721-8005	607-721-8004
Bureau of Public Work - Buffalo	716-847-7159	716-847-7650
Bureau of Public Work - Garden City	516-228-3915	516-794-3518
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Bureau of Public Work - Patchogue	631-687-4882	631-687-4902
Bureau of Public Work - Rochester	585-258-4505	585-258-4708
Bureau of Public Work - Syracuse	315-428-4056	315-428-4671
Bureau of Public Work - Utica	315-793-2314	315-793-2514
Bureau of Public Work - White Plains	914-997-9507	914-997-9523
Bureau of Public Work - Central Office	518-457-5589	518-485-1870

Westchester County General Construction

Boilermaker — 08/01/2026

JOB DESCRIPTION Boilermaker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2026	01/01/2027
Boilermaker	$ 70.38	$ 71.88
Repairs & Renovations	70.38	71.88

Repairs & Renovation: Includes Repairing, Renovating, and Replacement of parts to an existing unit(s).

SUPPLEMENTAL BENEFITS
Per Hour:

Boilermaker	33.5% of Hourly
Repair & Renovations	Wage Paid + $26.85

NOTE: "Hourly Wage Paid" shall include any and all premium(s) pay.

OVERTIME PAY
See (*B, O, **U) on OVERTIME PAGE
Note:* Includes 9th & 10th hours, double for 11th or more.
** Labor Day ONLY, if worked.

Repairs & Renovation see (B,E,Q) on OT Page

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 12, 15, 25, 26, 29) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1/2) Year Terms at the following percentage of Boilermaker's wage per hour:

1st	2nd	3rd	4th	5th	6th	7th
65%	70%	75%	80%	85%	90%	95%

SUPPLEMENTAL BENEFITS:

33.5% of Hourly Wage Paid Plus Amount Below:

1st	2nd	3rd	4th	5th	6th	7th
$20.36	$21.28	$22.22	$23.12	$24.07	$25.00	$25.93

NOTE: "Hourly Wage Paid" shall include any and all premium(s)

4-5

Broadband — 08/01/2026

JOB DESCRIPTION Broadband **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

PARTIAL COUNTIES
Orange: Entire County except Village of Greenwood Lake, Village of Highland Falls, Town of Tuxedo, and Town of Patterson

WAGES
NOTE: Applies to all public work and covered private projects, including those receiving ConnectAll funding subject to New York State Labor Law §224-E, solicited on or after July 1,2025. For all other projects solicited prior to July 1,2025 please see LINEMAN ELECTRICIAN(1)-TELEDATA

Per Hour:	07/01/2026	08/04/2026
Field Tech Install/Repair*	$ 55.59	$ 57.26

For outside work (excluding installation on building construction/alteration/renovation projects), stopping at first point of attachment (demarcation), installing/maintaining/repairing broadband internet service.

"Broadband", "Broadband Service", or "Broadband Internet" means mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all internet endpoints, including any capabilities that are incidental to and enable the operation of the communications service, but excluding dial-up internet access service.

*NOTE: EXCLUDES work within ten(10) feet of High Voltage (600 Volts and over) transmussion lines. Please see LINEMAN rates.
*NOTE: Does not include the operation of equipment. Please see OPERATING ENGINEER rates.
*NOTE: Does not include groundmen/flagger/flagmen. Please see LABORER/LABORER-HEAVY/HIGHWAY rates.

SUPPLEMENTAL BENEFITS
Per Hour:

$ 23.54

OVERTIME PAY
See (B, K, *R) on OVERTIME PAGE
*Two and one half times the hourly rate after the 8th hour

HOLIDAY
Paid: See (5, 6, 7, 11, 12) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 12) on HOLIDAY PAGE

4-CWA-Dist1

Carpenter — 08/01/2026

JOB DESCRIPTION Carpenter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per hour: 07/01/2026

Piledriver $ 62.59 + 10.16*

Dockbuilder $ 62.59 + 10.16*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker $ 47.48

OVERTIME PAY
See (B, E2, O) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,25)

Overtime: See (5,6,11,13,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per hour
(1)year terms:

1st	2nd	3rd	4th
$ 28.98 + 5.66*	$ 34.58 + 5.66*	$ 42.96 + 5.66*	$ 51.35 + 5.66*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:

All Terms: $ 34.03

8-1556 Db

Carpenter — 08/01/2026

JOB DESCRIPTION Carpenter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per hour: 07/01/2026

Carpet/Resilient
Floor Coverer $ 60.05
+ 8.39*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

INCLUDES HANDLING & INSTALLATION OF ARTIFICIAL TURF AND SIMILAR TURF INDOORS/OUTDOORS.

SUPPLEMENTAL BENEFITS
Per hour:
$ 42.24

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18, 19) on HOLIDAY PAGE.

Paid for 1st & 2nd yr.
Apprentices See (5,6,11,13,16,18,19,25)
Overtime: See (5,6,11,13,16,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wage per hour - (1) year terms:

1st	2nd	3rd	4th
$ 26.54	$ 29.60	$ 34.05	$ 42.40
+ 2.00*	+ 2.54*	+ 3.00*	+ 3.94*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:

1st	2nd	3rd	4th
$ 16.91	$ 18.13	$ 21.67	$ 22.98

8-2287

Carpenter — 08/01/2026

JOB DESCRIPTION Carpenter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per Hour: 07/01/2026

Marine Construction:

Marine Diver $ 77.46
+ 10.16*

Marine Tender $ 57.00
+ 10.16*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker $ 47.48

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18, 19) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 13, 16, 18, 19, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages per hour:
One (1) year terms.

1st year	$ 28.98
	+ 5.66*
2nd year	34.58
	+ 5.66*
3rd year	42.96
	+ 5.66*
4th year	51.35
	+ 5.66*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental Benefits
Per Hour:

All terms	$ 34.03

8-1456MC

Carpenter — 08/01/2026

JOB DESCRIPTION Carpenter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per hour: 07/01/2026

Building

Millwright	$ 62.03
	+ 13.12*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

SUPPLEMENTAL BENEFITS
Per hour:

Millwright	$ 46.66

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (18,19) on HOLIDAY PAGE.

Overtime: See (5,6,8,11,13,15,18,19,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per hour:
One (1) year terms:

1st.	2nd.	3rd.	4th.
$ 33.04	$ 38.89	$ 44.74	$ 56.44
+ 7.08*	+ 8.25*	+ 9.42*	+ 11.76*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:
One (1) year terms:

1st.	2nd.	3rd.	4th.
$ 31.81	$ 34.34	$ 37.52	$ 41.94

8-740.1

Carpenter — 08/01/2026

JOB DESCRIPTION Carpenter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
Per Hour:

	07/01/2026
Timberman	$ 57.59
	+ 10.42*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

SUPPLEMENTAL BENEFITS
Per Hour:
$ 46.79

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Overtime: See (5, 6, 11, 13, 25) on HOLIDAY PAGE
Paid: See (1) on HOLIDAY PAGE.

Paid: for 1st & 2nd yr.
Apprentices See (5,6,11,13,25)

Overtime: See (5,6,11,13,25) on HOLIDAY PAGE.

REGISTERED APPRENTICES
Wages per hour:
One (1) year terms:

1st	2nd	3rd	4th
$ 26.96	$ 32.07	$ 39.72	$ 47.38
+ 5.71*	+ 5.71*	+ 5.71*	+ 5.71*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental benefits per hour:
All terms $ 33.78

8-1556 Tm

Carpenter — 08/01/2026

JOB DESCRIPTION Carpenter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Westchester

PARTIAL COUNTIES
Orange: South of but including the following, Waterloo Mills, Slate Hill, New Hampton, Goshen, Blooming Grove, Mountainville, east to the Hudson River.
Putnam: South of but including the following, Cold Spring, TompkinsCorner, Mahopac, Croton Falls, east to Connecticut border.
Suffolk: West of Port Jefferson and Patchogue Road to Route 112 to the Atlantic Ocean.

WAGES

Per hour:	07/01/2026	10/18/2026
Core Drilling:		
Driller	$ 48.78	Additional
	+ 3.85*	+ $2.63
Driller Helper	$ 38.15	
	+ 3.85*	

Note: Hazardous Waste Pay Differential:
For Level C, an additional 15% above wage rate per hour
For Level B, an additional 15% above wage rate per hour
For Level A, an additional 15% above wage rate per hour
Note: Additional $3.00 per hour to be paid when required to work on water

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

SUPPLEMENTAL BENEFITS
Per hour:

Driller and Helper $ 32.37

OVERTIME PAY
See (B, G, P) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 13, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 13, 25) on HOLIDAY PAGE

8-1536-CoreDriller

Carpenter - Building / Heavy&Highway — 08/01/2026

JOB DESCRIPTION Carpenter - Building / Heavy&Highway **DISTRICT** 11

ENTIRE COUNTIES
Putnam, Rockland, Westchester

WAGES
WAGES:(per hour)
Applies to CARPENTER BUILDING/HEAVY & HIGHWAY/TUNNEL:

	07/01/2026
Base Wage	$ 43.68
	+$6.69*

*For all hours paid straight or premium.

SHIFT WORK
SHIFT DIFFERENTIAL: When it is mandated by a Government Agency irregular or off shift can be worked. The Carpenter shall receive an additional fifteen percent (15%) of wage plus applicable benefits.

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker	$ 33.11

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
BUILDING:
Paid: See (1) on HOLIDAY PAGE.

Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE.
- Holidays that fall on Sunday will be observed Monday.

HEAVY&HIGHWAY/TUNNEL:
Paid: See (5, 6, 25) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE
- Holidays that fall on Sunday will be observed Monday
- Must be employed during the five (5) work days immediately preceding a holiday or during the five (5) work days following the paid holiday to receive holiday pay
- If an employee is entitled to a paid holiday, the employee is paid the Holiday wage and supplemental benefits whether they work or not. If an employee works the Holiday, the employee will receive holiday pay (including supplemental benefits), plus the applicable premium wage for working the Holiday. If an employee works in excess of 8 hours on Holiday, then benefits will be paid for any hours in excess of 8 hours.

REGISTERED APPRENTICES
1 year terms at the following wage rates:

1st	2nd	3rd	4th
$ 21.84	$ 26.21	$ 30.58	$ 34.94
+3.86*	+3.86*	+3.86*	+3.86*

*For all hours paid straight or premium

SUPPLEMENTAL BENEFITS per hour:

All terms	$ 17.76

11-279.1B/HH

Electrician — 08/01/2026

JOB DESCRIPTION Electrician **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Queens, Richmond, Westchester

WAGES

Per hour:	07/01/2026	03/12/2027
Service Technician	$ 39.45	$ 40.45

Service and Maintenance on Alarm and Security Systems.

Maintenance, repair and /or replacement of defective (or damaged) equipment on, but not limited to, Burglar - Fire - Security - CCTV - Card Access - Life Safety Systems and associated devices. (Whether by service contract of T&M by customer request.)

SUPPLEMENTAL BENEFITS

Per hour:		
Journeyworker:	$ 23.33	$ 24.11

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 11, 15, 16, 17, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 17, 25, 26) on HOLIDAY PAGE

9-3H

Electrician 08/01/2026

JOB DESCRIPTION Electrician **DISTRICT** 8

ENTIRE COUNTIES
Westchester

WAGES

Per hour:	07/01/2026	04/15/2027
Electrician/A-Technician	$ 58.75	$ 60.75
Teledata	58.75	60.75

See "M" rate for all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls.

Note: On a job where employees are required to work on bridges over navigable waters, transmission towers, light poles, bosun chairs, swinging scaffolds , etc. 40 feet or more above the water or ground or under compressed air, or tunnel projects under construction or where assisted breathing apparatus is required, they will be paid at the rate of time and one-half for such work except on normal pole line or building construction work.

SUPPLEMENTAL BENEFITS

Per hour:		
Journeyworker	$ 65.07	$ 67.55

OVERTIME PAY
See (A, G, *J, P) on OVERTIME PAGE
*NOTE: Emergency work on Sunday and Holidays is at the time and one-half overtime rate.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE
Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES
(1) year terms at the following wage rates:

	07/01/2026	04/15/2027
1st term	$ 18.00	$ 18.00
2nd term	19.50	19.50
3rd term	21.00	21.00
4th term	22.50	22.50
MIJ 1-12 months	28.25	28.25

MIJ 13-18 months	31.75	31.75

Supplemental Benefits per hour:

	07/01/2026	04/15/2027
1st term	$ 15.23	$ 15.73
2nd term	18.75	19.25
3rd term	19.77	20.27
4th term	20.78	21.28
MIJ 1-12 months	16.56	17.06
MIJ 13-18 months	17.02	17.52

8-3/W

Electrician — 08/01/2026

JOB DESCRIPTION Electrician **DISTRICT** 8

ENTIRE COUNTIES
Westchester

WAGES
Per hour

	07/01/2026	04/15/2027
Electrician - M	$ 34.25	$ 34.25

"M" rate for all work necessary to retrofit, service, maintain and repair all kinds of lighting fixtures and local lighting controls.

SUPPLEMENTAL BENEFITS

	07/01/2026	04/15/2027
Electrician - M	$ 17.35	$ 17.85

OVERTIME PAY
See (B, G, *J, P) on OVERTIME PAGE
*Note: Emergency work on Sunday and Holidays is at the time and one-half overtime rate.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE
Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

8-3m

Elevator Constructor — 08/01/2026

JOB DESCRIPTION Elevator Constructor **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk

PARTIAL COUNTIES
Rockland: Entire County except for the Township of Stony Point
Westchester: Entire County except for the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

WAGES
Per hour:

	07/01/2026	03/17/2027
Elevator Constructor	$ 86.43	$ 89.76
Modernization & Service/Repair	$ 68.06	$ 70.72

SUPPLEMENTAL BENEFITS
Per Hour:

Elevator Constructor	$ 48.96	$ 50.27

Modernization & Service/Repairs	$ 47.73	$ 49.00

OVERTIME PAY
Constructor See (D, M, T) on OVERTIME PAGE.

Modern/Service See (B, E5, P) on OVERTIME PAGE.

HOLIDAY
Paid: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
WAGES PER HOUR:

6 MONTH TERMS:

1st Term*	2nd & 3rd Term*	4th & 5th Term	6th & 7th Term	8th & 9th Term
50%	50%	55%	65%	75%

* Note: 1st, 2nd, 3rd Terms are based on average of the Constructor, the Modernization and the Service/Repair wage.
Terms 4 thru 9 Based on the Journeyworker's wage of classification they are working in.

SUPPLEMENTAL BENEFITS:

	07/01/2026	03/17/2027
Elevator Constructor		
1st Term	$0.00	$ 0.00
2nd & 3rd Term	37.66	38.42
4th & 5th Term	38.80	39.62
6th & 7th Term	40.60	41.50
8th & 9th Term	42.39	43.39
Modernization & Service/Repair		
1st Term	$0.00	$ 0.00
2nd & 3rd Term	37.63	38.39
4th & 5th Term	38.37	39.17
6th & 7th Term	40.09	40.98
8th & 9th Term	41.81	42.79

Elevator Constructor — 08/01/2026

JOB DESCRIPTION Elevator Constructor **DISTRICT** 1

ENTIRE COUNTIES
Columbia, Dutchess, Greene, Orange, Putnam, Sullivan, Ulster

PARTIAL COUNTIES
Delaware: Towns of Andes, Bovina, Colchester, Davenport, Delhi, Harpersfield, Hemdon, Kortright, Meredith, Middletown, Roxbury, Hancock & Stamford
Rockland: Only the Township of Stony Point.
Westchester: Only the Townships of Bedford, Lewisboro, Cortland, Mt. Kisco, North Salem, Pound Ridge, Somers and Yorktown.

WAGES

Per Hour	07/01/2026	01/01/2027
Mechanic	$ 76.12	$ 79.37
Helper	70% of Mechanic Wage Rate	70% of Mechanic Wage Rate

SUPPLEMENTAL BENEFITS
Per hour

Journeyworker	$ 38.985*	$ 39.535*

*NOTE: Add 6% of regular hourly rate for all hours worked. Add 8% of regular hourly rate if more than 5 years of service.

OVERTIME PAY
See (D, O) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 15, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 15, 16) on HOLIDAY PAGE

Note: When a paid holiday falls on Saturday, it shall be observed on Friday. When a paid holiday falls on Sunday, it shall be observed on Monday.

REGISTERED APPRENTICES
WAGES per hour: 1 year terms at the following percentage of the Elevator Constructor Mechanic wage.

0-6 months	6-12 months	2nd year	3rd year	4th year
50%	55%	65%	70%	80%

SUPPLEMENTAL BENEFITS per hour:

0-6 months: 6% of the regular hourly apprentice rate paid, no additional supplemental benefits.

All other terms: Same as Journeyworker

1-138

Glazier — 08/01/2026

JOB DESCRIPTION Glazier **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES
Per hour:

	07/01/2026	11/01/2026
Glazier	$ 66.22	$ 67.20
Scaffolding, including swing scaffold	71.22	72.20
*Mechanical Equipment	67.23	68.20
**Repair & Maintenance	32.82	33.47

*Mechanical equipment, scissor jacks, man lifts, booms & buckets 30' or more, but not pipe scaffolding.
**Repair & Maintenance- All repair & maintenance work on a particular building whenever performed, where the total cumulative Repair & Maintenance contract value is under $202,000.

SUPPLEMENTAL BENEFITS
Per hour:

Glazier, Scaffolding and Mechanical Equipment	$ 44.81	$ 45.74
Repair & Maintenance	$ 26.01	$26.37

OVERTIME PAY
See (B, E, Q, V) on OVERTIME PAGE
For 'Repair & Maintenance' see (B, B2, I, S) on overtime page.

HOLIDAY
Paid: See (5, 6, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE
For 'Repair & Maintenance'
Paid: See(5, 6, 16, 25)
Overtime: See(5, 6, 16, 25)

REGISTERED APPRENTICES
Wage per hour:
(1) year terms at the following wage rates:

	07/01/2026	11/01/2026
1st term	$ 23.68	$ 24.06
2nd term	32.23	32.74
3rd term	42.89	43.55
4th term	52.47	53.23

Supplemental Benefits:
(Per hour)

1st term	$ 20.18	$ 20.56
2nd term	28.85	29.39
3rd term	34.77	35.45
4th term	38.18	38.95

8-1087 (DC9 NYC)

Insulator - Heat & Frost — 08/01/2026

JOB DESCRIPTION Insulator - Heat & Frost **DISTRICT** 8

ENTIRE COUNTIES
Dutchess, Orange, Putnam, Rockland, Westchester

WAGES

Per hour:	07/01/2026
Insulator/Fire Stop Work*	$ 64.27
Discomfort & Additional Training**	67.32

*Applies on all exclusive Fire Stop Work (When contract is for Fire Stop work only). No apprentices on these contracts only.

**Applies to work requiring; garb or equipment worn against the body not customarily worn by insulators; psychological evaluation ;special training, including but not limited to "Yellow Badge" radiation training

Note: Additional $10 a day for work 30 feet or more above floor or ground level.

SUPPLEMENTAL BENEFITS

Per hour:	
Insulator/Fire Stop Journeyworker:	$ 39.85
Discomfort & Additional Training:	$ 41.89

OVERTIME PAY
See (B, E, E2, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Note: Last working day preceding Christmas and New Years day, workers shall work no later than 12:00 noon and shall receive 8 hrs pay.

Overtime: See (2*, 4, 6, 16, 25) on HOLIDAY PAGE.
*Note: Labor Day triple time if worked.

REGISTERED APPRENTICES
(1) year terms:

Insulator Apprentices:

1st	2nd	3rd	4th
$ 35.09	$ 40.92	$ 46.76	$ 52.60

Discomfort & Additional Training Apprentices:

1st	2nd	3rd	4th
$ 36.61	$ 42.75	$ 48.89	$ 55.04

Supplemental Benefits paid per hour:

Insulator Apprentices:

1st term	$ 20.33
2nd term	24.23
3rd term	28.13
4th term	32.05

Discomfort & Additional Training Apprentices:

1st term	$ 21.34
2nd term	25.46
3rd term	29.56

4th term	33.68

8-91

Ironworker **08/01/2026**

JOB DESCRIPTION Ironworker **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per Hour:	07/01/2026	01/01/2027 Additional
Stone Derrickmen Rigger	$ 78.46	$ 1.84
Stone Handset Derrickman	$ 76.51	$ 1.64

SUPPLEMENTAL BENEFITS

Per hour:	
Stone Derrickmen Rigger	$ 49.02
Stone Handset Derrickman	$ 48.01

OVERTIME PAY
See (B, D1, *E, Q, **V) on OVERTIME PAGE
*Time and one-half shall be paid for all work on Saturday up to eight (8) hours and double time shall be paid for all work thereafter.
** Benefits same premium as wages on Holidays only

HOLIDAY
Paid: See (18) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 25) on HOLIDAY PAGE
Work stops at schedule lunch break with full day's pay.

REGISTERED APPRENTICES
Wage per hour:

Stone Derrickmen Rigger:

	1st	2nd	3rd	4th
07/01/2026	$ 38.98	$ 55.17	$ 61.37	$ 67.56

Supplemental Benefits:
Per hour:

07/01/2026	$ 24.77	$ 37.34	$ 37.34	$ 37.34

Stone Handset:

1/2 year terms at the following hourly wage rate:

	1st	2nd	3rd	4th
07/01/2026	$ 37.51	$ 53.51	$ 59.51	$ 65.51

Supplemental Benefits:
Per hour:

07/01/2026	$ 24.75	$ 36.90	$ 36.90	$ 36.90

9-197D/R

Ironworker **08/01/2026**

JOB DESCRIPTION Ironworker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per Hour:	07/01/2026	01/01/2027 Additional
Ornamental	$ 48.65	$ 1.05*
Chain Link Fence	48.65	

Guide Rail 48.65

* To be allocated at a later date.

SUPPLEMENTAL BENEFITS
Per hour:
Journeyworker: $ 68.84

OVERTIME PAY
See (B, B1, Q, V) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
1 year terms at the following wages per hour:

1st	2nd	3rd	4th
$ 25.98	$ 28.45	$ 30.80	$ 34.39

Supplemental Benefits per hour:

1st	2nd	3rd	4th
$ 17.29	$ 18.29	$ 19.29	$ 21.29

4-580-Or

Ironworker **08/01/2026**

JOB DESCRIPTION Ironworker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
PER HOUR:

	07/01/2026	01/01/2027
Ironworker:		Additional
Structural, Bridges, Machinery	$ 59.45	1.38*

* To be allocated at a later date.

SUPPLEMENTAL BENEFITS
Per hour paid:

Journeyman $ 95.26

OVERTIME PAY
See (B, B1, Q, *V) on OVERTIME PAGE
*NOTE: Benefits are calculated for every hour paid.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 18, 19) on HOLIDAY PAGE

REGISTERED APPRENTICES
6 month terms at the following wages per hour:

	1st	2nd	3rd-6th
07/01/2026	$ 30.87	$ 31.47	$ 32.08

Supplemental Benefits

PER HOUR PAID: $ 69.08

4-40/361-Str

Ironworker **08/01/2026**

JOB DESCRIPTION Ironworker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

PARTIAL COUNTIES
Rockland: Southern section - south of Convent Road and east of Blue Hills Road.

WAGES

Per hour:	07/01/2026
Reinforcing & Metal Lathing:	$ 58.85

SUPPLEMENTAL BENEFITS

Per hour:	
Reinforcing & Metal Lathing	$ 46.42

OVERTIME PAY
See (B, E, Q, *X) on OVERTIME PAGE
Wages Per Hour:

At Time & One Half	$ 87.35
At Double Time	115.85

Supplemental Benefit Premiums for Overtime Hours worked:

At Time & One Half	$ 52.77
At Double Time	59.27

*Only $24.00 per hour for non worked hours

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 11, 13, 20, 21, 22, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1) year terms at the following Wages Per Hour:

	1st	2nd	3rd	4th
Straight time	$ 22.55	$ 25.00	$ 28.00	$ 30.00
At Time & One Half	33.05	36.60	41.10	44.10
At Double Time	46.65	51.80	57.80	61.80

SUPPLEMENTAL BENEFITS Per Hour:

1st	2nd	3rd	4th
$ 18.17	$ 18.22	$ 17.22	$ 17.22

4-46Reinf

Laborer - Building — 08/01/2026

JOB DESCRIPTION Laborer - Building **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Westchester

WAGES

Per hour	07/01/2026
Laborer	$ 46.26
"Base Wage"	$ 46.16**
Laborer/Asbestos & Hazardous Materials Removal	$ 50.35*
"Base Wage"	$ 50.25**

* Abatement/Removal of:
- Lead based or lead containing paint on materials to be repainted is classified as Painter.
- Asbestos containing roofs and roofing material is classified as Roofer.

** Overtime premiums are calculated using Laborer "Base Wage"

NOTE: Upgrade/Material condition work plan for work performed during non-outage under a wage formula of 90% wage/100% fringe benefits at nuclear power plants.

SUPPLEMENTAL BENEFITS

Per hour:	07/01/2026
Journeyworker	$ 34.10

OVERTIME PAY
See (B, E, E2, Q, *V) on OVERTIME PAGE
*Note: For Sundays and Holidays worked benefits are at the same premium as wages.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE
Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES
LABORER ONLY
Hourly terms at the following wage:

	Level A	Level B	Level C	Level D
	0-1000	1001-2000	2001-3000	3001-4000
07/01/2026	$ 30.60	$ 35.35	$ 40.05	$ 42.05

Supplemental Benefits per hour:

Apprentices	
All terms	$ 25.95

8-235/B

Laborer - Heavy&Highway **08/01/2026**

JOB DESCRIPTION Laborer - Heavy&Highway **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Westchester

WAGES
PUTNAM: APPLIES TO ALL HEAVY & HIGHWAY WORK EXCLUDING HIGHWAYS, STREETS, AND BRIDGES

GROUP I: Blaster, Quarry Master, Curbs/Asphalt Screedman, Pipe Jacking and Boring Operations Operator, Qualified Dead Condition Pipe Fuser (B Mechanic)

GROUP II: Burner, Drillers(jumbo, joy, wagon, air track, hydraulic), Drill Operator, Self Contained Rotary Drill, Curbs, Raker, Bar Person, Concrete Finisher.

GROUP III: Pavement Breakers, Jeeper Operator, Jack Hammer, Pneumatic Tools (all), Gas Driller, Guniting, Railroad Spike Puller, Pipelayer, Chain Saw, Deck winches on scows, Power Buggy Operator, Power Wheelbarrow Operator, Bar Person Helper, Compressed Airlance, Water Jet Lance.

GROUP IV: Concrete Laborers, Asph. Worker, Rock Scaler, Vibrator Oper., Bit Grinder, Air Tamper, Pumps, Epoxy (adhesives, fillers and troweled on), Barco Rammer, Concrete Grinder, Crack Router Operator, Guide Rail-digging holes and placing concrete and demolition when not to be replaced, distribution of materials and tightening of bolts.

GROUP V: Drillers Helpers, Common Laborer, Mason Tenders, Signal Person, Pit Person, Truck Spotter, Powder Person, Landscape/Nursery Person, Dump Person, Temp. Heat.

GROUP VIA: Asbestos/Toxic Waste Laborer-All removal (Roads, Tunnels, Landfills, etc.) Confined space laborer, Bio-remediation, Phyto-remediation, Lead or Hazardous material, Abatement Laborer.

Wages:(per hour)	07/01/2026
GROUP I	$ 53.95*
GROUP II	52.49*
GROUP III	52.05*
GROUP IV	51.68*
GROUP V	51.30*

GROUP VIA Operator Qualified	53.46*
Gas Mechanic(A Mech) Operator Qualified	64.76*
Gas Mechanic(1st yr.)	57.95*
Flagperson	44.43*

*NOTE: To calculate overtime premiums, deduct $0.12 from above wages

SHIFT WORK
A shift premium will be paid on Public Work contracts for off-shift or irregular shift work when mandated by the NYS D.O.T. or other Governmental Agency contracts. Employees shall receive an additional 15% per hour above current rate for all off-shift and irregular shift work. Premium pay shall be calculated using the 15% per hour differential as base rate.

SUPPLEMENTAL BENEFITS
Per hour:
Journeyworker: $ 30.58

OVERTIME PAY
See (B, E, P, R, S) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
NOTE: For Holiday Overtime: 5, 6 - Code 'S' applies
For Holiday Overtime: 8, 15, 25, 26 - Code 'R' applies

REGISTERED APPRENTICES

1st term	2nd term	3rd term	4th term
1-1000hrs	1001-2000hrs	2001-3000hrs	3001-4000hrs
$ 33.35	$ 38.48	$ 43.61	$ 48.74

Supplemental Benefits per hour:
$ 26.42

8-60H/H

Laborer - Tunnel — 08/01/2026

JOB DESCRIPTION Laborer - Tunnel **DISTRICT** 11

ENTIRE COUNTIES
Columbia, Dutchess, Greene, Orange, Otsego, Putnam, Rockland, Sullivan, Ulster, Westchester

PARTIAL COUNTIES
Chenango: Townships of Columbus, Sherburne and New Berlin.
Delaware: Townships of Andes, Bovina, Middletown, Roxbury, Franklin, Hamden, Stamford, Delhi, Kortright, Harpersfield, Merideth and Davenport.

WAGES
Class 1: All support laborers/sandhogs working above the shaft or tunnel.

Class 2: All laborers/sandhogs working in the shaft or tunnel.

Class 4: Safety Miners

Class 5: Site work related to Shaft/Tunnel

WAGES: (per hour)

	07/01/2026
Class 1	$ 60.30
Class 2	62.45
Class 4	68.85
Class 5	53.15

Toxic and hazardous waste, lead abatement and asbestos abatement work will be paid an additional $ 3.00 an hour.

SUPPLEMENTAL BENEFITS
Per hour:

Benefit 1	$ 39.23
Benefit 2	55.66
Benefit 3	72.08

Benefit 1 applies to straight time hours, paid holidays not worked.
Benefit 2 applies to over 8 hours in a day (M-F) and Saturday hours worked.
Benefit 3 applies to Sunday and Holiday hours worked.

OVERTIME PAY
See (B, E, Q, X) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 15, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 15, 16, 25) on HOLIDAY PAGE
When a recognized Holidays falls on Saturday or Sunday, holidays falling on Saturday shall be recognized or observed on Friday and holidays falling on Sunday shall be recognized or observed on Monday. Employees ordered to work on the Saturday or Sunday of the holiday or on the recognized or the observed Friday or Monday for those holidays falling on Saturday or Sunday shall receive double time the established rate and benefits for the holiday.

REGISTERED APPRENTICES
FOR APPRENTICE RATES, refer to the appropriate Laborer Heavy & Highway wage rate contained in the wage schedule for the County and location where the work is to be performed.

11-17/60/235/754Tun

Lineman Electrician — 08/01/2026

JOB DESCRIPTION Lineman Electrician **DISTRICT** 6

ENTIRE COUNTIES
Westchester

WAGES
A Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors, assembly of all electrical materials, conduit, pipe or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

Crane Operators: Operation of any type of crane on line projects.
Crawler Backhoe: Operation of tracked excavator/crawler backhoe with 1/2 yard bucket or larger on line projects.
Digging Machine Operator: All other digging equipment and augering on line projects.

A Groundman/Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator equipment/operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

NOTE: Includes Teledata Work within ten (10) feet of High Voltage Transmission Lines. Also includes digging of holes for poles, anchors, footer, and foundations for electrical equipment.

-----Below rates applicable on all electrical overhead and underground distribution and maintenance work and overhead and underground transmission line work, electrical substations, switching structures, continuous pipe-type underground fluid or gas filled transmission conduit and cable installations, maintenance jobs or projects, railroad catenary installations and maintenance, third rail installations, the bonding of rails and the installation of fiber optic cable. Includes access matting for line work.

Per hour:	07/01/2026	05/03/2027	05/01/2028
Group A:			
Lineman, Tech, Welder	$ 67.64	$ 70.24	$ 73.01
Crane, Crawler Backhoe	67.64	70.24	73.01
Cable Splicer-Pipe Type	74.40	77.26	80.31
Cert. Welder-Pipe Type	71.02	73.75	76.66
Group B:			
Digging Mach Operator	$ 60.88	$ 63.22	$ 65.71
Group C:			
Tractor Trailer Driver	$ 57.49	$ 59.70	$ 62.06
Groundman, Truck Driver	54.11	56.19	58.41
Equipment Mechanic	54.11	56.19	58.41
Group D:			
Flagger	$ 37.20	$ 38.63	$ 40.16

Additional 3% per hour above regular rate for entire crew when a helicopter is used. This will increase to 5% on May 3, 2027.

SHIFT WORK

The following rates will apply on all contracting agency mandated multiple shifts of at least five (5) days duration worked between the hours listed below:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

SUPPLEMENTAL BENEFITS

Per hour:

	07/01/2026	05/03/2027	05/01/2028
Group A	$ 32.91*	$ 34.41*	$ 35.91*
Group B	$ 28.91*	$ 30.41*	$ 31.91*
Group C	$ 28.51*	$ 29.71*	$ 30.91*
Group D	$ 28.41*	$ 29.54*	$ 30.67*

*NOTE: Plus 7% of the hourly wage paid. The 7% is based on the straight time rate or the premium time rate.

OVERTIME PAY

See (B, E, Q, X) on OVERTIME PAGE. NOTE: Double time for emergency work designated by the Contracting Agency.
WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY

Paid	See (5, 6, 8, 15, 25) on HOLIDAY PAGE
Overtime	See (5, 6, 8, 15, 25) on HOLIDAY PAGE

NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES

WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyworker's Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

	07/01/2026	05/03/2027	05/01/2028
All terms:	$ 28.41*	$ 29.54*	$ 30.67*

*NOTE: Plus 7% of the hourly wage paid. The 7% is based on the straight time rate or the premium time rate.

6-1249aWest

Lineman Electrician - Teledata — 08/01/2026

JOB DESCRIPTION Lineman Electrician - Teledata **DISTRICT** 6

ENTIRE COUNTIES

Albany, Allegany, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Lewis, Livingston, Madison, Monroe, Montgomery, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

NOTE: Applies to all public work and covered private projects, including those receiving ConnectAll funding subject to LL 224-E,solicited prior to July 1, 2025. For all projects, excluding dial-up internet access service, solicited on or after July 1, 2025, please see BROADBAND

Per hour:	07/01/2026	01/04/2027	01/03/2028	01/01/2029
Cable Splicer	$ 42.03	$ 43.30	$ 44.59	$ 45.93
Installer, Repairman	39.89	41.09	42.32	43.59
Teledata Lineman	39.89	41.09	42.32	43.59
Tech., Equip. Operator	39.89	41.09	42.32	43.59
Groundman/Flagger	21.14	21.78	22.43	23.10

For outside work, stopping at first point of attachment (demarcation).

NOTE: EXCLUDES Teledata work within ten (10) feet of High Voltage (600 volts and over) transmission lines. For this work, please see LINEMAN.

SHIFT WORK
The following rates apply when the contracting agency mandates multiple shifts of at least five (5) days duration are worked. When two (2) or three (3) shifts are worked the following rates apply:

1ST SHIFT	REGULAR RATE
2ND SHIFT	REGULAR RATE PLUS 10%
3RD SHIFT	REGULAR RATE PLUS 15%

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker	$ 6.18 plus 4%*	$ 6.43 plus 5%*	$ 6.43 plus 6%*	$ 6.68 plus 7%*

*NOTE: The percentage (%) listed above is based on the hourly wage paid, straight time rate or premium time rate.

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE
WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16) on HOLIDAY PAGE

6-1249LT - Teledata

Lineman Electrician - Traffic Signal, Lighting — 08/01/2026

JOB DESCRIPTION Lineman Electrician - Traffic Signal, Lighting **DISTRICT** 6

ENTIRE COUNTIES
Westchester

WAGES
Lineman/Technician shall perform all overhead aerial work. A Lineman/Technician on the ground will install all electrical panels, connect all grounds, install and connect all electrical conductors which includes, but is not limited to road loop wires; conduit and plastic or other type pipes that carry conductors, flex cables and connectors, and to oversee the encasement or burial of such conduits or pipes.

Crane Operators: Operation of any type of crane on Traffic Signal/Lighting projects.
Crawler Backhoe: Operation of tracked excavator/crawler backhoe with 1/2 yard bucket or larger on Traffic Signal/Lighting projects.
Digging Machine Operator: All other digging equipment and augering on Traffic Signal/Lighting projects.

A Groundman/Groundman Truck Driver shall: Build and set concrete forms, handle steel mesh, set footer cages, transport concrete in a wheelbarrow, hand or machine concrete vibrator, finish concrete footers, mix mortar, grout pole bases, cover and maintain footers while curing in cold weather, operate jack hammer, operate hand pavement breaker, tamper, concrete and other motorized saws, as a drill helper, operate and maintain generators, water pumps, chainsaws, sand blasting, operate mulching and seeding machine, air tools, electric tools, gas tools, load and unload materials, hand shovel and/or broom, prepare and pour mastic and other fillers, assist digger operator/equipment operator in ground excavation and restoration, landscape work and painting. Only when assisting a lineman technician, a groundman/truck driver may assist in installing conduit, pipe, cables and equipment.

A flagger's duties shall consist of traffic control only.

Per hour:	07/01/2026	05/03/2027	05/01/2028
Group A:			
Lineman, Technician	$ 61.18	$ 63.52	$ 66.01
Crane, Crawler Backhoe	61.18	63.52	66.01
Certified Welder	64.24	66.70	69.31
Group B:			
Digging Machine	$ 55.06	$ 57.17	$ 59.41
Group C:			
Tractor Trailer Driver	$ 52.00	$ 53.99	$ 56.11
Groundman, Truck Driver	48.94	50.82	52.81
Equipment Mechanic	48.94	50.82	52.81
Group D:			

Flagger	$ 36.71	$ 38.11	$ 39.61

Above rates are applicable for installation, testing, operation, maintenance and repair on all Traffic Control (Signal) and Illumination (Lighting) projects, Traffic Monitoring Systems, and Road Weather Information Systems. Includes digging of holes for poles, anchors, footer foundations for electrical equipment; assembly of all electrical materials or raceway; placing of fish wire; pulling of cables, wires or fiber optic cable through such raceways; splicing of conductors; dismantling of such structures, lines or equipment.

SHIFT WORK
The following rates will apply on all contracting agency mandated multiple shifts of at least five (5) days duration worked between the hours listed below:

1ST SHIFT	8:00 AM TO 4:30 PM REGULAR RATE
2ND SHIFT	4:30 PM TO 1:00 AM REGULAR RATE PLUS 17.3%
3RD SHIFT	12:30 AM TO 9:00 AM REGULAR RATE PLUS 31.4%

SUPPLEMENTAL BENEFITS
Per hour:

	07/01/2026	05/03/2027	05/01/2028
Group A	$ 32.91*	$ 34.41*	$ 35.91*
Group B	$ 28.91*	$ 30.41*	$ 31.91*
Group C	$ 28.51*	$ 29.71*	$ 30.91*
Group D	$ 28.41*	$ 29.54*	$ 30.67*

*NOTE: Plus 7% of the hourly wage paid. The 7% is based on the straight time rate or the premium time rate.

OVERTIME PAY
See (B, E, Q, X) on OVERTIME PAGE. NOTE: Double time for emergency work designated by the Contracting Agency.
WAGE CAP - Double the straight time hourly base wage shall be the maximum hourly wage compensation for any hour worked. Contractor is still responsible to pay the hourly benefit amount for each hour worked.

HOLIDAY
Paid: See (5, 6, 8, 15, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25) on HOLIDAY PAGE
NOTE: All paid holidays falling on Saturday shall be observed on the preceding Friday. All paid holidays falling on Sunday shall be observed on the following Monday. Supplements for holidays paid at straight time.

REGISTERED APPRENTICES
WAGES per hour: 1000 hour terms at the following percentage of the applicable Journeyworker's Lineman wage.

1st	2nd	3rd	4th	5th	6th	7th
60%	65%	70%	75%	80%	85%	90%

SUPPLEMENTAL BENEFITS per hour:

	07/01/2026	05/03/2027	05/01/2028
All terms:	$ 28.41*	$ 29.54*	$ 30.67*

*NOTE: Plus 7% of the hourly wage paid. The 7% is based on the straight time rate or the premium time rate.

6-1249aWestLT

Mason - Building — 08/01/2026

JOB DESCRIPTION Mason - Building **DISTRICT** 11

ENTIRE COUNTIES
Putnam, Rockland, Westchester

PARTIAL COUNTIES
Orange: Only the Township of Tuxedo.

WAGES
Per hour:

	07/01/2026
Bricklayer	$ 50.15
Cement Mason	50.15
Plasterer/Stone Mason	50.15
Pointer/Caulker	50.15

Additional $1.00 per hour for power saw work
Additional $0.50 per hour for swing scaffold or staging work

SHIFT WORK
SHIFT WORK: When shift work or an irregular workday is mandated or required by state, federal, county, local or other governmental agency contracts, the following premiums apply:
Irregular workday requires 15% premium
Second shift an additional 15% of wage plus benefits to be paid
Third shift an additional 25% of wage plus benefits to be paid

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker $ 40.15

OVERTIME PAY
OVERTIME:
Cement Mason See (B, E, Q, W) on OVERTIME PAGE.
All Others See (B, E, E2, Q) on OVERTIME PAGE.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE
Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES
Wages per hour:

750 hour terms at the following percentage of Journeyworker's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of Journeyworker supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

11-5wp-b

Mason - Building — 08/01/2026

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
Building

Wages per hour:	07/01/2026	01/01/2027 Additional
Mosaic & Terrazzo Mechanic	$ 62.82	$ 1.06
Mosaic & Terrazzo Finisher	61.22	

SUPPLEMENTAL BENEFITS
Per hour:

Mosaic & Terrazzo Mechanic	$ 31.91* + $11.63
Mosaic & Terrazzo Finisher	$ 31.91* + 11.61

*This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY
See (A, E, Q) on OVERTIME PAGE
Deduct $7.00 from hourly wages before calculating overtime.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE
Easter Sunday is an observed holiday.Holidays falling on a Saturday will be observed on that Saturday. Holidays falling on a Sunday will be celebrated on the Monday.

REGISTERED APPRENTICES

Wages Per hour:

	1st 0-1500	2nd 1501-3000	3rd 3001-3750	4th 3751-4500	5th 4501-5250	6th 5251-6000
07/01/2026	$25.90	$33.30	$40.85	$42.00	$50.56	$57.05

Supplemental Benefits per hour:

07/01/2026	$7.26* + 4.07	$9.33* + 5.23	$15.99* + 6.98	$24.31* + 8.14	$25.21* + 9.32	$28.21* + 10.46

*This portion of benefits subject to same premium rate as shown for overtime wages.

9-7/3

Mason - Building — 08/01/2026

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES

Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour:	07/01/2026	12/07/2026 Additional	06/07/2027 Additional
Tile Setters	$ 66.35	$ 1.28	$ 1.41

SUPPLEMENTAL BENEFITS

Per Hour:

$ 30.56*
+8.56

*This portion of benefits subject to same premium rate as shown for overtime wages.

OVERTIME PAY

See (B, *E, Q, V) on OVERTIME PAGE
Work beyond 10 hours on Saturday shall be paid at double the hourly wage rate.

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage per hour:

750 hour terms at the following wage rate:

	1st 1-750	2nd 751-1500	3rd 1501-2250	4th 2251-3000	5th 3001-3750	6th 3751-4500	7th 4501-5250	8th 5251-6000	9th 6001-6750	10th 6501-7000
07/01/2026	$23.09	$28.32	$35.65	$40.86	$44.67	$48.38	$52.23	$57.45	$59.83	$66.35

Supplemental Benefits per hour:

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
07/01/2026	$13.05* + $.77	$13.05* + $.82	$16.16* + $.93	$16.16* + $.98	$17.16* +$1.45	$18.66* +$1.51	$19.66* +$1.94	$19.66* +$1.99	$19.96* +$4.59	$30.56* +$8.56

*This portion of benefits subject to same premium rate as shown for overtime wages.

9-7/52

Mason - Building — 08/01/2026

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2026	01/04/2027 Additional
Building-Marble Restoration:		
Marble, Stone & Terrazzo Polisher	$ 48.72	$ 0.57

SUPPLEMENTAL BENEFITS

Per Hour:	
Journeyworker	
Building-Marble Restoration:	
Marble, Stone & Polisher	$ 32.78

OVERTIME PAY
See (B, *E, Q, V) on OVERTIME PAGE
* On Saturdays, 8th hour and successive hours paid at double hourly rate.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
WAGES per hour:

900 hour term at the following wage:

	1st 1-900	2nd 901-1800	3rd 1801-2700	4th 2701
07/01/2026	$ 34.10	$ 38.97	$ 43.84	$ 48.72
Supplemental Benefits Per Hour:				
07/01/2026	$ 31.28	$ 31.78	$ 32.29	$ 32.78

9-7/24-MP

Mason - Building — 08/01/2026

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Dutchess, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Suffolk, Sullivan, Ulster, Westchester

WAGES
Per Hour:

	07/01/2026	01/04/2027 Additional
Marble Cutters & Setters	$ 65.61	$ 0.75

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker	$ 41.38

OVERTIME PAY
See (B, E, Q, V) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wage Per Hour:

750 hour terms at the following wage

1st	2nd	3rd	4th	5th	6th	7th	8th

	0-3000	3001-3750	3751-4500	4501-5250	5251-6000	6001-6750	6751-7500	7500+
07/01/2026	$28.35	$42.51	$46.05	$49.59	$53.14	$55.76	$65.61	$65.61

Supplemental Benefits per hour:

	1st	2nd	3rd	4th	5th	6th	7th	8th
07/01/2026	$27.95	$30.68	$31.37	$32.05	$32.73	$39.34	$41.38	$41.38

9-7/4

Mason - Building **08/01/2026**

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES

Per hour:	07/01/2026	12/07/2026 Additional	06/07/2027 Additional
Tile Finisher	$ 50.93	$ 1.05*	$ 1.15*

*To be allocated at a later date.

SUPPLEMENTAL BENEFITS
Per Hour:
$ 27.16*
+ $8.37

* This portion of benefits is subject to same premium rate as shown for overtime wages.

OVERTIME PAY
See (A, *E, Q) on OVERTIME PAGE
*Double time rate after 10 hours on Saturdays

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25) on HOLIDAY PAGE

9-7/88-tf

Mason - Building **08/01/2026**

JOB DESCRIPTION Mason - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2026	01/04/2027 Additional
Marble, Stone, Maintenance Finishers:	$ 28.56	$ 0.41

Note 1: An additional $2.00 per hour for time spent grinding floor using "60 grit" and below.
Note 2: Flaming equipment operator shall be paid an additional $25.00 per day.

SUPPLEMENTAL BENEFITS
Per Hour:

Marble, Stone
Maintenance Finishers: $ 16.54

OVERTIME PAY
See (B, *E, Q, V) on OVERTIME PAGE

*Double hourly rate after 8 hours on Saturday

HOLIDAY
Paid: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 11, 15, 25) on HOLIDAY PAGE
1st term apprentice gets paid for all observed holidays.

REGISTERED APPRENTICES
WAGES per hour:

	07/01/2026
0-750	$ 23.78
751-1500	24.43
1501-2250	25.07
2251-3000	25.70
3001-3750	26.65
3751-4500	27.93
4501+	28.56

Supplemental Benefits:
Per hour:

0-750	$ 12.61
751-1500	13.12
1501-2250	13.65
2251-3000	14.18
3001-3750	14.97
3751-4500	16.01
4501+	16.54

9-7/24M-MF

Mason - Building / Heavy&Highway — 08/01/2026

JOB DESCRIPTION Mason - Building / Heavy&Highway **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Suffolk, Westchester

WAGES
Per hour:

	07/01/2026	01/04/2027 Additional
Marble-Finisher	$ 51.04	$ 0.53

SUPPLEMENTAL BENEFITS
Journeyworker:
Per hour

Marble- Finisher	$ 38.46

OVERTIME PAY
See (B, E, Q, V) on OVERTIME PAGE
Work beyond 8 hours on a Saturday shall be paid at double the rate.

HOLIDAY
Overtime: See (5, 6, 8, 11, 15, 16, 25) on HOLIDAY PAGE
When an observed holiday falls on a Sunday, it will be observed the next day.

9-7/20-MF

Mason - Heavy&Highway — 08/01/2026

JOB DESCRIPTION Mason - Heavy&Highway **DISTRICT** 11

ENTIRE COUNTIES
Putnam, Rockland, Westchester

PARTIAL COUNTIES
Orange: Only the Township of Tuxedo.

WAGES
Per hour:

	07/01/2026
Bricklayer	$ 50.65
Cement Mason	50.65
Marble/Stone Mason	50.65

Plasterer	50.65
Pointer/Caulker	50.65

Additional $1.00 per hour for power saw work
Additional $0.50 per hour for swing scaffold or staging work

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker	$ 40.15

OVERTIME PAY

Cement Mason	See (B, E, Q, W)
All Others	See (B, E, Q,)

HOLIDAY

Paid:	See (5, 6, 16, 25) on HOLIDAY PAGE
Overtime:	See (5, 6, 16, 25) on HOLIDAY PAGE

- Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.
- Supplemental Benefits are not paid for paid Holiday
- If Holiday is worked, Supplemental Benefits are paid for hours worked.
- Whenever an Employee works within three (3) calendar days before a holiday, the Employee shall be paid for the Holiday.

REGISTERED APPRENTICES
Wages per hour:

750 hour terms at the following percentage of Journeyworker's wage

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

Supplemental Benefits per hour

750 hour terms at the following percentage of Journeyworker's supplements

1st	2nd	3rd	4th	5th	6th	7th	8th
50%	55%	60%	65%	70%	75%	80%	85%

11-5WP-H/H

Operating Engineer - Building — 08/01/2026

JOB DESCRIPTION Operating Engineer - Building **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, New York, Putnam, Queens, Richmond, Westchester

PARTIAL COUNTIES
Dutchess: that part of Dutchess County lying south of the North City Line of the City of Poughkeepsie.

WAGES
NOTE: Construction surveying
Party Chief--One who directs a survey party
Instrument Man--One who runs the instrument and assists Party Chief.
Rodman--One who holds the rod and assists the Survey Crew

Wages:(Per Hour) 07/01/2026

Building Construction:

Party Chief	$ 81.94
Instrument Man	60.49
Rodman	40.63

Steel Erection:

Party Chief	$ 84.04
Instrument Man	63.19
Rodman	43.31

Heavy Construction-NYC counties only:
(Foundation, Excavation.)

Party Chief	$ 88.97
Instrument man	66.04
Rodman	55.85

SUPPLEMENTAL BENEFITS

Per Hour:	07/01/2026
Building Construction	$ 29.45* + 7.65
Steel Erection	31.25* + 7.65
Heavy Construction	32.06* + 7.64

* This portion subject to SAME premium as wages

Non-Worked Holiday Supplemental Benefit:
$ 22.48

OVERTIME PAY
See (A, B, E, Q) on OVERTIME PAGE
Code "A" applies to Building Construction and is subject to double the rate after 7 hours on Saturdays.
Code "B" applies to Heavy Construction and Steel Erection and is subject to double the rate after 8 hours on Saturdays.

HOLIDAY
Paid: See (5, 6, 9, 11, 15, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 9, 11, 15, 16, 25) on HOLIDAY PAGE

9-15Db

Operating Engineer - Building 08/01/2026

JOB DESCRIPTION Operating Engineer - Building **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Westchester

PARTIAL COUNTIES
Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

WAGES
GROUP I:
Cranes (All Types up to 49 tons), Boom Trucks, Cherry Pickers (All Types), Clamshell Crane, Derrick (Stone and Steel), Dragline, Franki Pile Rig or similar, High Lift (Lull or similar) with crane attachment and winch used for hoisting or lifting, Hydraulic Cranes, Pile Drivers, Potain and similar.

Cranes (All types 50-99 tons), Drill Rig Casa Grande (CAT or similar), Franki Pile Rig or similar, Hydraulic Cranes (All types including Crawler Cranes- No specific boom length).

Cranes (All types 100 tons and over), All Tower Cranes, All Climbing Cranes irrespective of manufacturer and regardless of how the same is rigged, Franki Pile Rig or similar, Conventional Cranes (All types including Crawler Cranes-No specific boom length), Hydraulic Cranes.

GROUP I-A: Barber Green Loader-Euclid Loader, Bulldozer, Carrier-Trailer Horse, Concrete Cleaning Decontamination Machine Operator, Concrete-Portable Hoist, Conway or Similar Mucking Machines, Elevator & Cage, Excavators all types, Front End Loaders, Gradall, Shovel, Backhoe, etc.(Crawler or Truck), Heavy Equipment Robotics Operator/Mechanic, Hoist Engineer-Material, Hoist Portable Mobile Unit, Hoist(Single, Double or Triple Drum), Horizontal Directional Drill Locator, Horizontal Directional Drill Operator and Jersey Spreader, Letourneau or Tournapull(Scrapers over 20 yards Struck), Lift Slab Console, etc., Lull HiLift or Similar, Master Environmental Maintenance Mechanics, Mucking Machines Operator/Mechanic or Similar Type, Overhead Crane, Pavement Breaker(Air Ram), Paver(Concrete), Post Hole Digger, Power House Plant, Road Boring Machine, Road Mix Machine, Ross Carrier and Similar Machines, Rubber tire double end backhoes and similar machines, Scoopmobile Tractor-Shovel Over 1.5 yards, Shovel (Tunnels), Spreader (Asphalt) Telephie(Cableway), Tractor Type Demolition Equipment, Trenching Machines-Vermeer Concrete Saw Trencher and Similar, Ultra High Pressure Waterjet Cutting Tool System, Vacuum Blasting Machine operator/mechanic, Winch Truck A Frame.

GROUP I-B: Compressor (Steel Erection), Mechanic (Outside All Types), Negative Air Machine (Asbestos Removal), Push Button (Buzz Box) Elevator.

GROUP II: Compactor Self-Propelled, Concrete Pump, Crane Operator in Training (Over 100 Tons), Grader, Machines Pulling Sheep's Foot Roller, Roller (4 ton and over), Scrapers (20 yards Struck and Under), Vibratory Rollers, Welder.

GROUP III-A: Asphalt Plant, Concrete Mixing Plants, Forklift (All power sources), Joy Drill or similar, Tractor Drilling Machine, Loader (1 1/2 yards and under), Portable Asphalt Plant, Portable Batch Plant, Portable Crusher, Skid Steer (Bobcat or similar), Stone Crusher, Well Drilling Machine, Well Point System.

GROUP III-B: Compressor Over 125 cu. Feet, Conveyor Belt Machine regardless of size, Compressor Plant, Ladder Hoist, Stud Machine.

GROUP IV-A: Batch Plant, Concrete Breaker, Concrete Spreader, Curb Cutter Machine, Finishing Machine-Concrete, Fine Grading Machine, Hepa Vac Clean Air Machine, Material Hopper(sand, stone, cement), Mulching Grass Spreader, Pump Gypsum etc, Pump-Plaster-Grout-Fireproofing. Roller(Under 4 Ton),Spreading and Fine Grading Machine, Steel Cutting Machine, Siphon Pump, Tar Joint Machine, Television Cameras for Water, Sewer, Gas etc. Turbo Jet Burner or Similar Equipment, Vibrator (1 to 5).

GROUP IV-B: Compressor (all types), Heater (All Types), Fire Watchman, Lighting Unit (Portable & Generator) Pump, Pump Station(Water, Sewer, Portable, Temporary), Welding Machine (Steel Erection & Excavation).

GROUP V: Mechanics Helper, Motorized Roller (walk behind), Stock Attendant, Welder's Helper, Maintenance Engineer Crane(75 ton and over).

Group VI-A: Welder Certified
GROUP VI-B: Utility Man, Warehouse Man.

WAGES: (per hour)

	07/01/2026	03/01/2027
GROUP I		
Cranes- up to 49 tons	$ 71.19	$ 73.11
Cranes- 50 tons to 99 tons	73.69	75.69
Cranes- 100 tons and over	84.27	86.64
GROUP I-A	62.20	63.80
GROUP I-B	57.24	58.67
GROUP II	59.98	61.50
GROUP III-A	57.75	59.20
GROUP III-B	54.93	56.28
GROUP IV-A	57.16	58.58
GROUP IV-B	48.17	49.28
GROUP V	52.01	53.25
Group VI-A	61.05	62.61
GROUP VI-B		
Utility Man	49.30	50.45
Warehouse Man	51.72	52.95

An additional 20% of wage to be paid when required to wear protective equipment on hazardous/toxic waste projects.
Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional $2.00 per hour.
Engineers operating cranes with booms 149 feet or over in length will be paid an additional $3.00 per hour.
Loader operators over 5 cubic yard capacity additional .50 per hour.
Shovel operators over 4 cubic yard capacity additional $1.00 per hour.

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker	$ 34.42	$ 36.17

OVERTIME PAY
See (B, E, Q, V) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25, 26, 28) on HOLIDAY PAGE

8-137B

Operating Engineer - Heavy&Highway **08/01/2026**

JOB DESCRIPTION Operating Engineer - Heavy&Highway **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Westchester

PARTIAL COUNTIES
Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

WAGES
GROUP I: Boom Truck, Cherry Picker, Clamshell, Crane, (Crawler, Truck),
Dragline, Drill Rig (Casa Grande, Cat, or Similar), Floating Crane (Crane on Barges) under 100 tons, Gin Pole, Hoist Engineer-Concrete (Crane-Derrick-Mine Hoist), Knuckle Boom Crane, Rough Terrain Crane.

GROUP I-A: Auger (Truck or Truck Mounted), Boat Captain, Bulldozer-All Sizes, Central Mix Plant Operator, Chipper (all types), Close Circuit T.V., Combination Loader/Backhoe, Compactor with Blade, Concrete Finishing Machine, Gradall, Grader (Motor Grader), Elevator & Cage (Materials or Passenger), Excavator (and all attachments), Front End Loaders (1 1/2 yards and over), High Lift Lull and similar, Hoist (Single, Double, Triple Drum), Hoist Portable Mobile Unit, Hoist Engineer (Material), Jack and Bore Machine, Log Skidders, Mill Machines, Mucking Machines, Overhead Crane, Paver (concrete), Post Pounder (of any type), Push Cats, Road Reclaimer, Robot Hammer (Brokk or similar), Robotic Equipment (Scope of Engineer Schedule), Ross Carrier and similar, Scrapers (20 yard struck and over), Side Boom, Slip Form Machine, Spreader (Asphalt), Trenching Machines (Telephies-Vermeer Concrete Saw), Tractor Type Demolition Equipment, Vacuum Truck. Vibratory Roller(Riding) or Roller used in mainline paving operations.

GROUP I-B: Asphalt Mobile Conveyor/Transfer Machine, Road Paver (Asphalt).

GROUP II-A: Ballast Regulators, Compactor Self Propelled, Fusion Machine, Rail Anchor Machines, Roller (4 ton and over), Scrapers (20 yard struck and under).

GROUP II-B: Mechanic (Outside) All Types, Shop Mechanic.

GROUP III: Air Tractor Drill, Asphalt Plant, Batch Plant, Boiler (High Pressure), Concrete Breaker (Track or Rubber Tire), Concrete Pump, Concrete Spreader, Excavator Drill, Farm Tractor, Forklift (all types), Gas Tapping (Live), Hydroseeder, Loader (1 1/2 yards and under), Locomotive (all sizes), Machine Pulling Sheeps Foot Roller, Portable Asphalt Plant, Portable Batch Plant, Portable Crusher (Apprentice), Powerhouse Plant, Roller (under 4 ton), Sheer Excavator, Skid Steer/Bobcat, Stone Crusher, Sweeper (with seat), Well Drilling Machine.

GROUP IV: Service Person (Grease Truck), Deckhand.

GROUP IV-B: Conveyor Belt Machine (Truck Mounted), Heater (all types), Lighting Unit (Portable), Maintenance Engineer (For Crane Only), Mechanics Helper, Pump (Fireproofing), Pumps-Pump Station/Water/Sewer/Gypsum/Plaster, etc., Pump Truck (Sewer Jet or Similar), Welders Helper, Welding Machine (Steel Erection), Well Point System.

GROUP V: All Tower Cranes-All Climbing Cranes and all cranes of 100-ton capacity or greater (3900 Manitowac or similar) irrespective of manufacturer and regardless of how the same is rigged, Hoist Engineer (Steel), Engineer-Pile Driver, Jersey Spreader, Pavement Breaker/Post Hole Digger.

WAGES: Per hour:	07/01/2026	03/01/2027
Group I	$ 72.77	$ 75.10
Group I-A	63.97	65.99
Group I-B	67.49	69.64
Group II-A	61.21	63.14
Group II-B	63.17	65.17
Group III	60.12	62.01
Group IV	54.49	56.18
Group IV-B	46.59	48.01
Group V		
Engineer All Tower, Climbing and Cranes of 100 Tons	82.61	85.29
Hoist Engineer(Steel)	74.67	77.07
Engineer(Pile Driver)	79.73	82.31
Jersey Spreader, Pavement Breaker (Air Ram)Post Hole Digger	62.66	64.64

Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional $2.00 per hour over the rate listed in the Wage Schedule. Engineers operating cranes with booms 149 feet or over in length will be paid an additional $3.00 per hour over the rate listed in the Wage Schedule. Loader and Excavator Operators: over 5 cubic yards capacity $0.50 per hour over the rate listed in the Wage Schedule. Shovel Operators: over 4 cubic yards capacity $1.00 per hour over the rate listed in the Wage Schedule.

SHIFT WORK

A 15% premium on all hours paid, including overtime hours for 2nd and 3rd shifts on all government mandated off-shift work

SUPPLEMENTAL BENEFITS

Per hour:

Journeyworker:	$ 38.08 up to 40 Hours	$ 39.68 up to 40 hours
	After 40 hours $ 27.63* PLUS $ 1.45 on all hours worked	After 40 hours $ 28.68* PLUS $ 1.50 on all hours worked

*This amount is subject to premium

OVERTIME PAY
See (B, E, P, *R, **U) on OVERTIME PAGE
* For Holiday codes 8,15,25,26 code R applies
** For Holiday codes 5 & 6 code U applies

HOLIDAY
Paid: See (5, 6, 8, 15, 25, 26, 28) on HOLIDAY PAGE
Overtime See (5, 6, 8, 15, 25, 26) on OVERTIME PAGE

* For Holiday codes 8,15,25,26 code R applies
** For Holiday codes 5 & 6 code U applies

Note: If employees are required to work on Easter Sunday they shall be paid at the rate of triple time.

REGISTERED APPRENTICES
(1)year terms at the following rate.

1st term	$ 38.38	$ 39.59
2nd term	44.78	46.19
3rd term	51.18	52.79
4th term	57.57	59.39

Supplemental Benefits per hour:

	$ 29.08	$ 30.18

8-137HH

Operating Engineer - Heavy&Highway — 08/01/2026

JOB DESCRIPTION Operating Engineer - Heavy&Highway **DISTRICT** 9

ENTIRE COUNTIES
Putnam, Westchester

PARTIAL COUNTIES
Dutchess: South of the North city line of Poughkeepsie

WAGES
Party Chief - One who directs a survey party
Instrument Man - One who runs the instrument and assists Party Chief
Rodman - One who holds the rod and in general, assists the Survey Crew
Categories cover GPS & Underground Surveying

Per Hour:	07/01/2026
Party Chief	$ 85.77
Instrument Man	63.48
Rodman	53.53

SUPPLEMENTAL BENEFITS
Per Hour: 07/01/2026

All Categories
Straight Time: $ 32.06* + $7.64

Premium:
Time & 1/2 $ 48.09* + $7.64

Double Time $ 64.12* + $7.64

*This portion is subject to the SAME premium as wages.

Non-Worked Holiday Supplemental Benefits:
$ 22.47

OVERTIME PAY
See (B, *E, Q) on OVERTIME PAGE
* Doubletime paid on all hours in excess of 8 hours on Saturday

HOLIDAY
Paid: See (5, 6, 7, 11, 12) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 12) on HOLIDAY PAGE

Operating Engineer - Heavy&Highway - Tunnel 08/01/2026

JOB DESCRIPTION Operating Engineer - Heavy&Highway - Tunnel **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Westchester

PARTIAL COUNTIES
Dutchess: All the counties of Westchester and Putnam and the southern part of Dutchess County defined by the northern boundary line of the City of Poughkeepsie, then due east to Route 115, then north along Route 115 to Bedell Road, then east along Bedell Road to Van Wagner Road, then north along Van Wagner Road to Bower Road, then east along Bower Road to Route 44 and along Route 44 east to Route 343, then along Route 343 east to the northern boundary of Town of Dover Plains and east along the northern boundary of Town of Dover Plains to the border line of the State of Connecticut and bordered on the west by the middle of the Hudson River.

WAGES
GROUP I: Boom Truck, Cherry Picker, Clamshell, Crane(Crawler, Truck), Dragline, Drill Rig Casa Grande(Cat or Similar), Floating Crane(Crane on Barge-Under 100 Tons), Hoist Engineer(Concrete/Crane-Derrick-Mine Hoist), Knuckle Boom Crane, Rough Terrain Crane.

GROUP I-A: Auger(Truck or Truck Mounted), Boat Captain, Bull Dozer-all sizes, Central Mix Plant Operator, Chipper-all types, Close Circuit T.V., Combination Loader/Backhoe, Compactor with Blade, Concrete Finishing Machine, Gradall, Grader(Motor Grader), Elevator & Cage(Materials or Passengers), Excavator(and all attachments), Front End Loaders(1 1/2 yards and over), High Lift Lull, Hoist(Single, Double, Triple Drum), Hoist Portable Mobile Unit, Hoist Engineer(Material), Jack and Bore Machine, Log Skidder, Milling Machine, Moveable Concrete Barrier Transfer & Transport Vehicle, Mucking Machines. Overhead Crane, Paver(Concrete), Post Pounder of any type, Push Cats, Road Reclaimer, Robot Hammer(Brokk or similar), Robotic Equipment(Scope of Engineer Schedule), Ross Carrier and similar machines, Scrapers(20 yards struck and over), Side Boom, Slip Form Machine, Spreader(Asphalt), Trenching Machines, Telephies-Vermeer Concrete Saw, Tractor type demolition equipment, Vacuum Truck, Vibratory Roller (Riding) used in mainline paving operations.

GROUP I-B: Asphalt Mobile Conveyor/Transfer Machine, Road Paver(Asphalt).

GROUP II-A: Ballast Regulators, Compactor(Self-propelled), Fusion Machine, Rail Anchor Machines, Roller(4 ton and over), Scrapers(20 yard struck and under).

GROUP II-B: Mechanic(outside)all types, Shop Mechanic.

GROUP III: Air Tractor Drill, Asphalt Plant, Batch Plant, Boiler(High Pressure), Concrete Breaker(Track or Rubber Tire), Concrete Pump, Concrete Spreader, Excavator Drill, Farm Tractor, Forklift(all types of power), Gas Tapping(Live), Hydroseeder, Loader(1 1/2 yards and under), Locomotive(all sizes), Machine Pulling Sheeps Foot Roller, Portable Asphalt Plant, Portable Batch Plant, Portable Crusher(Apprentice), Powerhouse Plant, Roller(under 4 ton), Sheer Excavator, Skidsteer/Bobcat, Stone Crusher, Sweeper(with seat), Well Drilling Machine.

GROUP IV-A: Service Person(Grease Truck), Deckhand.

GROUP IV-B: Conveyor Belt Machine(Truck Mounted), Heater(all types), Lighting Unit(Portable), Maintenance Engineer(for Crane only), Mechanics Helper, Pump(Fireproofing), Pumps-Pump Station/Water/Sewer/Gypsum/Plaster, etc., Pump Truck(Sewer Jet or similar), Welding Machine(Steel Erection), Welders Helper.

GROUP V-A: Engineer(all Tower Cranes, all Climbing Cranes & all Cranes of 100 ton capacity or greater),Hoist Engineer(Steel-Sub Structure), Engineer-Pile Driver, Jersey-Spreader, Pavement breaker, Post Hole Digger

WAGES: (per hour)

	07/01/2026	03/01/2027
GROUP I	$ 72.77	$ 75.10
GROUP I-A	63.97	65.99
GROUP I-B	67.49	69.64
GROUP II-A	61.21	63.14
GROUP II-B	63.17	65.17
GROUP III	60.12	62.01
GROUP IV-A	54.49	56.18
GROUP IV-B	46.59	48.01

GROUP V-A		
Engineer-Cranes	82.61	85.29
Engineer-Pile Driver	79.73	82.31
Hoist Engineer	74.67	77.07
Jersey Spreader/Post Hole Digger	62.66	64.64

An additional 20% of wage to be paid when required to wear protective equipment on hazardous/toxic waste projects.
Operators required to use two buckets pouring concrete on other than road pavement shall receive $0.50 per hour over scale.
Engineers operating cranes with booms 100 feet but less than 149 feet in length will be paid an additional $2.00 per hour.
Engineers operating cranes with booms 149 feet or over in length will be paid an additional $3.00 per hour.
Operators of shovels with a capacity over (4) cubic yards shall be paid an additional $1.00 per hour.
Operators of loaders with a capacity over (5) cubic yards shall be paid an additional $0.50 per hour.

SHIFT WORK
A 15% premium on all hours paid, including overtime hours for 2nd and 3rd shifts
on all government mandated off-shift work

SUPPLEMENTAL BENEFITS
Per hour:
Journeyworker:

$ 38.08 up to 40 hours	$ 39.68 up to 40 hours
After 40 hours: $27.63 plus $1.45 on all hours worked	After 40 hours: $28.68 plus $1.50 on all hours worked

OVERTIME PAY
See (E, P, *R, **T, ***U) on OVERTIME PAGE
*For Holiday codes 8, 15, 25, 26, code R applies.
**For Holiday code 28, code T applies.
***For Holiday codes 5 & 6, code U applies.

HOLIDAY
Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
For Holiday codes 5 & 6, code U applies.
For Holiday codes 8, 15, 25, 26, code R applies.
If employees are required to work on Easter Sunday, they shall be paid at the rate of triple time.

REGISTERED APPRENTICES
(1)year terms at the following rates:

1st term	$ 38.38	$ 39.59
2nd term	44.78	46.19
3rd term	51.18	52.79
4th term	57.57	59.39
Supplemental Benefits per hour:		
All terms	$ 29.08	$ 30.18

8-137Tun

Operating Engineer - Marine Dredging — 08/01/2026

JOB DESCRIPTION Operating Engineer - Marine Dredging **DISTRICT** 4

ENTIRE COUNTIES
Albany, Bronx, Cayuga, Clinton, Columbia, Dutchess, Essex, Franklin, Greene, Jefferson, Kings, Monroe, Nassau, New York, Orange, Oswego, Putnam, Queens, Rensselaer, Richmond, Rockland, St. Lawrence, Suffolk, Ulster, Washington, Wayne, Westchester

WAGES
These wage rates do not apply to Operating Engineers on land-based construction projects. For those projects, refer to the Operating Engineers Heavy/Highway rates. The wage rates listed below apply specifically to all equipment and operators involved in marine dredging work within navigable waters located in the counties listed above.

Per Hour:	07/01/2026	10/01/2026

CLASS A1 Deck Captain, Leverman, Mechanical Dredge Operator, Licensed Tug Operator with MOTV	$ 48.48	$ 49.94
CLASS A2 Crane Operator (360 swing)	43.20	44.50
CLASS B Dozer, Front Loader Operator (On Land)	To conform to Operating Engineer Prevailing Wage in locality where work is being performed including benefits.	
CLASS B1 Derrick Operator (180 swing), Spider/Spill Barge Operator I/II, Fill Placer, Engineer, Chief Mate, Electrician,Chief Welder,Maintenance Engineer, Licensed Boat, Crew Boat Operator	41.93	43.18
CLASS B2 Certified Welder	39.46	40.65
CLASS C1 Drag Barge Operator, Steward, Mate, Assistant Fill Placer	38.38	39.53
CLASS C2 Boat Operator	37.15	38.26
CLASS D Shoreman, Deckhand, Oiler, Rodman, Scowman, Cook, Messman, Porter/Janitor	30.86	31.79

SUPPLEMENTAL BENEFITS
Per Hour:
THE FOLLOWING SUPPLEMENTAL BENEFITS APPLY TO ALL CATEGORIES

All Classes:	7% of Hourly Straight time wage + $12.00.	7.5% of Hourly Straight time wage + $12.00.

- Additional $0.63 per hour for Overtime hours

OVERTIME PAY
See (B2, F, R) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 26) on HOLIDAY PAGE

4-25a-MarDredge

Operating Engineer - Survey Crew - Consulting Engineer — 08/01/2026

JOB DESCRIPTION Operating Engineer - Survey Crew - Consulting Engineer **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

PARTIAL COUNTIES
Dutchess: That part in Duchess County lying South of the North City line of Poughkeepsie.

WAGES
Feasibility and preliminary design surveying, any line and grade surveying for inspection or supervision of construction.

Per hour: Survey Classifications	07/01/2026
Party Chief	$ 51.16
Instrument Man	42.44
Rodman	36.92

SUPPLEMENTAL BENEFITS
Per Hour:

All Crew Members: $ 24.53

OVERTIME PAY
OVERTIME:.... See (B, E*, Q, V) ON OVERTIME PAGE.
*Double-time paid on the 9th hour on Saturday.

HOLIDAY
Paid: See (5, 6, 7, 11, 16) on HOLIDAY PAGE
Overtime: See (5, 6, 7, 11, 16) on HOLIDAY PAGE

9-15dconsult

Painter — 08/01/2026

JOB DESCRIPTION Painter **DISTRICT** 8

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Putnam, Queens, Richmond, Suffolk, Westchester

WAGES

Per hour:	07/01/2026	05/01/2027 Additional
Brush	$ 55.76	$2.77*
Abatement/Removal of lead based or lead containing paint on materials to be repainted.	55.76	
Spray & Scaffold	$ 58.76	
Fire Escape	58.76	
Decorator	58.76	
Paperhanger/Wall Coverer	57.27	

*To be allocated at a later date.

SHIFT WORK
Agency/Government mandated off-shift work to be paid at time and one-half the hourly wage.

SUPPLEMENTAL BENEFITS
Per hour:

Paperhanger	$ 39.86
All others	36.72
Paperhanger Premium	45.26
Premium	41.23**

**Applies only to "All others" category, not paperhanger journeyworker.

OVERTIME PAY
See (A, F, R) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
One (1) year terms at the following wage rate.

Per hour:	07/01/2026
Appr 1st term...	$ 21.18
Appr 2nd term...	27.40
Appr 3rd term...	33.30
Appr 4th term...	44.67

Supplemental benefits:
Per Hour:

Appr 1st term...	$ 18.06
Appr 2nd term...	22.14
Appr 3rd term...	25.59

Appr 4th term... 32.55

8-NYDC9-B/S

Painter 08/01/2026

JOB DESCRIPTION Painter **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Suffolk, Westchester

PARTIAL COUNTIES
Nassau: All of Nassau except the areas described below: Atlantic Beach, Ceaderhurst, East Rockaway, Gibson, Hewlett, Hewlett Bay, Hewlett Neck, Hewlett Park, Inwood, Lawrence, Lido Beach, Long Beach, parts of Lynbrook, parts of Oceanside, parts of Valley Stream, and Woodmere. Starting on the South side of Sunrise Hwy in Valley Stream running east to Windsor and Rockaway Ave., Rockville Centre is the boundary line up to Lawson Blvd. turn right going west all the above territory. Starting at Union Turnpike and Lakeville Rd. going north to Northern Blvd. the west side of Lakeville road to Northern blvd. At Northern blvd. going east the district north of Northern blvd. to Port Washington Blvd. West of Port Washington blvd.to St.Francis Hospital then north of first traffic light to Port Washington and Sands Point, Manor HAven, Harbour Acres.

WAGES

Per hour:	07/01/2026	05/01/2027
		Additional
Drywall Taper:	$ 55.76	$ 2.77*
Scaffold:	$ 58.76	

* To be allocated a later date.

SHIFT WORK
Agency/Government mandated off-shift work to be paid at time and one-half hourly wage

SUPPLEMENTAL BENEFITS
Per hour:
Journeyworker $ 36.72

OVERTIME PAY
See (A, F, R) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages - Per Hour:

1500 hour terms at the following wage rate:

1st term	$ 21.18
2nd term	27.40
3rd term	33.30
4th term	44.67

Supplemental Benefits - Per hour:
One year term (1500 hours) at the following dollar amount.

1st year	$ 18.06
2nd year	22.14
3rd year	25.59
4th year	32.55

8-NYDCT9-DWT

Painter - Bridge & Structural Steel 08/01/2026

JOB DESCRIPTION Painter - Bridge & Structural Steel **DISTRICT** 8

ENTIRE COUNTIES
Albany, Bronx, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Kings, Montgomery, Nassau, New York, Orange, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES
Per Hour:
STEEL:

Bridge Painting:	07/01/2026	10/01/2026
	$ 57.00*	Additional
	+ 12.90**	+ 3.64***

ADDITIONAL $7.00 per hour for POWER TOOL/SPRAY, whether straight time or overtime.

*NOTE: All premium wages are to be calculated on base rate per hour only.

** For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (50 hour cap).

*** To be allocated a later date

NOTE: Generally, for Bridge Painting Contracts, ALL WORKERS on and off the bridge (including Flagmen) are to be paid Painter's Rate; the contract must be ONLY for Bridge Painting.

SHIFT WORK

When directly specified in public agency or authority contract documents for an employer to work a second shift and works the second shift with employees other than from the first shift, all employees who work the second shift will be paid 10% of the base wage shift differential in lieu of overtime for the first eight (8) hours worked after which the employees shall be paid at time and one half of the regular wage rate. When a single irregular work shift is mandated in the job specifications or by the contracting agency, wages shall be paid at time and one half for single shifts between the hours of 3pm-11pm or 11pm-7am.

SUPPLEMENTAL BENEFITS

Per Hour:
Journeyworker:

$ 13.49
+ 31.67*

OVERTIME PAY

See (B, F, R) on OVERTIME PAGE

HOLIDAY

Paid: See (1) on HOLIDAY PAGE
Overtime: See (4, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES

Wage - Per hour:
Apprentices: (1) year terms.

	07/01/2026
1st year	$ 22.80* + 5.64**
2nd year	$ 34.20* + 7.74**
3rd year	$ 45.60* + 10.31**

*NOTE: All premium wages are to be calculated on base rate per hour only.

** For the period of May 1st to November 15th, this amount is payable up to 40 hours. For the period of Nov 16th to April 30th, this amount is payable up to 50 hours. EXCEPTION: First and last week of employment, and for the weeks of Memorial Day, Independence Day and Labor Day, where the amount is paid for the actual number of hours worked (50 hour cap).

Supplemental Benefits - Per hour:

1st year	$ 13.74
2nd year	$ 8.09* + 18.99
3rd year	$ 10.79* + 25.34

*Portion not applicable to May 1st to November 15th and Nov 16th to April 30th period mentioned above.

8-DC-9/806/155-BrSS

Painter - Line Striping **08/01/2026**

JOB DESCRIPTION Painter - Line Striping **DISTRICT** 8

ENTIRE COUNTIES
Albany, Clinton, Columbia, Dutchess, Essex, Franklin, Fulton, Greene, Hamilton, Montgomery, Nassau, Orange, Putnam, Rensselaer, Rockland, Saratoga, Schenectady, Schoharie, Suffolk, Sullivan, Ulster, Warren, Washington, Westchester

WAGES
Per hour:

Painter (Striping-Highway):	07/01/2026	04/01/2027
Striping-Machine Operator*	$ 36.93	$ 38.45
Linerman Thermoplastic	44.44	46.22

Note: * Includes but is not limited to: Positioning of cones and directing of traffic using hand held devices. Excludes the Driver/Operator of equipment used in the maintenance and protection of traffic safety.

SHIFT WORK
When directly specified in public agency or authority contract documents there shall be a 30% night shift premium pay differential for all work performed after 9:00pm and before 5:00am.

SUPPLEMENTAL BENEFITS
Per hour paid:
Journeyworker:

Striping Machine Operator:	$ 24.95	$ 25.60
Linerman Thermoplastic:	24.95	25.60

OVERTIME PAY
See (B, B2, E2, F, S) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 20) on HOLIDAY PAGE
Overtime: See (5, 20) on HOLIDAY PAGE

REGISTERED APPRENTICES
One (1) year terms at the following wage rates:

	07/01/2026
1st Term:	$ 21.18
2nd Term:	27.40
3rd Term:	33.30

Supplemental Benefits per hour:

1st term:	$ 18.06
2nd term:	22.14
3rd term:	25.59

8-1456-LS

Painter - Metal Polisher 08/01/2026

JOB DESCRIPTION Painter - Metal Polisher **DISTRICT** 8

ENTIRE COUNTIES
Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES

	07/01/2026
Metal Polisher	$ 41.33
Metal Polisher*	42.43
Metal Polisher**	45.33

*Note: Applies on New Construction & complete renovation
** Note: Applies when working on scaffolds over 34 feet.

SUPPLEMENTAL BENEFITS
Per Hour:

Journeyworker:
All classifications $ 13.99

OVERTIME PAY
See (B, E, P, T) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 11, 15, 16, 25, 26) on HOLIDAY PAGE

REGISTERED APPRENTICES
Wages per hour:
One (1) year term at the following wage rates:

	07/01/2026
1st year	$ 20.67
2nd year	22.73
3rd year	24.80
1st year*	$ 21.06
2nd year*	23.17
3rd year*	25.34
1st year**	$ 23.17
2nd year**	25.23
3rd year**	27.30

*Note: Applies on New Construction & complete renovation
** Note: Applies when working on scaffolds over 34 feet.

Supplemental benefits:
Per hour:

1st year	$ 9.19
2nd year	9.19
3rd year	9.19

8-8A/28A-MP

Plumber — 08/01/2026

JOB DESCRIPTION Plumber **DISTRICT** 8

ENTIRE COUNTIES
Putnam, Westchester

WAGES
Per hour:

	07/01/2026
Plumber and Steamfitter	$ 66.83

SHIFT WORK

SHIFT WORK:
When directly specified in public agency or authority contract documents, shift work outside the regular hours of work shall be comprised of eight (8) hours per shift not including Saturday, Sundays and holidays. One half (1/2) hour shall be allowed for lunch after the first four (4) hours of each shift. Wage and Fringes for shift work shall be straight time plus a shift premium of twenty-five (25%) percent. A minimum of five days Monday through Friday must be worked to establish shift work.

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker $ 46.79

OVERTIME PAY
See (B, E, E2, Q, V) on OVERTIME PAGE
OVERTIME:... See on OVERTIME PAGE.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1)year terms at the following wages:

1st Term	$ 24.95
2nd Term	28.59
3rd Term	33.07
4th Term	47.01
5th Term	50.42

Supplemental Benefits per hour:

1st term	$ 19.16
2nd term	21.42
3rd term	25.44
4th term	33.77
5th term	35.82

8-21.1-ST

Plumber - HVAC / Service — 08/01/2026

JOB DESCRIPTION Plumber - HVAC / Service **DISTRICT** 8

ENTIRE COUNTIES
Dutchess, Putnam, Westchester

PARTIAL COUNTIES
Delaware: Only the townships of Middletown and Roxbury
Ulster: Entire County(including Wallkill and Shawangunk Prisons) except for remainder of Town of Shawangunk and Towns of Plattekill, Marlboro, and Wawarsing.

WAGES
Per hour: 07/01/2026

HVAC Service	$ 45.43
	+ $ 4.52*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

SUPPLEMENTAL BENEFITS
Per hour:

Journeyworker HVAC Service
$ 33.34

OVERTIME PAY
See (B, F, R) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
HVAC SERVICE
(1)year terms at the following wages:

1st yr.	2nd yr.	3rd yr.	4th yr.	5th yr.
$ 20.56	$ 24.42	$ 30.35	$ 37.33	$ 40.63
+$2.45*	+$2.79*	+$3.34*	+$4.00*	+$4.26*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental Benefits per hour:

Apprentices 07/01/2026

1st term	$ 22.81
2nd term	24.68
3rd term	26.69
4th term	29.49
5th term	31.46

8-21.1&2-SF/Re/AC

Plumber - Jobbing & Alterations — 08/01/2026

JOB DESCRIPTION Plumber - Jobbing & Alterations **DISTRICT** 8

ENTIRE COUNTIES
Dutchess, Putnam, Westchester

PARTIAL COUNTIES
Ulster: Entire county (including Wallkill and Shawangunk Prisons in Town of Shawangunk) EXCEPT for remainder of Town of Shawangunk, and Towns of Plattekill, Marlboro, and Wawarsing.

WAGES

Per hour:	07/01/2026
Journeyworker:	$ 52.14

Repairs, replacements and alteration work is any repair or replacement of a present plumbing system that does not change existing roughing or water supply lines.

SHIFT WORK
When directly specified in public agency or authority contract documents, shift work outside the regular hours of work shall be comprised of eight (8) hours per shift not including Saturday, Sundays and holidays. One half (1/2) hour shall be allowed for lunch after the first four (4) hours of each shift. Wage and Fringes for shift work shall be straight time plus a shift premium of twenty-five (25%) percent. A minimum of five days Monday through Friday must be worked to establish shift work.

SUPPLEMENTAL BENEFITS

Per hour:	
Journeyworker	$ 38.99

OVERTIME PAY
See (B, *E, E2, Q, V) on OVERTIME PAGE
*When used as a make-up day, hours after 8 on Saturday shall be paid at time and one half.

HOLIDAY

Paid:	See (1) on HOLIDAY PAGE
Overtime:	See (5, 6, 8, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1) year terms at the following wages:

1st year	$ 22.32
2nd year	24.83
3rd year	27.16
4th year	38.07
5th year	40.25

Supplemental Benefits per hour:

1st year	$ 13.07
2nd year	15.31
3rd year	19.67
4th year	26.65
5th year	28.88

8-21.3-J&A

Roofer 08/01/2026

JOB DESCRIPTION Roofer **DISTRICT** 9

ENTIRE COUNTIES
Bronx, Dutchess, Kings, New York, Orange, Putnam, Queens, Richmond, Rockland, Sullivan, Ulster, Westchester

WAGES

Per Hour:	07/01/2026	05/01/2027 Additional
Roofer/Waterproofer	$ 52.50 + $7.00*	+ $ 3.00

* This portion is not subjected to overtime premiums.

Note: Abatement/Removal of Asbestos containing roofs and roofing material is classified as Roofer.

SUPPLEMENTAL BENEFITS
Per Hour: $ 33.12

OVERTIME PAY
See (B, H) on OVERTIME PAGE

Note: An observed holiday that falls on a Sunday will be observed the following Monday.

HOLIDAY
Overtime: See (5, 6) on HOLIDAY PAGE

REGISTERED APPRENTICES
(1) year term apprentices indentured prior to 01/01/2023

1st	2nd	3rd	4th
$ 18.38	$ 26.25	$ 31.50	$ 39.38
	+ 3.50*	+ 4.20*	+ 5.26*

Supplemental Benefits:

1st	2nd	3rd	4th
$ 4.32	$ 16.94	$ 20.17	$ 25.03

* This portion is not subjected to overtime premiums.

(1) year term apprentices indentured after 01/01/2023

1st	2nd	3rd	4th	5th
$ 19.95	$ 23.63	$ 26.25	$ 31.50	$ 39.38
	+ 3.16*	+ 3.50*	+ 4.20*	+ 5.26*

Supplemental Benefits:

1st	2nd	3rd	4th	5th
$ 8.15	$ 15.32	$ 16.94	$ 20.17	$ 25.03

* This portion is not subjected to overtime premiums.

9-8R

Sheetmetal Worker — 08/01/2026

JOB DESCRIPTION Sheetmetal Worker **DISTRICT** 8

ENTIRE COUNTIES
Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

WAGES

	07/01/2026
SheetMetal Worker	$ 53.48
	+ 3.81*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

SHIFT WORK
For all NYS D.O.T. and other Governmental mandated off-shift work:
12% increase for additional shifts for a minimum of five (5) days

SUPPLEMENTAL BENEFITS
Journeyworker $ 48.71

OVERTIME PAY
See (B, E, Q,) on OVERTIME PAGE.

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 16, 23) on HOLIDAY PAGE
Whenever any of the above holidays fall on Sunday, they will be observed on Monday. Whenever any of the above holidays fall on Saturday, they will be observed on Friday.

REGISTERED APPRENTICES

1st	2nd	3rd	4th	5th	6th	7th	8th
$ 21.80	$ 22.61	$ 25.12	$ 27.61	$ 30.13	$ 32.67	$ 35.65	$ 38.61
+ 1.52*	+ 1.71*	+ 1.91*	+ 2.10*	+ 2.29*	+ 2.48*	+ 2.67*	+ 2.86*

*This portion of the benefit is NOT subject to the SAME PREMIUM as shown for overtime.

Supplemental Benefits per hour:

Apprentices	
1st term	$ 19.09
2nd term	23.39
3rd term	25.99
4th term	28.59
5th term	31.18
6th term	33.76

7th term	35.89
8th term	38.04

8-38

Sheetmetal Worker — 08/01/2026

JOB DESCRIPTION Sheetmetal Worker **DISTRICT** 4

ENTIRE COUNTIES
Bronx, Kings, Nassau, New York, Queens, Richmond, Rockland, Suffolk, Westchester

WAGES
Per Hour:

	07/01/2026	08/01/2026
Sign Erector	$ 62.00	$ 64.00

NOTE: For Structurally Supported Overhead Highway Signs (See STRUCTURAL IRON WORKER CLASSIFICATION)

SUPPLEMENTAL BENEFITS
Per Hour:

Sign Erector	$ 59.58	$ 60.62

OVERTIME PAY
See (B, F, S) on OVERTIME PAGE

HOLIDAY
Paid: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE
Overtime: See (5, 6, 10, 11, 12, 16, 25) on HOLIDAY PAGE

REGISTERED APPRENTICES
Per Hour:
6 month Terms at the following percentage of Sign Erectors wage rate:

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
35%	40%	45%	50%	55%	60%	65%	70%	75%	80%

SUPPLEMENTAL BENEFITS Per Hour:

07/01/2026

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
$ 19.04	$ 21.62	$ 24.21	$ 26.79	$36.17	$ 39.36	$ 43.50	$ 46.77	$ 50.05	$ 53.32

08/01/2026

1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
$ 19.45	$ 22.09	$ 24.72	$ 27.36	$36.81	$ 40.07	$ 44.29	$ 47.62	$ 50.95	$ 54.29

4-137-SE

Sprinkler Fitter — 08/01/2026

JOB DESCRIPTION Sprinkler Fitter **DISTRICT** 1

ENTIRE COUNTIES
Dutchess, Orange, Putnam, Rockland, Sullivan, Ulster, Westchester

WAGES
Per hour

	07/01/2026	01/01/2027	04/01/2027	01/01/2028
Sprinkler Fitter	$ 60.78	$ 60.78	$ 64.37	$ 64.37

SUPPLEMENTAL BENEFITS
Per hour

Journeyworker	$ 32.66	$ 33.66	$ 33.66	$ 34.66

OVERTIME PAY
See (B, E, Q) on OVERTIME PAGE

HOLIDAY
Paid: See (1) on HOLIDAY PAGE
Overtime: See (5, 6) on HOLIDAY PAGE

Note: When a holiday falls on Sunday, the following Monday shall be considered a holiday and all work performed on either day shall be at the double time rate. When a holiday falls on Saturday, the preceding Friday shall be considered a holiday and all work performed on either day shall be at the double time rate.

REGISTERED APPRENTICES

One Half Year terms at the following wage per hour:

	07/01/2026	01/01/2027	04/01/2027	01/01/2028
1st Term	$ 30.87	$ 30.87	$ 32.42	$ 32.42
2nd Term	34.46	34.46	36.19	36.19
3rd Term	37.34	37.34	39.20	39.20
4th Term	40.21	40.21	42.22	42.22
5th Term	42.36	42.36	44.48	44.48
6th Term	45.95	45.95	48.25	48.25
7th Term	48.82	48.82	51.27	51.27
8th Term	51.70	51.70	54.28	54.28
9th Term	54.57	54.57	57.30	57.30
10th Term	57.44	57.44	60.31	60.31
Supplemental Benefits per hour:				
1st & 2nd Term	$ 10.23	$ 11.23	$ 11.23	$ 12.23
3rd & 4th Term	22.79	23.79	23.79	24.79
All Other Terms	23.04	24.04	24.04	25.04

1-669.2

Teamster - Building / Heavy&Highway — 08/01/2026

JOB DESCRIPTION Teamster - Building / Heavy&Highway **DISTRICT** 8

ENTIRE COUNTIES

Putnam, Westchester

WAGES

GROUP A: Straight Trucks (6-wheeler and 10-wheeler), A-frame, Winch, Dynamite Seeding, Mulching, Agitator, Water, Attenuator, Light Towers, Cement (all types), Suburban, Station Wagons, Cars, Pick Ups, any vehicle carrying materials of any kind.
GROUP AA: Tack Coat
GROUP B: Tractor & Trailers (all types).
GROUP BB: Tri-Axle,14 Wheeler
GROUP C: Low Boy (carrying equipment).
GROUP D: Fuel Trucks, Tire Trucks.
GROUP DD: Tow Truck/Flatbed Single axle.
GROUP E: Off-road Equipment (over 40 tons): Athey Wagons, Belly Dumps, Articulated Dumps, Trailer Wagons.
GROUP F: Off-road Equipment (over 40 tons) Euclid, DJB.
GROUP G: Off-road Equipment (under 40 tons) Athey Wagons, Belly Articulated Dumps, Trailer Wagons, Tracker/Crawler Dump Truck.
GROUP H: Off-road Equipment(under 40 tons), Euclid.
GROUP HH: Off-road Equipment(under 40 tons) D.J.B.
GROUP I: Off-road Equipment(under 40 tons) Darts.
GROUP II: Off-road Equipment(under 40 tons) RXS.

WAGES:(per hour)

	07/01/2026
GROUP A	$ 49.61*
GROUP AA	52.61*
GROUP B	50.23*
GROUP BB	49.73*
GROUP C	52.36*
GROUP D	50.06*
GROUP DD	38.74*
GROUP E	50.61*
GROUP F	51.61*
GROUP G	50.36*
GROUP H	50.98*
GROUP HH	51.36*
GROUP I	51.11*
GROUP II	51.48*

* To calculate premium wage, subtract $ .10 from the hourly wage.

Note: Fuel truck operators on construction sites addit. $5.00 per day.

For work on hazardous/toxic waste site addit. 20% of hourly rate.

Note: For aggregate and asphalt delivery, the applicable prevailing rate is based on the type of vehicle operated.

SHIFT WORK
When mandated by the contracting agency, DOT, or any governmental agency contracts shall receive a shift differential of fifteen (15%) above the wage rate for all work performed during the irregular shift.

SUPPLEMENTAL BENEFITS
Per hour:
Journeyworker

First 40 hours	$ 40.83
Over 40 hours	31.64

OVERTIME PAY
See (B, E, P, *R, **T) on OVERTIME PAGE
*For code (8,15,25,26) code R applies
**For code (5,6) code T applies

HOLIDAY
Paid: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE
Overtime: See (5, 6, 8, 15, 25, 26) on HOLIDAY PAGE

8-456

Welder 08/01/2026

JOB DESCRIPTION Welder **DISTRICT** 1

ENTIRE COUNTIES
Albany, Allegany, Bronx, Broome, Cattaraugus, Cayuga, Chautauqua, Chemung, Chenango, Clinton, Columbia, Cortland, Delaware, Dutchess, Erie, Essex, Franklin, Fulton, Genesee, Greene, Hamilton, Herkimer, Jefferson, Kings, Lewis, Livingston, Madison, Monroe, Montgomery, Nassau, New York, Niagara, Oneida, Onondaga, Ontario, Orange, Orleans, Oswego, Otsego, Putnam, Queens, Rensselaer, Richmond, Rockland, Saratoga, Schenectady, Schoharie, Schuyler, Seneca, St. Lawrence, Steuben, Suffolk, Sullivan, Tioga, Tompkins, Ulster, Warren, Washington, Wayne, Westchester, Wyoming, Yates

WAGES
Per hour 07/01/2026

Welder: To be paid the same rate of the mechanic performing the work.*

*EXCEPTION: If a specific welder certification is required, then the 'Certified Welder' rate in that trade tag will be paid.

OVERTIME PAY

HOLIDAY

1-As Per Trade

Overtime Codes

Following is an explanation of the code(s) listed in the OVERTIME section of each classification contained in the attached schedule. Additional requirements may also be listed in the HOLIDAY section.

NOTE: Supplemental Benefits are 'Per hour worked' (for each hour worked) unless otherwise noted

(AA)	Time and one half of the hourly rate after 7 and one half hours per day
(A)	Time and one half of the hourly rate after 7 hours per day
(B)	Time and one half of the hourly rate after 8 hours per day
(B1)	Time and one half of the hourly rate for the 9th & 10th hours week days and the 1st 8 hours on Saturday. Double the hourly rate for all additional hours
(B2)	Time and one half of the hourly rate after 40 hours per week
(B3)	Time and one half of the hourly rate after 40 straight hours per week
(C)	Double the hourly rate after 7 hours per day
(C1)	Double the hourly rate after 7 and one half hours per day
(D)	Double the hourly rate after 8 hours per day
(D1)	Double the hourly rate after 9 hours per day
(E)	Time and one half of the hourly rate on Saturday
(E1)	Time and one half 1st 4 hours on Saturday; Double the hourly rate all additional Saturday hours
(E2)	Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
(E3)	Between November 1st and March 3rd Saturday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather, provided a given employee has worked between 16 and 32 hours that week
(E4)	Sunday may be used as a make-up day at straight time when a day is lost during that week due to inclement weather
(E5)	Double time after 8 hours on Saturdays
(F)	Time and one half of the hourly rate on Saturday and Sunday
(G)	Time and one half of the hourly rate on Saturday and Holidays
(H)	Time and one half of the hourly rate on Saturday, Sunday, and Holidays
(I)	Time and one half of the hourly rate on Sunday
(J)	Time and one half of the hourly rate on Sunday and Holidays
(K)	Time and one half of the hourly rate on Holidays
(L)	Double the hourly rate on Saturday
(M)	Double the hourly rate on Saturday and Sunday
(N)	Double the hourly rate on Saturday and Holidays
(O)	Double the hourly rate on Saturday, Sunday, and Holidays
(P)	Double the hourly rate on Sunday
(Q)	Double the hourly rate on Sunday and Holidays
(R)	Double the hourly rate on Holidays

(S)	Two and one half times the hourly rate for Holidays
(S1)	Two and one half times the hourly rate the first 8 hours on Sunday or Holidays One and one half times the hourly rate all additional hours.
(T)	Triple the hourly rate for Holidays
(U)	Four times the hourly rate for Holidays
(V)	Including benefits at SAME PREMIUM as shown for overtime
(W)	Time and one half for benefits on all overtime hours.
(X)	Benefits payable on Paid Holiday at straight time. If worked, additional benefit amount will be required for worked hours. (Refer to other codes listed.)

Holiday Codes

PAID Holidays:

Paid Holidays are days for which an eligible employee receives a regular day's pay, but is not required to perform work. If an employee works on a day listed as a paid holiday, this remuneration is in addition to payment of the required prevailing rate for the work actually performed.

OVERTIME Holiday Pay:

Overtime holiday pay is the premium pay that is required for work performed on specified holidays. It is only required where the employee actually performs work on such holidays. The applicable holidays are listed under HOLIDAYS: OVERTIME. The required rate of pay for these covered holidays can be found in the OVERTIME PAY section listings for each classification.

Following is an explanation of the code(s) listed in the HOLIDAY section of each classification contained in the attached schedule. The Holidays as listed below are to be paid at the wage rates at which the employee is normally classified.

(1)	None
(2)	Labor Day
(3)	Memorial Day and Labor Day
(4)	Memorial Day and July 4th
(5)	Memorial Day, July 4th, and Labor Day
(6)	New Year's, Thanksgiving, and Christmas
(7)	Lincoln's Birthday, Washington's Birthday, and Veterans Day
(8)	Good Friday
(9)	Lincoln's Birthday
(10)	Washington's Birthday
(11)	Columbus Day
(12)	Election Day
(13)	Presidential Election Day
(14)	1/2 Day on Presidential Election Day
(15)	Veterans Day
(16)	Day after Thanksgiving
(17)	July 4th
(18)	1/2 Day before Christmas
(19)	1/2 Day before New Years
(20)	Thanksgiving
(21)	New Year's Day
(22)	Christmas
(23)	Day before Christmas
(24)	Day before New Year's
(25)	Presidents' Day
(26)	Martin Luther King, Jr. Day
(27)	Memorial Day
(28)	Easter Sunday

(29) Juneteenth

New York State Department of Labor - Bureau of Public Work
State Office Building Campus
Building 12 - Room 130
Albany, New York 12226

REQUEST FOR WAGE AND SUPPLEMENT INFORMATION

As Required by Articles 8 and 9 of the NYS Labor Law

Fax (518) 485-1870 or mail this form for new schedules or for determination for additional occupations.

This Form Must Be Typed

Submitted By: (Check Only One) ☐ Contracting Agency ☐ Architect or Engineering Firm ☐ Public Work District Office Date:

A. Public Work Contract to be let by: (Enter Data Pertaining to Contracting/Public Agency)

1. Name and complete address ☐ (Check if new or change)

Telephone Fax

E-Mail:

2. NY State Units (see Item 5).

- ☐ 01 DOT
- ☐ 02 OGS
- ☐ 03 Dormitory Authority
- ☐ 04 State University Construction Fund
- ☐ 05 Mental Hygiene Facilities Corp.
- ☐ 06 OTHER N.Y. STATE UNIT
- ☐ 07 City
- ☐ 08 Local School District
- ☐ 09 Special Local District, i.e., Fire, Sewer, Water District
- ☐ 1O Village
- ☐ 11 Town
- ☐ 12 County
- ☐ 13 Other Non-N.Y. State (Describe)

3. SEND REPLY TO ☐ (check if new or change)
Name and complete address:

Telephone Fax

E-Mail:

4. SERVICE REQUIRED. Check appropriate box and provide project information.

☐ New Schedule of Wages and Supplements.

APPROXIMATE BID DATE :

☐ Additional Occupation and/or Redetermination

PRC NUMBER ISSUED PREVIOUSLY FOR THIS PROJECT :

OFFICE USE ONLY

B. PROJECT PARTICULARS

5. Project Title _____

Description of Work _____

Contract Identification Number _____

Note: For NYS units, the OSC Contract No. _____

6. Location of Project:
Location on Site _____

Route No/Street Address _____

Village or City _____

Town _____

County _____

7. Nature of Project - Check One:

- ☐ 1. New Building
- ☐ 2. Addition to Existing Structure
- ☐ 3. Heavy and Highway Construction (New and Repair)
- ☐ 4. New Sewer or Waterline
- ☐ 5. Other New Construction (Explain)
- ☐ 6. Other Reconstruction, Maintenance, Repair or Alteration
- ☐ 7. Demolition
- ☐ 8. Building Service Contract

8. OCCUPATION FOR PROJECT :

- ☐ Construction (Building, Heavy Highway/Sewer/Water)
- ☐ Tunnel
- ☐ Residential
- ☐ Landscape Maintenance
- ☐ Elevator maintenance
- ☐ Exterminators, Fumigators
- ☐ Fire Safety Director, NYC Only
- ☐ Fuel Delivery
- ☐ Guards, Watchmen
- ☐ Janitors, Porters, Cleaners, Elevator Operators
- ☐ Moving furniture and equipment
- ☐ Trash and refuse removal
- ☐ Window cleaners
- ☐ Other (Describe)

9. Does this project comply with the Wicks Law involving separate bidding? YES ☐ NO ☐

10. Name and Title of Requester

Signature

SEE PAGE TWO FOR LAWS RELATING TO PUBLIC WORK CONTRACTS

NEW YORK STATE DEPARTMENT OF LABOR
Bureau of Public Work - Debarment List

LIST OF EMPLOYERS INELIGIBLE TO BID ON OR BE AWARDED ANY PUBLIC WORK CONTRACT

Under Article 8 and Article 9 of the NYS Labor Law, a contractor, sub-contractor and/or its successor shall be debarred and ineligible to submit a bid on or be awarded any public work or public building service contract/sub-contract with the state, any municipal corporation or public body for a period of five (5) years from the date of debarment when:

- Two (2) final determinations have been rendered within any consecutive six-year (6) period determining that such contractor, sub-contractor and/or its successor has WILLFULLY failed to pay the prevailing wage and/or supplements;
- One (1) final determination involves falsification of payroll records or the kickback of wages and/or supplements.

The agency issuing the determination and providing the information, is denoted under the heading 'Fiscal Officer'. DOL = New York State Department of Labor; NYC = New York City Comptroller's Office; AG = New York State Attorney General's Office; DA = County District Attorney's Office.

Debarment Database: To search for contractors, sub-contractors and/or their successors debarred from bidding or being awarded any public work contract or subcontract under NYS Labor Law Articles 8 and 9, or under NYS Workers' Compensation Law Section 141-b, access the database at this link: https://apps.labor.ny.gov/EDList/searchPage.do

For inquiries please call 518-457-5589.

NYSDOL Bureau of Public Work Debarment List 07/31/2026

Article 8

AGENCY	Fiscal Officer	FEIN	EMPLOYER NAME	EMPLOYER DBA NAME	ADDRESS	DEBARMENT START DATE	DEBARMENT END DATE
DOL	DOL	*****5784	A.J.M. TRUCKING, INC.		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	DOL		AKHLAQ OULAKH		4307 28TH AVE ASTORIA NY 11103	10/11/2024	10/11/2029
DOL	DOL		ALEXANDER DELISA		411 THEODORE FREMND SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	NYC		ALL COUNTY SEWER & DRAIN, INC.		7 GREENFIELD DR WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL	*****8387	AMERICAN PAVING & MASONRY, CORP.		8 FOREST AVE GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	DOL	*****8654	AMERICAN PAVING, INC.		8 FORREST AVE. GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	NYC	*****8017	AMIN ELECTRICAL CORP.		97-23 218TH STREET QUEENS VILLAGE NY 11429	12/04/2025	12/04/2030
DOL	DOL		ANGELO STANCO		8 FOREST AVE. GLEN COVE NY 11542	05/24/2024	05/24/2029
DOL	DOL		ANGELO TONDO		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL	*****4231	ANKER'S ELECTRIC SERVICE, INC.		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL		ANTHONY CASALE		20 HEATHER RIDGE ROAD TROY NY 12180	05/20/2025	05/20/2030
DOL	DOL		ANTHONY MONGELLI		PO BOX 2064 MONROE NY 10950	02/12/2024	02/12/2029
DOL	DOL	*****8421	B & B DRYWALL, INC		206 WARREN AVE APT 1WHITE PLAINS NY 10603	12/14/2021	12/14/2026
DOL	DOL	*****3932	B ROC CONSTRUCTION INC		7307 WOODSIDE ROAD VICTOR NY 14564	05/06/2025	05/06/2030
DOL	DA	*****2404	BJA RENOVATION, CORP		33 DOLLARD DR NORTH BABYLON NY 11703	03/19/2025	03/19/2030
DOL	DOL	*****5078	BLACK RIVER TREE REMOVAL, LLC		29807 ANDREWS ROAD BLACK RIVER NY 13032	10/17/2023	10/17/2028
DOL	DOL		C.M.C CONTRACTORS, INC.		500 WEST PUTNAM AVE SUITE 400GREENWICH CT 06830	09/03/2025	09/03/2030
DOL	DOL		CARLOS F. ESCOBAR		411 THEODORE FREMD AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DOL		CARLOS FIGUEROA		411 THEODORE FREMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DOL	*****4155	CASA BUILDERS, INC.	FRIEDLANDER CONSTRUCTION	64 N PUTT CONNERS ROAD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	AG	*****7247	CENTURY CONCRETE CORP		2375 RAYNOR ST RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL		CESAREO TULA		120 SEARS AVE ELMSFORD NY 10523	09/26/2025	09/26/2030
DOL	DOL	*****2292	CHAMPION MAINTENANCE CONTRACTORS, INC.		211 SOUTH RIDGE STREET RYE BROOK NY 10573	09/03/2025	09/03/2030
DOL	NYC	*****2117	CHARAN ELECTRICAL ENTERPRISES		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	DOL		CHARLES CASALE		55 MAIN AVENUE WYNANTSKILL NY 12198	05/20/2025	05/20/2030
DOL	DOL		CHARLES CASALE		55 MAIN AVENUE WYNANTSKILL NY 12198	05/20/2025	05/20/2030
DOL	DOL		CHRISTOPHER PEROSI		5507 NESCONSET HIGHWAY MT. SINAI NY 11766	07/17/2025	07/17/2030
DOL	DOL	*****2281	CORRAO TRUCKING, INC.		PO BOX 393 NANUET NY 10954	09/17/2024	09/17/2029
DOL	DOL		CRAIG JOHANSEN		10 SOUTH 5TH ST LOCUST VALLEY NY 11560	09/26/2022	09/26/2027
DOL	DOL	*****7619	DANCO CONSTRUCTION UNLIMITED INC.		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL		DANIEL DELISA		211 SOUTH RIDGE STREET RYE BROOK NY 10573	09/03/2025	09/03/2030
DOL	DOL		DANIEL LOHAN		6836 N. LEXINGTON LANE NILES IL 60714	05/28/2026	05/28/2031
DOL	DOL		DANIEL ROBERT MCNALLY		7 GREENFIELD DRIVE WARWICK NY 10990	03/25/2022	03/25/2027
DOL	DOL		DARWIN PEGUESE		6400 BALTIMORE NATIONAL SUITE 602CANTONSVILLE NY 21228	10/24/2024	10/24/2029
DOL	DOL		DAVID FRIEDLANDER		64 NORTH PUTT CORNERS RD	05/10/2023	05/10/2028

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DOL	DOL		DENISE NAGLE		36 OAKWOOD TRAIL S AL MONROE NY 10950	10/29/2025	10/29/2030
DOL	DOL		DINA TAYLOR		64 N PUTT CONNERS RD NEW PALTZ NY 12561	05/10/2023	05/10/2028
DOL	AG		EDWIN HUTZLER		23 NORTH HOWELLS RD BELLPORT NY 11713	08/04/2021	08/04/2026
DOL	DA		EDWIN HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****2337	EGL DRAINAGE SOLUTION & REPAIRS LLC		5507 NESCONSET HIGHWAY MT. SINAI NY 11766	07/17/2025	07/17/2030
DOL	DOL	*****0780	EMES HEATING & PLUMBING CONTR		5 EMES LANE MONSEY NY 10952	01/20/2002	01/20/3002
DOL	DOL		EMIL KISZKO		84 DIAMOND ST BROOKLYN NY 11222	07/18/2024	07/18/2029
DOL	DOL	*****3298	EMJACK CONSTRUCTION CORP.		84 DIAMOND ST BROOKLYN NY 11222	07/18/2024	07/18/2029
DOL	DOL	*****3298	EMJACK CONSTRUCTION LLC		4192 SIR ANDREW CIRCLE DOYLESTOWN PA 18902	07/18/2024	07/18/2029
DOL	NYC		ENRICO MANETTA		101 MALBA DR. WHITESTONE NY 11357	04/01/2026	04/01/2031
DOL	DOL		EUGENIUSZ "GINO" KUCHAR		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	DA		FREDERICK HUTZLER		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026
DOL	DOL	*****2998	G.E.M. AMERICAN CONSTRUCTION CORP.		195 KINGSLAND AVE BROOKLYN NY 11222	12/22/2023	12/22/2028
DOL	DA		GEORGE LUCEY		150 KINGS STREET BROOKLYN NY 11231	01/19/1998	01/19/2998
DOL	NYC		GHANSHYAM AMIN		97-23 218TH STREET QUEENS VILLAGE NY 11429	12/04/2025	12/04/2030
DOL	DA		GIOVANNA TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DA		GIOVANNI NAPOLITANO		2501 BAYVIEW AVENUE WANTAGH NY 11793	02/21/2024	02/21/2029
DOL	DA	*****0213	GORILLA CONTRACTING GROUP, LLC		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028
DOL	DA	*****4760	GTX CONSTRUCTION ASSOCIATES, CORP		2501 BAYVIEW AVE WANTAGH NY 11793	02/21/2024	02/21/2029
DOL	DOL		HENRY WICKE A/K/A HENRY WICKE, JR.		36 OAKWOOD TRAIL S AL MONROE NY 10950	10/29/2025	10/29/2030
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		HERBERT CLEMEN		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****6961	HUNTER ELEVATOR COMPANY, INC.		36 OAKWOOD TRAIL S AL MONROE NY 10950	10/29/2025	10/29/2030
DOL	DOL	*****2397	ISLAND BREEZE MARINE, INC.		6400 BALTIMORE NATIONAL CANTONSVILLE MD 21228	10/24/2024	10/24/2029
DOL	DOL	*****5010	J. LINDSLEY ENTERPRISE, LLC		1002 STATE ROUTE 176 FULTON NY 13069	07/30/2025	07/30/2030
DOL	DOL	*****0241	J. LINDSLEY ROOFING, LLC		211 NORTH 2ND STREET FULTON NY 13069	07/30/2025	07/30/2030
DOL	DOL		J.M.J CONSTRUCTION		151 OSTRANDER AVENUE SYRACUSE NY 13205	11/21/2022	11/21/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON CONSTRUCTION		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R. NELSON, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	12/12/2022	12/12/2027
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		J.R.N COMPANIES, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST	11/07/2023	11/07/2028

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DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL	*****1147	J.R.N. CONSTRUCTION, LLC		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JAMES J. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL		JAMES LINDSLEY		211 NORTH 2ND STREET FULTON NY 13069	07/30/2025	07/30/2030
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		JASON P. RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****7993	JBS DIRT, INC.		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****2435	JEFFEL D. JOHNSON	JMJ7 AND SON	5553 CAIRNSTRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JEFFEL JOHNSON ELITE CARPENTER REMODEL AND CONSTRUCTION		C2 EVERGREEN CIRCLE LIVERPOOL NY 13090	11/21/2022	11/21/2027
DOL	DOL	*****2435	JEFFREY M. JOHNSON	JMJ7 AND SON	5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JENNIFER LINDSLEY		211 NORTH 2ND STREET FULTON NY 13069	07/30/2025	07/30/2030
DOL	DOL		JERRY DASTON		36 OAKWOOD TRAIL S AL MONROE NY 10950	10/29/2025	10/29/2030
DOL	DOL		JMJ7 & SON CONSTRUCTION, LLC		5553 CAIRNS TRAIL LIVERPOOL NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 AND SONS CONTRACTORS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS		7014 13TH AVENUE BROOKLYN NY 11228	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS AND SONS		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JMJ7 CONTRACTORS, LLC		5553 CAIRNS TRAIL CLAY NY 13041	11/21/2022	11/21/2027
DOL	DOL		JOHN NAGLE A/K/A JOHN NAGLE, JR.		36 OAKWOOD TRAIL S AL MONROE NY 10950	10/29/2025	10/29/2030
DOL	DOL		JONATHAN DELISA		411 THEODORE FREMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DOL		JORGE FIGUEROA		411 THEODORE FRMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DA		JOSEPH DEMASCO		33 DOLLARD DRIVE NORTH BABYLON NY 11703	01/30/2026	01/30/2031
DOL	DA		JOSEPH DEMASCO		33 DOLLARD DRIVE NORTH BABYLON NY 11703	03/19/2025	03/19/2030
DOL	DOL		JOSEPH HALL		937 US ROUTE 11 CENTRAL SQUARE NY 13036	10/21/2024	10/21/2029
DOL	DOL	*****2271	JOSEPH HALL COMPANIES LLC		937 US ROUTE 11 CENTRAL SQUARE NY 13036	10/21/2024	10/21/2029
DOL	DOL		JOSEPH K. SALERNO		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL		JOSEPH K. SALERNO II		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL	*****5116	JP RACE PAINTING, INC. T/A RACE PAINTING		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		JRN CONSTRUCTION CO, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL	*****1147	JRN CONSTRUCTION, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027

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DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		JRN PAVING, LLC		531 THIRD STREET ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL		JULIUS AND GITA BEHREND		5 EMES LANE MONSEY NY 10952	11/20/2002	11/20/3002
DOL	DOL		KEAN INDUSTRIES, LLC		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		KEVIN FUNEZ URBINA A/K/A KEVIN FUNEZ		1009 LYNDALE AVE TRENTON NJ 08629	12/16/2024	12/16/2029
DOL	DOL		KIMBERLY F. BAKER		7901 GEE ROAD CANASTOTA NY 13032	08/17/2021	08/17/2026
DOL	DOL	*****8760	KJ&J CONSTRUCTION, LLC		1009 LYNDALE AVE TRENTON NJ 08629	12/16/2024	12/16/2029
DOL	DOL		KMA GROUP II, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL	*****1833	KMA GROUP INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KMA INSULATION, INC.		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028
DOL	DOL		KRIN HEINEMANN		2345 ROUTE 52, SUITE 2N HOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	NYC		KULWANT S. DEOL		9-11 40TH AVENUE LONG ISLAND CITY NY 11101	09/26/2023	09/26/2028
DOL	DA	*****8816	LAKE CONSTRUCTION AND DEVELOPMENT CORPORATION		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	10/25/2022	10/25/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	12/22/2022	12/22/2027
DOL	DOL		LEROY E. NELSON JR		531 THIRD ST ALBANY NY 12206	11/07/2023	11/07/2028
DOL	DOL	*****3716	LIGHTNIN ELECTRIC INC.		3418 NORTHERN BLVD SUITE 5-27LONG ISLAND CITY NY 11101	12/13/2024	12/13/2029
DOL	AG	*****3291	LINTECH ELECTRIC, INC.		3006 TILDEN AVE BROOKLYN NY 11226	02/16/2022	02/16/2027
DOL	DOL		LIZETTE PONCE		411 THEODORE FREMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	NYC	*****7516	MANCO ENTERPRISES OF NY, INC.		44-17 54TH DR. MASPETH NY 11378	04/01/2026	04/01/2031
DOL	NYC	*****1783	MANETTA ENTERPISES, INC. D/B/A MANETTA INDUSTRIES		44-17 54TH DR. MASPETH NY 11378	04/01/2026	04/01/2031
DOL	DA		MANUEL P TOBIO		150 KINGS STREET BROOKLYN NY 14444	08/19/1998	08/19/2998
DOL	DA		MANUEL TOBIO		150 KINGS STREET BROOKLYN NY 11231	08/19/1998	08/19/2998
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	10/25/2022	10/25/2027
DOL	DOL	*****1320	MJC MASON CONTRACTING, INC.		42 FOWLER AVENUE CORTLAND MANOR NY 10567	01/24/2023	01/24/2028
DOL	DOL		MOHAMMAD MIAN		8269 21ST ST BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	NYC		NASEER CHAUDHRY		2349 BRAGG STREET BROOKLYN NY 11229	04/22/2025	04/22/2030
DOL	DOL	*****7790	NATIONAL BUILDING & RESTORATION CORP		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	DOL	*****1797	NATIONAL CONSTRUCTION SERVICES, INC		1010 TILDEN AVE UTICA NY 13501	07/24/2023	07/24/2028
DOL	NYC		NAVIT SINGH		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		NELCO CONTRACTING, LLC		1024 BROADWAY ALBANY NY 12204	11/07/2023	11/07/2028
DOL	DA		NICHOLAS BARNETT		33 DOLLARD DR BABYLON NY 11703	03/04/2025	03/04/2030
DOL	DOL		NICHOLAS RAO		411 THEODORE FREMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DA		NICHOLAS T. ANALITIS		505 MANHATTAN AVE WEST BABYLON NY 11704	10/05/2023	10/05/2028

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DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	03/01/2022	03/01/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	11/15/2022	11/15/2027
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	09/29/2021	09/29/2026
DOL	DOL		NICHOLE E. FRASER A/K/A NICHOLE RACE		3469 STATE RT. 69 PERISH NY 13131	02/09/2022	02/09/2027
DOL	DOL		NIKOLA NTONI		3418 NORTHERN BLVD SUITE 5-27LONG ISLAND CITY NY 11101	12/13/2024	12/13/2029
DOL	NYC	*****6971	NN CONSTRUCTION, INC.		2349 BRAGG STREET BROOKLYN NY 11229	04/22/2025	04/22/2030
DOL	NYC	*****5643	NYC LINE CONTRACTORS, INC.		402 JERICHO TURNPIKE NEW HYDE PARK NY 11040	08/10/2022	08/10/2027
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL		PATRICK PENNACCHIO		2345 RT. 52 SUITE 2NHOPEWELL JUNCTION NY 12533	12/18/2023	12/18/2028
DOL	DOL	*****4168	PHANTOM CONSTRUCTION CORP.		95-27 116TH STREET QUEENS NY 11419	07/12/2024	07/12/2029
DOL	DOL	*****4168	PHANTOM CONSTRUCTION CORP.		95-27 116TH STREET QUEENS NY 11419	05/28/2024	05/28/2029
DOL	DOL	*****2041	QUALITY STEEL ERECTORS INC.		6836 N. LEXINGTON LANE NILES IL 60714	05/28/2026	05/28/2031
DOL	DOL	*****4772	R.W. LOBDELL CONSTRUCTION LLC		635 WEST DRYDEN ROAD FREEVILLE NY 13068	01/31/2025	01/31/2030
DOL	DOL	*****2633	RAW POWER ELECTRIC CORP.		3 PARK CIRCLE MIDDLETOWN NY 10940	07/11/2022	07/11/2027
DOL	DOL		ROBBYE BISSESAR		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	01/11/2003	01/11/3003
DOL	DOL		ROMEO WARREN		161 ROBYN RD MONROE NY 10950	07/11/2022	07/11/2027
DOL	DOL		ROSA GARCIA		411 THEODORE FRMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DOL	*****7172	RZ & AL INC.		198 RIDGE AVENUE VALLEY STREAM NY 11581	06/06/2022	06/06/2027
DOL	DA	*****0476	SAMCO ELECTRIC CORP.		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	DA		SILVANO TRAVALJA		3735 9TH ST LONG ISLAND CITY NY 11101	01/05/2023	01/05/2028
DOL	NYC	*****3661	SPANIER BUILDING MAINTENANCE CORP		200 OAK DRIVE SYOSSET NY 11791	03/14/2022	03/14/2027
DOL	DOL		STANADOS KALOGELAS		485 RAFT AVENUE HOLBROOK NY 11741	10/19/2021	10/19/2026
DOL	DOL	*****3496	STAR INTERNATIONAL INC		89-51 SPRINGFIELD BLVD QUEENS VILLAGE NY 11427	08/11/2003	08/11/3003
DOL	DOL		STEVEN DELISA		411 THEODORE FREMND AVE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DOL	*****9150	SURGE INC.		8269 21ST STREET BELLEROSE NY 11426	12/22/2022	12/22/2027
DOL	DOL		SYED MUHAMMAD S. JAFRI A/K/A SHARRUKH JAFRI		4307 28TH AVE ASTORIA NY 11103	10/11/2024	10/11/2029
DOL	DOL		SYED RAZA		198 RIDGE AVENUE NY 11581	06/06/2022	06/06/2027
DOL	DOL		TARLOK SINGH		95-27 116TH STREET QUEENS NY 11419	05/28/2024	05/28/2029
DOL	DOL		TARLOK SINGH		95-27 116TH STREET QUEENS NY 11419	07/12/2024	07/12/2029
DOL	DOL	*****4855	TECH INDUSTRIES LLC		20 HEATHER RIDGE ROAD TROY NY 12180	05/20/2025	05/20/2030
DOL	DOL	*****2426	THE MATRUKH GROUP, INC.		4307 28TH AVE PO BOX 9082ASTORIA NY 11103	10/11/2024	10/11/2029
DOL	DOL		THOMAS LOBDELL		635 WEST DRYDEN ROAD FREEVILLE NY 13068	01/31/2025	01/31/2030
DOL	DOL		TIMOTHY PERCY		29807 ANDREWS ROAD BLACK RIVER NY 13612	10/17/2023	10/17/2028
DOL	DA	*****1050	TRI STATE CONSTRUCTION OF NY CORP.		50-39 175TH PLACE FRESH MEADOWS NY 11365	03/28/2022	03/28/2027
DOL	DA	*****4106	TRIPLE H CONCRETE CORP		2375 RAYNOR STREET RONKONKOMA NY 11779	08/04/2021	08/04/2026

NYSDOL Bureau of Public Work Debarment List 07/31/2026

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DOL	DOL	*****8485	TULA PLUMBING AND HEATING LLC		120 SEARS AVE ELMSFORD NY 10523	09/26/2025	09/26/2030
DOL	DOL	*****8210	UPSTATE CONCRETE & MASONRY CONTRACTING CO INC		449 WEST MOMBSHA ROAD MONROE NY 10950	06/06/2022	06/06/2027
DOL	DOL		VINCENT CORRAO		PO BOX 393 NANUET NY 10954	09/17/2024	09/17/2029
DOL	DOL		WILLIAM A BELL		7307 WOODSIDE ROAD VICTOR NY 14564	05/06/2025	05/06/2030
DOL	DOL	*****8266	WILLIAM CHRIS MCCLENDON	MCCLENDON ASPHALT PAVING	1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM CHRIS MCCLENDON		1646 FALLS STREET NIAGARA FALLS NY 14303	05/01/2023	05/01/2028
DOL	DOL		WILLIAM SCRIVENS		4192 SIR ANDREW CIRCLE DOYELSTOWN PA 18902	07/18/2024	07/18/2029
DOL	DOL	*****9494	WND CONSTRUCTION LLC		411 THEODORE FREMD AVENUE SUITE 206RYE NY 10580	09/03/2025	09/03/2030
DOL	DOL		XENOFON EFTHIMIADIS		29-10 38TH AVENUE LONG ISLAND CITY NY 11101	10/11/2023	10/11/2028

Kenneth W. Jenkins, Westchester County Executive

PROJECT LABOR AGREEMENT (PLA)

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

PROJECT LABOR AGREEMENT

Contract No. XX-YYY
Contract Title

COVERING

CONSTRUCTION PERFORMED

ON BEHALF OF

WESTCHESTER COUNTY, NEW YORK

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PROJECT LABOR AGREEMENT
COVERING CONSTRUCTION WORK PERFORMED
ON BEHALF OF WESTCHESTER COUNTY, NEW YORK

ARTICLE 1 - PREAMBLE

WHEREAS, *Contractor Company Name* (the "Contractor") on behalf of itself, and reflecting the objectives of the owner, **Westchester County, New York** (the "County"), desires to provide for the efficient, safe, quality, and timely completion of the following construction project: *Contract No. XX-YYY, Contract Title* ("Project") in a manner designed to afford the lowest reasonable costs to the County and the public it represents, and the advancement of public policy objectives;

WHEREAS, this Project Labor Agreement will foster the achievement of these goals, inter alia, by:

1. avoiding the costly delays of potential strikes, slowdowns, walkouts, picketing and other disruptions arising from work disputes and promote labor harmony and peace for the duration of the Project;
2. standardizing the terms and conditions governing the employment of labor on the Project;
3. permitting wide flexibility in work scheduling and shift hours and times;
4. receiving negotiated adjustments to work rules and staffing requirements from those which otherwise might control;
5. providing comprehensive and standardized mechanisms for the settlement of work disputes, including but not limited to, those relating to jurisdiction;
6. ensuring a reliable source of skilled and experienced labor;
7. furthering public policy objectives as to improved employment opportunities for minorities, women and the economically disadvantaged in the construction industry;
8. minimizing potential losses of revenues through timely completion of contracts;
9. expediting the construction process and otherwise minimizing the inconveniences of citizens of the County; and

WHEREAS, the parties desire to maximize Project safety conditions for both workers and the public; and

WHEREAS, the Agreement has been approved by the NYS Building & Construction Trades Council and the North America's Building Trades Unions.

NOW, THEREFORE, the parties enter into this Agreement:

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SECTION 1 - PARTIES TO THE AGREEMENT

This is a Project Labor Agreement ("Agreement") entered into by and between the Contractor, on behalf of itself and its successors, assigns and its subcontractors engaged in On-Site Project Work as defined in Article 3; and by the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO, on behalf of itself and all of its affiliated Local Unions that perform On-Site Project Work and their members.

ARTICLE 2 - GENERAL CONDITIONS

SECTION 1 - DEFINITIONS

Throughout this Agreement, "Council" shall refer to the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO. "Local Unions" shall refer to all of the Council's affiliated Local Unions that perform On-Site Project Work and their members. "Contractor(s)" shall include the Contractor, all other contractors who sign a similar Project Labor Agreement in connection with the Project and their subcontractors of whatever tier, engaged in On-Site Project Work within the scope of this Agreement as defined in Article 3.

SECTION 2 - CONDITIONS FOR AGREEMENT TO BECOME EFFECTIVE

This Agreement shall not become effective unless each of the following conditions is met: (1) the Agreement is signed by the Council on behalf of itself and all of its affiliated Local Unions that perform On-Site Project Work; (2) the Agreement is signed by the Contractor; and (3) the Agreement is approved by the County.

SECTION 3 - ENTITIES BOUND & ADMINISTRATION OF AGREEMENT

This Agreement shall be binding on the Council, the Local Unions and the Contractors performing On-site Project Work, including site preparation and staging areas, as defined in Article 3. The Contractors shall include in any subcontract that they let, for performance during the term of this Agreement, a requirement that each and every one of their subcontractors, of whatever tier, become bound by this Agreement with respect to subcontracted work performed within the scope of Article 3, and shall sign the Letter of Assent provided herewith. This Agreement shall be administered by the Contractor, on behalf of itself and its subcontractors. In the event a Contractor desires to review the provisions of a Local Union's collective bargaining agreement, that Contractor shall request a copy of same from the Council and the Council shall provide same without delay.

SECTION 4 - SUPREMACY CLAUSE

This Agreement together with the applicable collective bargaining agreements of the Local Unions, copies of which can be obtained from the Council, represents the complete understanding of all signatories and

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supersedes any national agreement, local agreement or collective bargaining agreement of any type which would otherwise apply to this Project, in whole or in part, with the exception that the NTL Articles of Agreement, the National Stack/Liner/Chimney Agreements, the National Cooling Tower Agreement, the UA/IBEW Joint National Agreement for Instrument and Control Systems Technicians, and the National Agreement of the International Union of Elevator Constructors ("National Agreements") shall apply. Where a subject covered by the provisions, explicit or implicit, of this Agreement is also covered by the collective bargaining agreements of one or more of the Local Unions, the provisions of this Agreement shall prevail. It is further understood that no Contractor or subcontractor shall be required to sign any other agreement with the Council or the Local Unions as a condition of performing work on this Project. No practice, understanding or agreement between a Contractor and a Local Union which is not set forth or referenced in this Agreement shall be binding on this Project unless endorsed in writing by the Contractor or subcontractor. Nothing in this Agreement requires employees to join a union or pay dues or fees to a union as a condition of working on the covered project. This Agreement is not, however, intended to supersede independent requirements in applicable local union agreements as to contractors that are otherwise signatory to those agreements and as to employees of such employers performing covered work.

SECTION 5 - LIABILITY

The liability of any Contractor or subcontractor and the liability of any Local Union under this Agreement shall be several and not joint. The Contractor and any subcontractor shall not be liable for any violations of this Agreement by any other contractor, and the Council and Local Unions shall not be liable for any violations of this Agreement by any other Local Union.

SECTION 6 - THE COUNTY

The County requires in its bid specifications that all successful bidders become bound by and signatory to this Agreement for work within the scope of Article 3. In addition, all of their subcontracts, of any tier, shall provide that their subcontractors, of any tier, are subject to all terms and conditions set forth in this Agreement as if signatories thereto. The County is not a party to this Agreement and shall not be liable in any manner under this Agreement. It is understood that nothing in this Agreement shall be construed as limiting the sole discretion of the County in determining which Contractors shall be awarded contracts for Project work; nor as limiting any of the rights or remedies of the County as set forth in any and all of the Contract Documents that pertain in any way to the Project. It is further understood that the County has sole discretion at any time to terminate, delay or suspend the work, in whole or in part, on this Project.

SECTION 7 - AVAILABILITY & APPLICABILITY TO ALL SUCCESSFUL BIDDERS

The Local Unions agree that this Agreement will be made available to, and will fully apply to any successful bidder for Project work who becomes signatory hereto, without regard to whether that successful bidder

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performs work at other sites on either a union or non-union basis and without regard to whether employees of such successful bidder are, or are not, members of any union. This Agreement shall not apply to the work of any contractor or subcontractor which is performed at any location other than the Project site, as defined in Article 3, Section 1.

ARTICLE 3 - SCOPE OF THIS AGREEMENT

The Project work covered by this Agreement shall be as defined and limited by the following sections of this Article.

SECTION 1 - THE WORK

This Agreement shall only apply to On-Site Project Work performed in connection with the Project.

"On-Site Project Work" shall be defined to include Project work performed at the Project site and preparation and staging areas located within 15 miles of the Project site.

SECTION 2 - EXCLUDED EMPLOYEES

The following persons are not subject to the provisions of this Agreement, even though performing On-Site Project Work:

a) Superintendents, supervisors (excluding field engineers/supervisors, general and forepersons specifically covered by a Local Union's collective bargaining agreement), engineers, inspectors and testers (except for high voltage testers who are performing work traditionally does by members of IBEW Local 3 and/or which is covered by a Local 3 collective bargaining agreement), quality control/assurance personnel, timekeepers, mail carriers, clerks, office workers, messengers, guards, technicians, non-manual employees, and all professional, engineering (except general forepersons and field craft surveyors who are performing work traditionally done by members of the International Union of Operating Engineers Local 15D, AFL-CIO and/or which is covered by the Local 15D Surveying and Consulting Agreements), administrative and management persons;

b) Employees of the County, or of any State agency, authority or entity or employees of any municipality or other public employer;

c) Employees and entities engaged in off-site manufacture, modifications, repair, maintenance, assembly, painting, handling or fabrication of components, materials, equipment or machinery or involved in deliveries to and from the Project site, excepting local deliveries of all major construction materials including fill, ready mix concrete, asphalt and sub-base stone/gravel materials which are covered by this Agreement. However, operation of vehicles on the Project Site, site preparation, staging and stockpiling areas, and deliveries to and from the Project Site (including

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site preparation, staging, and stockpiling areas) involving construction equipment or major building and construction materials, including but not limited to, fuel oil for construction vehicles and equipment on the Project Site, redi-mix concrete, asphalt, dynamite, concrete block, lumber, and aggregates, such as, fill and sub-base stone/gravel, and item 4, shall not be excluded and are covered by this Agreement;

d) Employees of the Contractor, other contractors or subcontractors excepting those performing manual, on-site construction labor who will be covered by this Agreement;

e) Manufacturer employees engaged in on-site equipment maintenance/warranty work. When a Contractor has on site an employee already certified by the relevant manufacturer to make warranty repairs on that Contractor's equipment, that employee shall be used; when a Contractor has on site an employee already qualified to make warranty repairs, although not certified by the equipment manufacturer to do so, that employee shall be used to make repairs working under the direction of a manufacturer certified warranty representative. Notwithstanding the foregoing, if a Contractor, in order to satisfy the warranty requirements of a manufacturer must utilize a person or entity designated by the manufacturer, it may do so without coverage under this Agreement;

f) Employees engaged in laboratory or specialty testing or inspections whether on or off-site, unless ordinarily done by a member of a Trade Union and covered by a Schedule A Agreement.

g) Employees engaged in geophysical testing (whether land or water) other than boring for core samples;

h) Employees engaged in ancillary Project work performed by third parties such as electric utilities, gas utilities, telephone companies, and railroads, and such third parties may perform their work to a demarcation point (e.g., the demarcation or terminus point will be the first point of distribution of system service) on the Project site established by the General Contractor/Construction Manager at the commencement of the Project; and

i) Employees of "Artisans" shall be individuals or entities whom Owner may (or may not) employ directly to create unique, one-of-a-kind decorative elements, including architectural finishes for incorporation into the building, with the exception of "Artisans" represented by Local 7, Marble, Tile and Terrazzo union and Painters DC 9, provided Local 7 and DC 9 can supply "Artisans" acceptable to the Contractor and/or the Owner. Employees, workers, or vendors engaged by the Owner to install signage (including digital signage), branding and/or branded wall-covering shall be excluded from this Agreement.

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SECTION 3 - NON-APPLICATION TO CERTAIN ENTITIES

This Agreement shall not apply to the parents, affiliates, subsidiaries, or other joint or sole ventures of any Contractors which do not perform work at this Project. It is agreed, for the purposes of this Agreement only, that this Agreement does not have the effect of creating any joint employment, single employer or alter ego status among the County and the Contractors. This Agreement shall further not apply to the County or any other state agency, authority, or other municipal or public entity and nothing contained herein shall be construed to prohibit or restrict the County or its employees or any other state authority, agency or entity and its employees from performing on or off-site work related to the Project.

SECTION 4 - COUNTY LIABILITY

The County shall not be liable, directly or indirectly, to any party for any act or omission of the Contractor, any other contractors or subcontractors, the Council or Local Unions, including but not limited to, any violation or breach of this Agreement by any of the aforementioned.

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ARTICLE 4 - UNION RECOGNITION AND EMPLOYMENT

SECTION 1 - PRE-HIRE RECOGNITION

The Contractors recognize the Local Unions as the sole and exclusive bargaining representatives of all trade employees who are performing On-Site Project Work within the scope of this Agreement as defined in Article 3.

SECTION 2 - UNION'S REFERRAL

A. The Contractors agree to hire trade employees covered by this Agreement through the job referral system and hiring halls (where the referrals meet the qualifications set forth in items 1, 2 and 4 of subparagraph B below) established in the collective bargaining agreements of the applicable Local Unions listed in Schedule A. Notwithstanding this, the Contractors shall have the sole right to determine the competency of all referrals; the number of employees required; the selection of employees to be laid off (except as provided in Article 5, Section 3); and to reject any applicant referred by a Local Union, subject to the show-up payments required in the applicable Local Union's collective bargaining agreement. In the event that a Local Union is unable to fill any request for qualified employees within a 48 hour period after such requisition is made by the Contractor (Saturdays, Sundays and Holidays excepted), the Contractor may employ qualified applicants from any other available source. In the event that the Local Union does not have a job referral system, the Contractor shall give the Local Union first preference to refer applicants, subject to the other provisions of this Article. The Contractor shall notify the applicable Local

Union of trade employees hired within its jurisdiction from any source other than referral by the Local Union.

B. A Contractor not signatory to any Schedule A Agreements, may request by name, and the Local Union will honor, referral of persons who have applied to the Local Union for On-Site Project Work and who meet the following qualifications as determined by a committee of 3 persons (the "Committee") designated, respectively, by the applicable Local Union, the Contractor and a mutually selected third party or, in the absence of agreement, the permanent arbitrator (or designee) designated in Article 7:

1. possess licenses required by New York State law for the On-Site Project Work to be performed by that individual;
2. have worked a total of at least 1000 hours in the applicable construction trade during the prior 3 years;
3. were on the Contractor's active payroll for at least 60 out of the 180 calendar days prior to the contract award;
4. have demonstrated ability to safely perform the basic functions of the applicable trade.

C. No more than 12 percent of the employees covered by this Agreement, per Contractor by trade, shall be hired through the special provisions in subsection B, above (any fraction shall be rounded to the next highest whole number).

D. The Committee may also allow a Contractor, subject to the above percent, to employ apprentice equivalents to afford an opportunity to minority, women or economically disadvantaged persons for entry into the construction industry outside of the formal apprenticeship program.

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SECTION 3 - NON-DISCRIMINATION IN REFERRALS

The Local Unions represent that their hiring halls and referral systems will be operated in a non-discriminatory manner and in full compliance with all applicable federal, state and local laws and regulations which require equal employment opportunities. Referrals shall not be affected in any way by the rules, regulations, bylaws, constitutional provisions or any other aspects or obligations of union membership, policies or requirements and shall be subject to such other conditions as are established in this Article. No employment applicant shall be discriminated against by any referral system or hiring hall because of the applicant's union membership, or lack thereof.

SECTION 4 - MINORITY AND FEMALE REFERRALS

In the event a Local Union either fails, or is unable, to refer qualified minority or female applicants in percentages equaling Project affirmative action goals as set forth in the County's Project specifications, the Contractor may employ qualified minority or female applicants from any other available source.

SECTION 5 - CROSS AND QUALIFIED REFERRALS

The Local Union shall not knowingly refer to a Contractor an employee then employed by another Contractor working under this Agreement. The Local Unions will exert their utmost efforts to recruit sufficient numbers of skilled and qualified trade employees to fulfill the requirements of the Contractor.

SECTION 6 - TRADE FOREPERSONS AND GENERAL FOREPERSONS

A. The selection of trade forepersons and/or general forepersons and the number of forepersons required shall be solely the responsibility of the Contractor except where otherwise provided by specific provisions of an applicable Local Union's collective bargaining agreement. All forepersons shall take orders exclusively from the designated Contractor representatives. Trade forepersons shall be designated as working forepersons at the request of the Contractor, except when an existing Local Union's collective bargaining agreement prohibits a foreperson from working when the trade persons he is leading exceed a specified number.

B. There will be no non-productive employees of any title on the Project.

ARTICLE 5 - UNION REPRESENTATION

SECTION 1 - LOCAL UNION REPRESENTATIVE

Each Local Union representing employees who perform On-Site Project Work shall be entitled to designate in writing (copy to Contractor) one representative, and/or the Business Manager, who shall be afforded access to the Project. The Contractor shall provide a copy of such notification to each of its subcontractors.

SECTION 2 - STEWARDS

A. Each Local Union shall have the right to designate a working journey person as a Steward and an alternate, and shall notify the Contractor of the identity of the designated Steward (and alternate) prior to the assumption of such duties. Stewards shall not exercise supervisory functions and will receive the regular rate of pay for their trade classifications. There will be no non-working Stewards on the Project.

B. In addition to their work as employees, Stewards shall have the right to receive complaints or grievances and to discuss and assist in their adjustment with the Contractor's appropriate

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supervisor. Each Steward shall be concerned with the employees of the Steward's Contractor, and, if applicable, subcontractors of the Contractor, but not with the employees of any other contractor. The Contractor will not discriminate against the Steward in the proper performance of Union duties.

C. The Stewards shall not have the right to determine when overtime shall be worked, or who shall work overtime except pursuant to a provision in a Local Union's collective bargaining agreement providing procedures for the equitable distribution of overtime.

SECTION 3 - LAYOFF OF A STEWARD

Contractors agree to notify the appropriate Union 24 hours prior to the layoff of a Steward, except in cases of discipline or discharge for just cause. If a Steward is protected against layoff by a Local Union's collective bargaining agreement, such provisions shall be recognized to the extent the Steward possesses the necessary qualifications to perform the work required. In any case in which a Steward is discharged or disciplined for just cause, the Local Union involved shall be notified immediately by the Contractor.

ARTICLE 6 - MANAGEMENT'S RIGHTS

SECTION 1 - RESERVATION OF RIGHTS

Except as expressly limited by a specific provision of this Agreement, the Contractor retains full and exclusive authority for the management of the Project operations including, but not limited to: the right to direct the work force, including determination as to the number to be hired and the qualifications therefore; the promotion, transfer, and layoff of its employees; the discipline or discharge for just cause of its employees; the assignment and schedule of work; the promulgation of reasonable Project work rules; and, the requirement, timing and number of employees to be utilized for overtime work. No rules, customs, or practices which limit or restrict productivity or efficiency of the individual, as determined by the Contractor, and/or joint working efforts with other employees shall be permitted or observed.

SECTION 2 - MATERIALS, METHODS & EQUIPMENT

There shall be no limitation or restriction upon the Contractor's choice of materials, techniques, methods, technology or design, or, regardless of source or location, upon the use and installation of equipment, machinery, package units, pre-cast, pre-fabricated, pre-finished, or pre-assembled materials, tools or other labor-saving devices. Contractors may, without restriction, install or use materials, supplies or equipment regardless of their source. The on-site installation or application of such items shall be performed by the trade having jurisdiction over such work; provided, however, it is recognized that other personnel having special qualifications may participate, in a supervisory capacity, in the installation, check-off or testing of specialized or unusual equipment or facilities as designated by the Contractor. There shall be no restrictions as to work which is not On-Site Project Work.

SAMPLE

ARTICLE 7 - WORK STOPPAGES AND LOCKOUTS

SECTION 1 - NO STRIKES - NO LOCKOUTS

There shall be no strikes, sympathy strikes, picketing, work stoppages, slowdowns, hand billing, demonstrations or other disruptive activity at the Project for any reason by any Local Union or employee against any Contractors or employer while performing On-Site Project Work. There shall be no other Local Union, or concerted or employee activity which disrupts or interferes with the operation of the Contractors or the County. Failure of any Local Union or employee to cross any picket line established by any union, signatory or non-signatory to this Agreement, or the picket or demonstration line of any other organization, at or in proximity to the On-Site Project Work shall be deemed a violation of this Article. There shall be no lockout at the Project by any Contractor. Contractors and Local Unions shall take all steps necessary to ensure compliance with this Section 1 and to ensure uninterrupted construction for the duration of this Agreement.

SECTION 2 - DISCHARGE FOR VIOLATION

Contractors may discharge any employee violating Section 1, above, and any such employee will not be eligible thereafter for referral under this Agreement for a period of 100 days.

SECTION 3 - NOTIFICATION

If the Contractor contends that any Local Union has violated this Article, it will notify the President of the Council advising of such fact, with copies of the notification to the Local Union. The President of the Council shall instruct, order and otherwise use its best efforts to cause the employees and/or the Local Unions to immediately cease and desist from any violation of this Article. The Council, in complying with these obligations, shall not be liable for the unauthorized acts of a Local Union or its members.

SECTION 4 - EXPEDITED ARBITRATION

Any Contractor or Local Union alleging a violation of Section 1 of this Article may utilize the expedited procedure set forth below in lieu of, or in addition to, any actions at law or equity that may be brought.

A. A party invoking this procedure shall notify the American Arbitration Association to appoint an Arbitrator under this expedited arbitration procedure. Copies of such notification will be simultaneously sent to the alleged violator and, if a Local Union is alleged to be in violation, its International Union, the Council, and the Contractor.

B. Upon appointment in accordance with the rules and regulations of the American Arbitration Association for an expedited arbitration proceeding, the Arbitrator shall thereupon, after notice as to time and place to the Contractor, the Local Union involved, and the Council hold a hearing within 48 hours of receipt of the notice invoking the procedure if it is contended that the violation still

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exists. The hearing will not, however, be scheduled for less than 24 hours after the notice to the Council required by Section 3, above.

C. All notices pursuant to this Article may be by telephone, telegraph, hand delivery, or fax, confirmed by overnight delivery, to the Arbitrator, Contractor, the involved Local Union and the Council. The hearing may be held on any day including Saturdays or Sundays. The hearing shall be completed in one session, which shall not exceed 8 hours duration (no more than 4 hours being allowed to either side to present their case, and conduct their cross examination) unless otherwise agreed. A failure of any Local Union or Contractor to attend the hearing shall not delay the hearing of evidence by those present or the issuance of an award by the Arbitrator.

D. The sole issue at the hearing shall be whether a violation of Section 1, above, occurred. If a violation is found to have occurred, the Arbitrator shall issue a Cease and Desist Award restraining such violation and serve copies on the Contractor and the Local Union involved. The Arbitrator shall have no authority to consider any matter in justification, explanation or mitigation of such violation or to award damages, which issue is reserved solely for court proceedings, if any. The Award shall be issued in writing within 3 hours after the close of the hearing, and may be issued without an Opinion. If any involved party desires an Opinion, one shall be issued within 15 calendar days, but its issuance shall not delay compliance with, or enforcement of, the Award.

E. An Award issued under this procedure may be enforced by any court of competent jurisdiction upon the filing of this Agreement, together with the Award. Notice of the filing of such enforcement proceedings shall be given to the Local Union or Contractor involved. In any court proceeding to obtain a temporary or preliminary order enforcing the Arbitrator's award as issued under this expedited procedure, the involved Local Union and Contractor waive their right to a hearing and agree that such proceedings may be *ex parte*, provided notice is given to opposing counsel. Such agreement does not waive any party's right to participate in a hearing for a final court order of enforcement or in any contempt proceeding.

F. Any rights created by statute or law governing arbitration proceedings which are inconsistent with the procedure set forth in this Article, or which interfere with compliance thereto, are hereby waived by the Contractors and Local Unions to whom they accrue.

G. The fees and expenses of the Arbitrator shall be equally divided between the involved Contractor and Local Union.

SAMPLE

SECTION 5 - ARBITRATION OF DISCHARGES

Procedures contained in Article 9 shall not be applicable to any alleged violation of this Article, with the single exception that an employee discharged for violation of Section 1, above, may have recourse to the procedures of Article 9 to determine only if the employee did, in fact, violate the provisions of Section 1 of this Article; but not for the purpose of modifying the discipline imposed where a violation is found to have occurred.

ARTICLE 8 - LABOR MANAGEMENT COMMITTEE

SECTION 1 - SUBJECTS

The Project Labor Management Committee ("Labor Management Committee") will meet on a regular basis to: 1) promote harmonious relations among the contractors and Unions; 2) enhance safety awareness, cost effectiveness and productivity of construction operations; 3) protect the public interests; 4) discuss matters relating to staffing and scheduling with safety and productivity as considerations; 5) review Affirmative Action and equal employment opportunity matters pertaining to the Project; and 6) discuss such other matters as may be desirable or necessary in furtherance of the expeditious completion of the Project.

SECTION 2 - COMPOSITION

The Labor Management Committee shall be composed of one designee each of the Council, the Contractors and the Local Unions involved in the issues being discussed. The Labor Management Committee may conduct business through mutually agreed sub-committees. In all such cases, the Committee and its subcommittees shall maintain equal representation between the Local Unions and the Contractor entities.

ARTICLE 9 - GRIEVANCE & ARBITRATION PROCEDURE

SECTION 1 - PROCEDURE FOR RESOLUTION OF GRIEVANCES

Any question, dispute or claim arising out of, or involving the interpretation or application of this Agreement (other than jurisdictional disputes or alleged violations of Article 7, Section 1) shall be considered a grievance and shall be resolved pursuant to the exclusive procedure described below; provided, in all cases, that the question, dispute or claim arose during the term of this Agreement.

Step 1:

(a) When any employee covered by this Agreement feels aggrieved by a claimed violation of this Agreement, the employee shall, through the Local Union business representative or job steward give notice of the claimed violation to the work site representative of the involved Contractor. To be timely, such notice of the grievance must be given within 14 calendar days after the act, or within fourteen (14) days of when the employee or union first gained knowledge of the act, occurrence or

SAMPLE

event giving rise to the grievance. The business representative of the Local Union or the job steward and the work site representative of the involved Contractor shall meet and endeavor to adjust the matter with 14 calendar days after a timely notice has been given. If they fail to resolve the matter within the prescribed period, the grieving party, may, within 14 calendar days thereafter, pursue Step 2 of the grievance procedure by serving the involved Contractor with written copies of the grievance setting forth a description of the claimed violation, the date on which the grievance occurred, and the provisions of the Agreement alleged to have been violated. Grievances and disputes settled at Step 1 are non-precedential except as to the specific Local Union, employee and Contractor directly involved unless the settlement is accepted in writing by the Contractor as creating a precedent.

(b) Should any Contractor or Local Union have a dispute (excepting jurisdictional disputes or alleged violations of Article 7, Section 1) with any other Contractor or Local Union and after conferring a settlement is not reached within 14 calendar days, the dispute shall be reduced to writing and proceed to Step 2 in the same manner as outlined in subparagraph (a) for the adjustment of employee grievances.

Step 2:

The Business Manager or designee of the involved Local Union, together with representatives of the Council and the involved Contractor, shall meet in Step 2 within 14 calendar days of service of the written grievance to arrive at a satisfactory settlement.

Step 3:

(a) If the grievance shall have been submitted but not resolved in Step 2, any of the participating Step 2 entities may, within 21 calendar days after the initial Step 2 meeting, submit the grievance in writing (copies to other participants) to the American Arbitration Association. The Labor Arbitration Rules of the American Arbitration Association shall govern the appointment and conduct of the arbitration hearing, at which all Step 2 participants shall be parties. The decision of the Arbitrator shall be final and binding on the involved Contractor, Local Union and employees and the fees and expenses of such arbitration shall be borne equally by the involved Contractor and Local Union.

(b) Failure of the grieving party to adhere to the time limits set forth in this Article shall render the grievance null and void. These time limits may be extended only by written consent of the Contractor and the involved Local Union at the particular step where the extension is agreed upon.

SAMPLE

The Arbitrator shall have authority to make decisions only on the issues presented to him and shall not have the authority to change, add to, delete or modify any provision of this Agreement.

ARTICLE 10 - JURISDICTIONAL DISPUTES

SECTION 1 - NO DISRUPTIONS

There will be no strikes, sympathy strikes, work stoppages, slowdowns, picketing or other disruptive activity of any kind arising out of any jurisdictional dispute. Pending the resolution of the dispute, the work shall continue uninterrupted and as assigned by the Contractor. No jurisdictional dispute shall excuse a violation of Article 7.

SECTION 2 - ASSIGNMENT

All On-Site Project Work assignments shall be made pursuant to law.

SECTION 3 - PROCEDURE FOR SETTLEMENT OF JURISDICTIONAL DISPUTES

A. Any Local Union having a jurisdictional dispute with respect to On-Site Project Work assigned to another Local Union will submit the dispute in writing to the Administrator, Plan for the Settlement of Jurisdictional Disputes in the Construction Industry ("the Plan") within 72 hours and send a copy of the letter to the Local Union and the International Union involved, the President of the Council, the County and the Contractor involved. Upon receipt of a dispute letter from any Local Union, the Administrator will invoke the procedures set forth in the Plan to resolve the jurisdictional dispute. The jurisdictional dispute letter shall contain the information described in Article IV of the Plan.

B. Within 5 calendar days of receipt of the dispute letter, there shall be a meeting of the Contractor involved, the Local Unions involved and the President of the Council for the purpose of resolving the jurisdictional dispute.

C. If the dispute remains unresolved after this meeting, the parties will proceed to final and binding arbitration in accordance with the principles and procedures set forth in the rules of the Plan.

D. The Arbitrator will render a short-form decision within 5 days of the hearing based upon the evidence submitted at the hearing, with a full written decision to follow within 30 days of the close of the hearing.

E. This Jurisdictional Dispute Resolution Procedure will only apply to On-Site Project Work performed by Local Unions. A representative of the County and the International Union involved may also attend the meeting.

F. Any Local Union involved in a jurisdictional dispute on this Project shall continue working in accordance with Section 2 above and without disruption of any kind.

SAMPLE

G. Copies of the Plan will be provided by the Council upon request.

SECTION 4 - AWARD

Any jurisdictional award pursuant to Section 3 shall be final and binding on the disputing Local Unions and the involved Contractor on this Project only, and may be enforced in any court of competent jurisdiction. Such award or resolution shall not establish a precedent on any other construction work not covered by this Agreement. In all disputes under this Article, the involved Contractors shall be considered parties in interest.

SECTION 5 - LIMITATIONS

The Jurisdictional Dispute Arbitrator shall have no authority to assign work to a double crew, that is, to more employees than the minimum required by the involved Contractor to perform the work involved; nor to assign the work to employees who are not qualified to perform work involved; nor to assign work being performed by non-union employees to union employees. This does not prohibit the establishment, with the agreement of the involved Contractor, of composite crews where more than one employee is needed for the job. The aforesaid determinations shall decide only to whom the disputed work belongs.

SECTION 6 - NO INTERFERENCE WITH WORK

There shall be no interference or interruption of any kind with the On-Site Project Work while any jurisdictional dispute is being resolved. The On-Site Project Work shall proceed as assigned by the involved Contractor until finally resolved under the applicable procedure of this Article. The award shall be confirmed in writing to the involved parties. There shall be no strike, work stoppage, or interruption in protest of any such award.

SAMPLE

ARTICLE 11 - WAGES AND BENEFITS

SECTION 1 - CLASSIFICATION AND BASE HOURLY RATE

All employees covered by this Agreement shall be classified in accordance with the work performed and paid the base hourly wage rates for those classifications as specified in the applicable Local Unions' collective bargaining agreements, as they may be amended during the term of this Agreement. Recognizing, however, that special conditions may exist or occur on the Project, the parties, by mutual agreement may establish rates and/or hours for one or more classifications which may differ from the applicable collective bargaining agreements. Parties to such agreements shall be the Contractor involved, the involved Local Unions and the Council.

SECTION 2 - EMPLOYEE BENEFIT FUNDS

The Contractors agree to pay contributions on behalf of all employees covered by this Agreement to the established employee benefit funds in the amount designated in the appropriate Local Unions' collective

bargaining agreements; provided, however, that the involved Contractors and the Local Unions agree that only such bona fide employee benefits as are explicitly required under Section 220 of the New York State Labor Law shall be included in this requirement and paid by the Contractors on this Project. Bona fide jointly trusteed fringe benefit plans established or negotiated through collective bargaining during the life of this Agreement may be added if similarly protected under Section 220. Contractors shall not be required to contribute to non-Section 220 benefits, trusts or plans.

The Contractors agree to be bound by the written terms of the legally-established Local Union collective bargaining agreement and/or Trust Agreements specifying the detailed basis on which payments are to be paid into, and benefits paid out of, such Trust Funds but only with regard to work done on this Project and only for those employees to whom this Agreement requires such benefit payments. Copies of such Trust Agreements will be provided by the Council upon request. Notices of deficiencies in the payment of fringe benefit contributions may be provided to the following identified contacts for the Contractor and the County of Westchester, as project Owner (insert name, addresses and emails below):

Contractor:
Contractor
Contractor Title
Contractor Company Name
Contractor Address 1
Contractor Address 2
Contractor Email Address

County of Westchester:
Westchester County Project Director
Westchester County Dept. of Public Works & Transportation
148 Martine Avenue, Room 512
White Plains, New York 10601
Westchester County Project Director Email Address

SAMPLE

ARTICLE 12 - HOURS OF WORK, PREMIUM PAYMENTS, SHIFTS AND HOLIDAYS

SECTION 1 - WORK WEEK AND WORK DAY

A. The standard work week shall consist of 40 hours of work at straight time rates per one of the following schedules:

i) Five-Day Work Week: Monday-Friday; 5 days, 8 hours plus 1/2 hour unpaid lunch period each day.

ii) Four-Day Work Week: Monday-Thursday; 4 days, 10 hours plus 1/2 hour unpaid lunch period each day.

B. The day shift shall commence between the hours of 6:00 a.m. and 9:00 a.m. and shall end between the hours of 2:00 p.m. and 7:30 p.m. Starting and quitting times shall occur at the staging areas as may be designated by the Contractor.

C. Scheduling – The Contractor shall have the option of scheduling either a five-day or four-day work week and the work day hours consistent with the Project requirements, the Project schedule and minimization of interference. When conditions beyond the control of the Contractor, such as severe weather, power failure, fire or natural disaster, prevent the performance of On-Site Project Work on a regularly scheduled work day, the Contractor may, with mutual agreement of the involved Local Unions on a trade-by-trade basis, schedule work on Friday (where on four 10s) or Saturday (where on five 8s) during that calendar week in which a work day was lost, at straight time pay, provided that the employees involved work a total of 40 hours or less during that work week. When conditions on the Project cause the Contractor to stop work or be unable to commence work on the day in question, the Contractor will notify the Local Unions and the employees at that time that Friday or Saturday, as the case may be, will be a make-up day for the affected operation(s) and the Friday or Saturday work will then be at straight time for the day or any portion of the work day that work was stopped. The balance of the day on Friday or Saturday, if any, will be at time and one-half (1/2) the straight time rate of pay, assuming such Friday or Saturday is the sixth consecutive day worked. In the event that work is performed on a seventh consecutive day, the balance of the day, if any, will be at double time the straight time rate of pay. If the Contractor seeks to cancel a day's work in advance of that day and to schedule the following Friday or Saturday as a make-up day, the determination of whether the Contractor is unable to perform the affected work operation(s) shall be jointly made between the Contractor and the involved Local Unions, the Local Unions' agreement not to be unreasonably withheld.

D. Notice – Contractors shall provide not less than five (5) days prior notice to the Local Unions as to the work week and work hours scheduled to be worked or such lesser notice as may be mutually agreed upon.

SECTION 2 - OVERTIME

Overtime pay for hours outside of the standard work week and work day, described in Paragraph A above, shall be paid in accordance with the applicable Local Unions' collective bargaining agreements. There will be no restriction upon the Contractor's scheduling of overtime or the non-discriminatory designation of

SAMPLE

employees who work. There shall be no pyramiding of overtime pay under any circumstances. The Contractor shall have the right to schedule work so as to minimize overtime.

SECTION 3 - SHIFTS

A. Flexible Schedules - Scheduling of shift work shall remain flexible in order to meet Project schedules and existing Project conditions including the minimization of interference with traffic. It is not necessary to work a day shift in order to schedule a second shift. Shifts must be worked a minimum of five consecutive work days, must have prior approval of the Contractor and/or subcontractor, and must be scheduled with not less than five work days notice to the Local Union.

B. Second Shift - The second shift (starting between 2 p.m. and 8 p.m.) shall consist of 8 hours work (or 10 hours of work) for an equal number of hours pay at the straight time rate plus 15% in lieu of overtime and exclusive of a 1/2 hour unpaid lunch period. Where specifically required by the applicable Local Unions' collective bargaining agreements, employees on second shift, where there are no first shift employees scheduled for that trade, will be paid at time and one-half rates for such second shift work, but without any shift differential. In all other cases, the first sentence of this paragraph B shall apply.

C. Flexible Starting Times - Shift starting times will be adjusted by the Contractor as necessary to fulfill Project requirements subject to the notice requirements of Paragraph A.

D. Four Tens - When working a four-day work week, the standard work day shall consist of 10 hours work for 10 hours of pay at the straight time rate exclusive of an unpaid 1/2 hour meal period and regardless of the starting time. This provision is applicable to night shifts only, and such night shifts are subject to the shift differential in paragraph B above.

SECTION 4 - HOLIDAYS

A. Schedule - There shall be nine (9) recognized holidays on the Project:

New Year's Day	Labor Day	Dr. Martin Luther King, Jr. Day
President's Day	Veterans Day	
Memorial Day	Thanksgiving Day	
Fourth of July	Christmas Day	

All said holidays shall be observed on the dates designated by New York State law. In the absence of such designation, they shall be observed on the calendar date except those holidays which occur on Sunday shall be observed on the following Monday.

B. Payment - Regular holiday pay, if any, and/or premium pay for work performed on such a recognized holiday shall be in accordance with the applicable Local Unions' collective bargaining agreements.

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C. Exclusivity - No holidays other than those listed in paragraph A above shall be recognized nor observed.

D. Whenever a paid holiday falls within a work week, which defined for the purpose of this Section as commencing on Sunday and concluding on the following Saturday, then an Employee covered by this Agreement shall be paid for such holiday.

SECTION 5 - REPORTING PAY

A. Employees who report to the work location pursuant to regular schedule and who are not provided with work or whose work is terminated early by a Contractor, for whatever reason, shall receive minimum reporting pay in accordance with the applicable Local Unions' collective bargaining agreements.

B. When an employee, who has completed his/her scheduled shift and left the Project site, is "called out" to perform special work of a casual, incidental or irregular nature, the employee shall receive pay for actual hours worked with a minimum guarantee, as may be required by the applicable Local Union's collective bargaining agreement, at the employee's straight time rate.

C. When an employee leaves the job or work location of his/her own volition or is discharged for cause or is not working as a result of the Contractor's invocation of Section 7 below, he/she shall be paid only for the actual time worked.

D. Except as specifically set forth in this Article, there shall be no premiums, bonuses, hazardous duty, high time or other special payment of any kind.

E. There shall be no pay for time not actually worked except as specifically set forth in this Article and except where an applicable Local Union's collective bargaining agreement requires a full week's pay for forepersons.

SAMPLE

SECTION 6 - PAYMENT OF WAGES

A. Payday - A statement shall be furnished with the payment of wages showing the Employer's name; the Employee's name; the Total Earnings, the Total Hours and itemized Tax Deductions and/or Withholdings. A payroll check shall be drawn upon a local Federal Deposit Insurance Corporation insured financial institution within the region where the project work is being performed, payable on demand at its identified value. The Employer may also pay electronically with transfer from a direct deposit fund so long as the Employee has a viable bank account in which to transfer funds and has requested same. All Employees shall be paid by 3:00 p.m. on Thursdays. In the event that the following Friday is a bank holiday, payroll shall be issued on Wednesday of that week. Not more than one week's wages shall be held back in any pay period.

B. Termination - Employees who are laid off or discharged for cause shall be paid in full for that which is due them at the time of termination. The Contractor shall also provide the employee with a written statement setting forth the date of lay off or discharge.

SECTION 7 - EMERGENCY WORK SUSPENSION

A Contractor may, if considered necessary for the protection of life and/or safety of employees or others, suspend all or a portion of On-Site Project Work. In such instances, employees will be paid for actual time worked; provided, however, that when a Contractor requests that employees remain at the job site available for work, employees will be paid for "stand by" time at their hourly rate of pay.

SECTION 8 - INJURY-DISABILITY

An employee who, after commencing work, suffers a work-related injury or disability while performing work duties, shall receive no less than 8 hours wages for that day. Further, the employee shall be rehired at such time as able to return to duties provided there is still work available on the Project for which the employee is qualified and able to perform.

SECTION 9 - TIME KEEPING

A Contractor may utilize systems to check employees in and out. Each employee must check in and out and sign a daily sign-in sheet, or other attendance protocol as directed in writing by the Project Owner. The Contractor will provide adequate facilities for checking in and out in an expeditious manner.

SECTION 10 - MEAL PERIOD

A Contractor shall schedule an unpaid period of a 1/2 hour duration at the work location between the 3rd and 5th hour of the scheduled shift. A Contractor may, for efficiency of operation, establish a schedule which coordinates the meal periods of two or more trades. If an employee is required to work through the meal period, the employee shall be compensated in a manner established in the applicable Local Union's collective bargaining agreement.

SECTION 11 - BREAK PERIODS

There will be no rest periods, organized coffee breaks or other non-working time established during working hours. Individual coffee containers will be permitted at the employee's work location.

ARTICLE 13 - APPRENTICES

SECTION 1 - RATIOS

Recognizing the need to maintain continuing supportive programs designed to develop adequate numbers of competent workers in the construction industry and to provide trade entry opportunities for minorities and women, Contractors will employ apprentices in their respective trades to perform such work as is within their capabilities and which is customarily performed by the trade in which they are indentured. Contractors

SAMPLE

may utilize apprentices and such other appropriate classifications as are contained in the applicable Local Union's collective bargaining agreement in a ratio not to exceed 25% of the work force by trade (without regard to whether a lesser ratio is set forth in the applicable Local Union's collective bargaining agreement), unless the applicable Local Union's collective bargaining agreement provides for a higher percentage. Apprentices and such other classifications as are appropriate shall be employed in a manner consistent with the provisions of the appropriate Local Union's collective bargaining agreement.

SECTION 2 - DEPARTMENT OF LABOR

To assist the Contractors in attaining a maximum effort on this Project, the Local Unions agree to work in close cooperation with, and accept monitoring by, the New York State Department of Labor and the County to try and achieve a goal that minorities and women are afforded every opportunity to participate in apprenticeship programs which result in the placement of apprentices on this Project. To try and achieve this goal, up to 50% of the apprentices placed on this Project shall be first year minority or women apprentices as shall be 60% of the apprentice equivalents, placed on the Project, who do not necessarily meet all of the age or entrance requirements for the apprentice program or have not necessarily passed the entrance examination. The Local Unions will cooperate with the contractor requests for minority, women or economically disadvantaged referrals to meet this contractor goal.

ARTICLE 14 - SAFETY PROTECTION OF PERSON AND PROPERTY

SECTION 1 - SAFETY REQUIREMENTS

Each Contractor will ensure that applicable OSHA requirements are at all times maintained on the Project and the employees and the Local Unions agree to cooperate fully with these efforts. Employees must perform their work at all times in a safe manner and protect themselves and the property of the Contractors and the County from injury or harm. Failure to do so will be grounds for discipline, including discharge.

SECTION 2 - CONTRACTOR RULES

Employees covered by this Agreement shall at all times be bound by the reasonable safety, security, and visitor rules as established by the Contractors for this Project. Such rules will be published and posted in conspicuous places throughout the Project.

SECTION 3 - INSPECTIONS

The Contractors retain the right to inspect incoming shipments of equipment, apparatus, machinery and construction materials of every kind.

SAMPLE

ARTICLE 15 - NO DISCRIMINATION

SECTION 1 - COOPERATIVE EFFORTS

The Contractors and the Local Unions agree that they will not discriminate against any employee or applicant for employment because of race, color, religion, sex, sexual orientation, national origin, age or marital status, or any other protected class as established by Federal or New York State law, in any manner prohibited by law or regulation. It is recognized that special procedures may be established by the Contractors, the Local Unions and the New York State Department of Labor for the training and employment of persons who have not previously qualified to be employed on construction projects of the type covered by this Agreement. The parties to this Agreement will assist in such programs and agree to use their best efforts to ensure that the goals for female and minority employment are met on this Project.

SECTION 2 - LANGUAGE OF AGREEMENT

The use of the masculine or feminine gender in this Agreement shall be construed as including both genders.

ARTICLE 16 - GENERAL TERMS

SECTION 1 - PROJECT RULES

The Contractors shall establish such reasonable Project rules as are appropriate for the good order of the Project. These rules will be explained at the pre-job conference and posted at the Project site and may be amended thereafter as necessary. Failure of an employee to observe these rules and regulations shall be grounds for discipline, including discharge. The fact that no order was posted prohibiting a certain type of misconduct shall not be a defense to an employee disciplined or discharged for such misconduct when the action taken is for cause.

SECTION 2 - TOOLS OF THE TRADE

The welding/cutting torch and chain fall are tools of the trade having jurisdiction over the work performed. Employees using these tools shall perform any of the work of the trade. There shall be no restrictions on the emergency use of any tools or equipment by any qualified employee or on the use of any tools or equipment for the performance of work within the employee's jurisdictions.

SECTION 3 - SUPERVISION

Employees shall work under the supervision of the trade foreperson or general foreperson.

SECTION 4 - TRAVEL ALLOWANCES

There shall be no payments for travel expenses, travel time, subsistence allowance or other such reimbursements or special pay except as expressly set forth in this Agreement.

SAMPLE

SECTION 5 - FULL WORK DAY

Employees shall be at their staging area at the starting time established by the Contractor and shall be returned to their staging area by quitting time after performing their assigned functions under the supervision of the Contractor. The signatories reaffirm their policy of a fair day's work for a fair day's wage.

SECTION 6 - COOPERATION

The Contractor and the Local Unions will cooperate in seeking any New York State Department of Labor approvals that may be required for implementation of any terms of this Agreement.

ARTICLE 17 - SAVINGS AND SEPARABILITY

SECTION 1 - THIS AGREEMENT

In the event that the application of any provision of this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law, the provision involved shall be rendered, temporarily or permanently, null and void but the remainder of the Agreement shall remain in full force and effect. In such event, the Agreement shall remain in effect for contracts already bid and awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties to this Agreement will enter into negotiations for a substitute provision in conformity with the law and the intent of the parties for contracts to be let in the future.

SECTION 2 - THE BID SPECIFICATIONS

In the event that the County bid specifications, or other action, requiring that a successful bidder become signatory to this Agreement is enjoined, on either an interlocutory or permanent basis, or otherwise found in violation of law such requirement shall be rendered, temporarily or permanently, null and void but the Agreement shall remain in full force and effect to the extent allowed by law. In such event, the Agreement shall remain in effect for contracts already bid and awarded or in construction where the Contractor voluntarily accepts the Agreement. The parties will enter into negotiations as to modifications to the Agreement to reflect the court action taken and the intent of the parties for contracts to be let in the future.

SECTION 3 - NON-LIABILITY

In the event of an occurrence referenced in Section 1 or Section 2 of this Article, neither the County, the Contractors, or any Local Union shall be liable, directly or indirectly, for any action taken, or not taken, to comply with any court order, injunction or determination. Project bid specifications will be issued in conformance with court orders then in effect and no retroactive payments or other action will be required if the original court determination is ultimately reversed.

SAMPLE

SECTION 4 - NON-WAIVER

Nothing in this Article shall be construed as waiving the prohibitions of Article 7 as to Contractors and Local Unions.

ARTICLE 18 - FUTURE CHANGES IN SCHEDULE "A" COLLECTIVE BARGAINING AGREEMENTS

SECTION 1 - CHANGES TO COLLECTIVE BARGAINING AGREEMENTS

A. The Contractors and/or Local Unions who are parties to the collective bargaining agreements which are applicable to the On-Site Project Work shall notify the Contractor in writing of any mutually agreed upon changes in provisions of such agreements and the effective dates of such changes.

B. It is agreed that any provisions negotiated into collective bargaining agreements will not apply to On-Site Project Work if such provisions are less favorable to this Project than those uniformly required of contractors for construction work normally covered by those agreements; nor shall any provision be recognized or applied on this Project if it may be construed to apply exclusively, or predominantly, to work covered by this Agreement.

C. Any disagreement between signatories to this Agreement over the application to On-Site Project Work of provisions agreed upon in the renegotiation of collective bargaining agreements shall be resolved in accordance with the procedure set forth in Article 9 of this Agreement.

SECTION 2 - LABOR DISPUTES DURING COLLECTIVE BARGAINING AGREEMENT NEGOTIATIONS

The Local Unions agree that there will be no strikes, work stoppages, sympathy actions, picketing, slowdowns or other disruptive activity or other violations of Article 7 affecting the Project by any Local Union involved in the renegotiation of collective bargaining agreements nor shall there be any lock-out on this Project affecting a Local Union during the course of such renegotiations.

SAMPLE

ARTICLE 19 – WORKERS' COMPENSATION ADR

All Local Unions, the Contractor and its subcontractors performing On-Site Project Work agree to adopt and be bound by the Alternative Dispute Resolution Agreement entered into between the Construction Industry Council of Westchester and Hudson Valley, Inc. and the Council as approved by the New York State Workers' Compensation Board on February 17, 2022, as amended (herein after referred to as the "Workers' Compensation ADR Agreement"). The Contractor and its subcontractors may provide Workers' Compensation insurance through an alternative insurance carrier (or through self-insurance) or may use an alternative Program Manager, other than the primary carrier or Program Manager designated in Article III, Section 2 of the Workers' Compensation ADR Agreement. The use of an alternative carrier (or self-

insurance) and/or Program Manager is subject to approval by the Workers' Compensation ADR Agreement Oversight Committee, which approval shall not be unreasonably withheld. The determination to utilize the Workers' Compensation ADR Agreement will be at the exclusive option of the County.

ARTICLE 20 – HELMETS & HARDHATS

Section 1. The parties recognize a desire to facilitate the entry into the building and construction trades of veterans who are interested in careers in the building and construction industry. The parties agree to utilize the services of the Center for Military Recruitment, Assessment and Veterans Employment (hereinafter "Center") and the Center's "Helmets to Hardhats" program to serve as a resource for preliminary orientation, assessment of construction aptitude, referral to apprenticeship programs or hiring halls, counseling and mentoring, support network, employment opportunities and other needs as identified by the parties.

Section 2. The parties agree to coordinate with the Center to create and maintain an integrated database of veterans interested in working on this Project and of apprenticeship and employment opportunities for this Project. To the extent permitted by law, the Unions will give credit to such veterans for bona fide, provable past experience.

SAMPLE

SIGNATURES

IN WITNESS WHEREOF the parties have caused this Agreement to be executed and effective as the _____ day of _____, 20___.

BUILDING AND CONSTRUCTION TRADES COUNCIL OF WESTCHESTER AND PUTNAM COUNTIES, NEW YORK, AFL-CIO on behalf of itself and its affiliated Local Unions.

BY:_____ DATE:_____
PRESIDENT

BY:_____ DATE_____
VICE-PRESIDENT

BY:_____ DATE_____
TREASURER

Contractor Company Name

BY:_____ DATE_____
(Name & Title)

APPROVED BY:
COUNTY OF WESTCHESTER

BY:_____ DATE:_____
Commissioner of Public Works and Transportation

Approved as to form:

_____
Sr. Assistant County Attorney
County of Westchester

SAMPLE

ACKNOWLEDGMENT

State of New York }
} ss.:
County of Westchester }

On the _____ day of _____ in the year 20___, before me, the undersigned, personally appeared _____, personally known to me or proved to me on the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he/she executed the same in his/her capacity, and that by his/her signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument; and, acknowledged if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed as required therein.

_____
Notary Public

SAMPLE

CERTIFICATE OF AUTHORITY

I, _____
(Officer other than Officer signing agreement)

certify that I am the _____ of
(Title)

_____, a corporation duly organized and in good
(the "Corporation")

standing under the _____
(Law under which organized, e.g., the New York Business Corporation Law)

named in the foregoing agreement; that _____
(Person executing agreement)

who signed said agreement on behalf of the Corporation was, at the time of execution

_____ of the Corporation and that said Agreement
(Title of Person Executing Agreement)

was duly signed for and on behalf of said Corporation by authority of its Board of Directors, thereunto duly authorized and that such authority is in full force and effect at the date hereof.

_____
(Signature)

State of New York }
} ss.:
County of Westchester }

On this _____ day of _____, 20___, before me, the undersigned, a Notary Public in and for said State, personally appeared _____

personally known to me or proved to me on the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he/she executed the same in his/her capacity, and that by his/her signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument; and, acknowledged if operating under any trade name, that the certificate required by the New York State General Business Law Section 130 has been filed as required therein.

_____
Notary Public

SAMPLE

SOLE CORPORATE OFFICER ACKNOWLEDGMENT

State of New York }
} ss.:
County of Westchester }

On this _____ day of _____, 20___, before me personally

came _____ personally known to me or proved to me on
(Name of Sole Officer)

the basis of satisfactory evidence to be the individual whose name is subscribed to the within instrument and acknowledged to me that he/she executed the same in his/her capacity as President and Sole Officer and Director of _____
(Name of Corporation)

the corporation described in and which executed the within instrument, and acknowledged that he/she owns all the issued and outstanding capital stock of said corporation, and that he/she signed the within instrument on behalf of said corporation.

_____
Notary Public

SAMPLE

Schedule "A" Local Collective Bargaining Agreements

Below is a list of the affiliate Local Unions of the Building and Construction Trades Council of Westchester and Putnam Counties, New York, AFL-CIO ("Council"). Copies of the applicable Collective Bargaining Agreements of the Local Unions can be obtained by writing to the Building and Construction Trades Council Westchester and Putnam Counties, New York AFL-CIO at 1360 Pleasantville Road, Briarcliff Manor, New York 10510, Attn: Jeff Loughlin, President.

1. Local One International Union of Elevator Constructors of New York and New Jersey, AFL-CIO
2. International Brotherhood of Electrical Workers Local No. 3
3. Boilermakers Local 5
4. Bricklayers and Allied Craftworks Local 1 NY
5. Tile, Marble & Terrazzo Bricklayers and Allied Craftsmen Local Union No. 7 of New York & New Jersey
6. United Union of Roofers, Waterproofers and Allied Workers Local No. 8, New York
7. District Council 9 International Brotherhood of Painters and Allied Trades, AFL-CIO
8. International Union of Operating Engineers Local 15D
9. Plumbers & Steamfitters Local 21
10. International Union of Operating Engineers Local 30
11. Sheet Metal Workers 'Local Union 38
12. Local Union No. 40 of the International Association of Bridge, Structural and Ornamental Iron Workers
13. Metallic Lathers Union Local 46
14. Heavy Construction Laborers Local 60
15. Asbestos Workers Local 91 (International Association of Heat and Frost Insulators and Asbestos Workers)
16. International Union of Operating Engineers Local 137
17. Stone Derrickmen and Riggers Local Union No. 197
18. Laborers International Union of North America, Local No. 235
19. Operative Plasterers 'and Cement Masons 'International Association Local 262
20. North Atlantic States Regional Council of Carpenters - Local 279
21. International Brotherhood of Electrical Workers Local Union 363
22. Teamsters Local 456
23. Ornamental Ironworkers Local Union No. 580
24. Road Sprinkler Fitters Local 669
25. NYCDCC Millwright and Machinery Erectors Local Union No. 740
26. United Cement Masons 'Union of Greater New York and Long Island Local 780
27. Bridge Painters Local 806
28. Teamsters Local 813
29. Teamsters Local 814
30. Glaziers Local 1087
31. NYCDCC Dockbuilders Local Union 1556
32. NYCDCC Resilient Floor Coverers Local 2287
33. Iron Workers District Council of Greater New York and Vicinity

Not all Local Unions will necessarily be involved in the Project. If it is determined that additional affiliates of the Council are required to be engaged in Project construction work, then the PLA will include those additional affiliates.

SAMPLE

Letter of Assent

On this ___ day of _____, 2024, the undersigned party confirms that it agrees to be a party to and be bound by the _____ Project Labor Agreement (hereinafter "Agreement" or "PLA") entered into between _____ and _____, and understands that such Agreement may, from time to time, be amended by the parties or interpreted pursuant to its terms. The terms of the Agreement and its Schedules are hereby incorporated by reference herein. The undersigned, as a Contractor or Subcontractor (hereinafter "Contractor") on the Project known as _____ and located at _____(hereinafter "Project"), for and in consideration of the award to it of a contract to perform work on said Project, and in further consideration of the mutual promises made in the PLA, a copy of which was received and is acknowledged, hereby:

1. accepts and agrees to be bound by the terms and conditions of the Agreement, together with any and all schedules, amendments, and supplements now existing or which are later made thereto;

2. agrees to be bound by, and incorporates and adopts the legally established collective bargaining agreements ("Schedule A Agreements") and local fringe benefit trust funds agreements as referenced in the PLA and this letter of Assent for this Project;

3. authorizes the parties to such local fringe benefit trust funds agreements to appoint trustees and successor trustees to administer the trust funds and hereby ratifies and accepts the trustees so appointed as if made by the Contractor;

4. certifies that it has no commitments or agreements that would preclude its full and complete compliance with the terms and conditions of this Agreement. The Contractor agrees to employ labor that can work in harmony with all other labor on the Project and shall require labor harmony from every lower tier Subcontractor it engages to work on the Project. Labor harmony disputes and/or issues shall be subject to the Labor Management Committee's Pre-Job conference provisions;

5. agrees to secure from any Contractor(s) (as defined in the PLA) which is or becomes a Subcontractor (of any tier) on the Project, a duly executed Agreement to be bound in from identical to this document; and

6. agrees that it will not invoke the Most Favored Nations Clause that may be contained in any of its collective bargaining agreements with Council affiliated Local Unions as a result of the application of this PLA to this Project.

SAMPLE

_____
Name of Contractor or Subcontractor

By:_____
Authorized Officer & Title

_____
Address

_____
Telephone No./Email Address/Facsimile No.

Contractor's State License # _____

Employer EIN_____Employer NYS IU _____WC# _____

SAMPLE

TECHNICAL SPECIFICATIONS

DEPARTMENT OF PUBLIC WORKS AND TRANSPORTATION

Division of Engineering

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:
   1. Demolition and removal of selected portions of building or structure.
   2. Demolition and removal of selected site elements.
   3. Salvage of existing items to be reused or recycled.

B. Related Requirements:
   1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
   2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
   3. Section 017300 "Execution" for cutting and patching procedures.
   4. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
   5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

C. Contractor shall carefully remove and salvage existing rooftop antennas, radio communication equipment, cabling, and associated mounting hardware for return to the Owner for later reinstallation.

1.4 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.5 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
   1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.6 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
   1. Inspect and discuss condition of construction to be selectively demolished.
   2. Review structural load limitations of existing structure.
   3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
   5. Review areas where existing construction is to remain and requires protection.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Engineering Survey: Submit engineering survey of condition of building.

C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for noise control. Indicate proposed locations and construction of barriers.

D. Schedule of Selective Demolition Activities: Indicate the following:
   1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's on-site operations are uninterrupted.
   2. Interruption of utility services. Indicate how long utility services will be interrupted.
   3. Coordination for shutoff, capping, and continuation of utility services.
   4. Use of elevator and stairs.

E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.

F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.8 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged. Include radio and other communcation devices mounted on the roof.

1.9 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.10 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
   1. Before selective demolition, Owner will remove the following items:
      a. Radio antenae and other communcation devices mounted on the roof..

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

D. Storage or sale of removed items or materials on-site is not permitted.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.11 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.12 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

B. Coordinate all demolition activities with Airport Operations in advance.
   1. Contractor shall comply with Airport Operations directives for all construction within airport property.
   2. All cranes, lifts, or equipment exceeding height limits must be coordinated with Airport Operations.
   3. Contractor shall use only Airport-approved haul routes. No construction traffic may enter airside areas.
   4. Daily FOD (Foreign Object Debris) housekeeping is required. Dumpsters shall be covered at all times when not in use.
   5. Contractor shall notify Airport Operations 72 hours prior to any activity producing significant noise, vibration, dust, or odors.
   6. All personnel shall comply with airport security requirements applicable to non-secured landside zones, including badges and gate-controlled access.

7. Fuel handling and spill response shall comply with Airport environmental protocols.
8. Contractor shall prevent standing water and manage exterior debris to avoid wildlife attractants.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings.
   1. Comply with requirements specified in Section 013233 "Photographic Documentation."
   2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
   3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.4 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
    1. The building is unoccupied for the duration of construction; no Owner protection measures are required inside the building.
    2. Protection requirements shall focus on airport-related operational impacts, including traffic routing, equipment height coordination, FOD control, environmental compliance, and maintaining secure site boundaries.
    3. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
    4. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
    5. Cover and protect furniture, furnishings, and equipment that have not been removed.
    6. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
    1. Strengthen or add new supports when required during progress of selective demolition.

C. Remove temporary barricades and protections where hazards no longer exist.

3.5 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
   3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
   5. Maintain fire watch during and for at least 4 hours after flame-cutting operations.
   6. Maintain adequate ventilation when using cutting torches.
   7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
   8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
   9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   10. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area on-site.
   5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a

suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19.05 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.

C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.

D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section ???Insert Section number and title??? for new roofing requirements.
   1. Remove existing roof membrane, flashings, copings, and roof accessories.
   2. Remove existing roofing system down to substrate.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.9 SELECTIVE DEMOLITION SCHEDULE

A. Remove: See drawings

B. Remove and Salvage: See drawings

C. Remove and Reinstall: See drawings

END OF SECTION 02 41 19

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. Comply with Contract Documents: All Work of this Section shall comply with the requirements of the Conditions of the Contract (General, Supplementary and Special), with all Sections of Division 1 - General Requirements, with this Section of the Specifications, with the Drawings and with all other Contract Documents.

B. Flammable Materials or materials not conforming in all respects to the fire resistive and fire safety provisions of governing regulations shall not be left in place in the Work.

C. Disposition of and Exposure to Materials: Contractor remains fully responsible for the disposition and the exposure to persons of all materials, whether or not hazardous.

D. Volatile Organic Compounds (VOC): Contractor remains fully responsible for the supplying of products and materials complying to the VOC limitations set forth by the *Building Code* and by governing agencies having jurisdiction.

E. Metrication: For convenience of Contractor, S.I. units are provided in this Specification. In the event of conflict between the basic unit and the S.I. unit, the basic unit shall prevail.

1.2 WORK INCLUDED

A. Scope: Contractor shall examine all of the Contract Documents for the extent of the Work of this Section of the Specifications. That Work shall include all labor, materials, devices, plants, tools, equipment, appliances and services necessary to complete the Work as shown in the Drawings, as specified herein, as required by job conditions, and as required by governing authorities having jurisdiction, including but not limited to the following:

1. Designing and testing of concrete mixes. Designing of concrete mixes shall be by Contractor's Professional Engineer licensed in the project's jurisdiction.
2. Submission of Shop Drawings, samples, supporting data, mill certificates and the like.
3. Furnishing, fabricating and placing of all reinforcing bars, field-applied concrete anchors, metal and plastic accessories, spacers and the like.
4. Cooperation in the making of concrete testing samples, in inspecting reinforcing steel and in all other activities related to Work of this Section.
5. Casting of concrete slabs, beams, walls, footings, other elements noted.
6. Concrete fills and topping slabs, where shown in Architectural or Structural Drawings.
7. Keys in construction joints.
8. Grouting, setting and building-in of embedded items provided under other Sections of this Specification.
9. Providing contraction and construction joints in concrete Work including the surface preparation and application of bonding compound where specified.

10. Forming and bracing of concrete Work and the subsequent removal of formwork, bracing and the like. Design of formwork shall be by Contractor's Professional Engineer licensed in the project's jurisdiction.
11. Formwork for pockets, chases, slots, reglets, depressions and openings in concrete Work required for the installation of Work specified under other Sections of this Specification.
12. Finishing, curing, and protection of all concrete Work, including both hot and cold weather protection of concrete Work.
13. Hardening and dustproofing of exposed, interior concrete floors, platforms, stairs, landings and the like.
14. Cleaning of concrete required to receive other materials.
15. Furnishing and placing concrete where concrete Work is delayed to accept block-outs and other Work associated with Contractor's means and methods of construction.
16. Plugging and sealing of holes potentially or actually subject to hydrostatic pressure. Exterior walls below grade shall be plugged and sealed.
17. Self-placing, self-leveling, self-consolidating or compacting (SCC) concrete. This specification allows for the use of SCC at Contractor's option. Provide SCC where specifically required in the Contract Documents.
18. Provisions for other Work.
19. Cooperate with Owner, with Construction Manager, with Architect and with Testing Agency in all aspects of quality assurance and in all other activities related to the work of this Section.
20. The safe handling and disposition of materials related to the Work of this Section, whether or not hazardous.
21. All other labor, materials and Work given in the Drawings, specified herein or required to make the Work complete.

B. Work Installed as Specified Elsewhere: Contractor shall examine all of the Contract Documents for the extent of Work to be installed under this Section. Such work shall include, but shall not be limited to:

1. Anchors, inserts, clips, field-applied concrete anchors and other embedded materials for precast or stonework, and the like.
2. Angle edging, corner guards, curb edging and the like at platforms, pits, and the like.
3. Sleeves for penetration through new concrete.
4. Provisions for electrical and lightning grounding
5. Embedded items of other trades similar to the items listed in this Article.

1.3 RELATED WORK

A. Related Work Specified Elsewhere, Amplified Elsewhere or Included in Other Contracts:

1. Submittals: Section 013000.
2. Owner's plant and field testing and inspection of concrete Work by Testing Agency engaged and paid for by Owner: Section 014000.
3. Furnishing of embedded items required by and specified under other Sections of this Specification.
4. Other items similar to the items listed in this Article.

1.4 APPLICABLE CODES AND STANDARDS

A. General: Except as modified or voided by requirements specified herein or by details or notes included in the Drawings, Work specified under this Section shall conform to all applicable provisions of the codes, specifications, standards and other reference documents cited in this Specification and/or noted in the Drawings. In the event of conflict between provisions of stipulated reference documents and of this Specification or of another stipulated reference document, Contractor shall report in writing the details of the conflict. Decisions regarding applicability of provisions of this Specification and provisions of reference documents applied independently or as supplemented, modified or voided, will be provided in writing and shall be final. Resolution of conflicts shall conform to the procedures set forth in the General Conditions of the Contract.

B. Codes: All Work under this Section shall conform to the requirements of the New York City Building Code, latest edition, hereinafter referred to as *Building Code*, and to the regulations of all governmental authorities having jurisdiction. Where more stringent, the following codes, standards, manuals and specifications, latest edition and revision, shall apply to the Work, all as modified herein or by *Building Code*:

1. *Standard Specification for Tolerances for Concrete Construction and Materials*, ACI 117.
2. *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*, ACI 211.1.
3. *Standard Practice for Selecting Proportions for Structural Lightweight Concrete*, ACI 211.2.
4. *Recommended Practice for Evaluation of Strength Test Results of Concrete*, ACI 214.
5. *Field Reference Manual: Specifications for Structural Concrete, ACI 301, with Selected ACI and ASTM References*, SP-l5. Contractor shall keep at least one full copy in the field office at all times.
6. *Guide for Measuring, Mixing, Transporting and Placing Concrete*, ACI 304.
7. *Building Code Requirements for Structural Concrete*, ACI 318 and Commentary, ACI 318R. (referred to hereinafter as ACI Code).
8. Standard Specification for Cold Weather Concreting, ACI 306.1.
9. *Standard Practice for Curing Concrete*, ACI 308.
10. *Guide for Consolidation of Concrete*, ACI 309.
11. *National Design Specification for Wood Construction*, National Forest Products Association.

C. Reference Documents: To the extent that the best quality of Work is provided, Work shall conform to the examples, procedures and recommendations listed below, latest edition and revision. Where provisions of the *Building Code*, this Specification, or codes, standards, manuals and specifications cited by this Specification are more restrictive or provide increased quality, the combination of provisions, examples, procedures and recommendations which provide both best quality and *Building Code* conformance shall control the Work.

1. *ACI Detailing Manual*, SP-66 (Includes ACI 315 and ACI 315R). Note that some aspects of SP-66 are out-of-date (bar development lengths, etc.)
2. ACI Concrete Terminology, ACI CT-13.
3. *Chemical Admixtures for Concrete*, ACI 212.3R.

4. *Guide for the Use of High-Range Water-Reducing Admixtures (Superplasticizers) in Concrete*, ACI 212.4R.
5. *Guide for Use of Normal Weight Aggregates in Concrete*, ACI 221R.
6. *Use of Fly Ash in Concrete*, ACI 226.3R.
7. *Guide for Concrete Floor and Slab Construction*, ACI 302.1R.
8. *Placing Concrete by Pumping Methods*, ACI 304.2R.
9. *Hot Weather Concreting*, ACI 305R.
10. *Cold Weather Concreting*, ACI 306R.
11. *Guide for Consolidation of Concrete*, ACI 309R.
12. Self-Consolidating Concrete, ACI 237R.
13. *Guide to Formwork for Concrete*, ACI 347R with the specific deletion of reference to tolerances where in conflict with this Specification. Tolerances given in ACI 117 shall apply to the Work except where less stringent than are provided under this Specification.
14. *Manual of Standard Practice*, Concrete Reinforcing Steel Institute.
15. *Mechanical Connections of Reinforcing Bars*, ACI 439.3R.
16. *Use of Epoxy Compounds with Concrete*, ACI 503R.
17. *Guide for the Selection of Polymer Adhesives with Concrete*, ACI 503.5R.
18. *Measurement of Properties of Fiber Reinforced Concrete*, ACI 544.2R.
19. *Guide to Durable Concrete*, ACI 201.2R.
20. *Qualification of Post-Installed Mechanical Anchors in Concrete*, ACI 355.2.
21. *Qualification of Post-Installed Adhesive Anchors in Concrete*, ACI 355.4.

D. ASTM (American Society for Testing and Materials) Specifications cited in ACI 318, ACI 301, this Specification or in cited reference documents shall be the year of adoption or tentative adoption and revision listed in the latest edition of the Annual Book of ASTM Standards, *Index*, except that, should a specific year of adoption or revision be cited by the Contract Documents, by *Building Code*, or be proposed by Contractor and be accepted by Structural Engineer, that edition shall apply to and shall control the Work.

E. Conformance to Regulations: Work of this Section shall conform to all applicable federal, state, and local laws and regulations.

1.5 SUBMITTALS

A. General: Submit samples, Shop Drawings, product data, test reports and data, manufacturer's names, certifications, procedures, methodology statements, and the like as stipulated. With the exception of samples, submittals shall be in PDF format and transmitted electronically, unless otherwise accepted.

1. Review of Contractor's submittals is only for the limited purpose of the examination of submittals for conformance with the design concept of the project and to assist Contractor in ascertaining that the information given in the submittals conforms to the requirements of the Contract Documents.
2. Review of Contractor's submittals is not conducted for the purpose of determining the accuracy or the completeness of the submittal, for dimensions or quantities, or for installation or performance of the system or the piece(s) being submitted.

3. Submittals by Contractor implies that Contractor has checked the submittal with care. Where by error or other cause, Contractor's check has not been accomplished, Contractor shall not rely on review but shall first check and shall then resubmit such material as though the submittal had been rejected.

B. Shop Drawings:

1. General: Shop Drawings, as the term is used under this Section, are not Contract Documents, but are intended to demonstrate the way that Contractor intends to conform to the requirements provided in the Contract Documents. Contractor may wish to use these same drawings as a part of the instructions given to craftpersons for the accomplishment of the Work.
2. Best Standards: Shop Drawings furnished under this Section shall conform to the best standards of the construction industry. Shop Drawings shall be prepared by and under the supervision of competent engineering personnel. Prior to preparation, Contractor shall retain a Professional Engineer, accepted by Construction Manager and by Structural Engineer and licensed in the project's jurisdiction, to supervise the preparation of and to check each Shop Drawing for compliance with the requirements of the Contract Documents

    a. Shop Drawings shall be prepared under the direction of personnel completely familiar with Architectural, Mechanical, Plumbing, Electrical and other building trades Drawings.
    b. Comply with the requirements of ACI SP-66 where more stringent than is specified herein. Show bar schedules; stirrup size and spacing, drawings of bent bars, and size and arrangement of all reinforcement.

STRUCTURAL ENGINEER REVIEW

NO EXCEPTIONS TAKEN ☐ RESUBMISSION NOT REQUIRED ☐
MAKE CORRECTIONS NOTED ☐ RESUBMIT ☐
NOT REVIEWED ☐

LERA CONSULTING STRUCTURAL ENGINEERS, RLLP

BY: _____

DATE: _____

3. Shop Drawings shall be submitted for review and to governing agencies having jurisdiction for acceptance in accordance with the provisions of the Contract Documents.
4. Shop Drawings shall be submitted in parts as follows:

    a. Sleeve, Insert and Fitting Location Drawings,
    b. Construction Joint and Crack Control Joint Location and Detail Drawings,
    c. Formwork Drawings,
    d. Placing Plans and Elevations,

e. Detail Drawings and Schedules,
f. As required for the work of other trades,
g. Field Work Drawings, and

5. Sleeve, Insert and Fitting Location Drawings shall show clearly the location and orientation of each item to be placed into the formwork. Include items for the Work of other trades.
6. Construction Joint and Crack Control Joint Drawings shall show the location of joints and shall show also the sequence of pours and all else needed for the proper detailing of reinforcing steel. Show and detail keys and the like. Indicate extent and type of bonding compound. Submit in sufficient time to allow the orderly detailing of reinforcing steel.
7. Formwork Drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale, all Work to be provided. Drawings shall be dimensioned accurately, where applicable, and shall be notated clearly. Detail ledges, curbs, pads, trenches, openings and the like from information given in Architectural, Structural, Plumbing, Electrical and other Contract Documents.

    a. Show in the Formwork Drawings and dimension thereon, holes required for passage of Work of other Divisions and other Sections of this Specification through Cast-In-Place Concrete Work.
    b. Contractor's Professional Engineer licensed in the project's jurisdiction shall be responsible for the design of formwork. As evidence of conformance with this requirement, each Formwork Drawing shall bear the seal and signature of Contractor's Professional Engineer.

8. Placing Plans and Elevations shall show, to scale with all dimensions, all concrete Work including top of slabs and depressions, pits, curbs, trenches, pads, steps, slopes, edges of slabs, openings, sleeves, blockouts and the like. Provide schedules and details showing placing sequences, bending, lengths and locations of all reinforcement. Show elevations of all concrete walls with top and bottom elevations, openings, ledges, pockets, construction joints, and all else needed to locate correctly all reinforcement. Indicate all lap lengths and lap locations in the placing plans.

    a. Detailing of Reinforcing Steel shall recognize the arrangement and dimensioning of individual bars, including the location of bend points, hooks and the like so as to preclude interference between bars, sets of bars, and embedded items and so as to allow clear spacing and concrete cover as provided in ACI 315 and ACI 318. Prepare details and provide sections showing placement sequences to minimize congestion of reinforcing steel at splices, intersecting bars around openings and block-outs, and adjacent to embedded items. Illustrate and note correct placing arrangement and placing sequence to enable field placing crews to properly place and execute the Work. Provide sections, typical details and notes to illustrate correct location and arrangement of and clear cover for reinforcement and required placement locations. Provide suitable and necessary details and placing sequence information in Shop Drawings so as to properly instruct reinforcing steel placement personnel.

9. Detail Drawings and Schedules for reinforcing steel, including welded wire fabric (WWF), shall be prepared in strict accord with the methods and procedures provided in ACI SP-66 except that provisions of the Drawings and of this Specification shall prevail. Detail Drawings shall include bar and fabric lists; applicable bar lists shall be submitted simultaneously with related Detail Drawings. Prepare Detail Drawings which provide for reinforcement, including dowels, properly positioned in all concrete Work, so that material can be properly cut, bent and packaged from information given in Detail Drawings.

    a. Reinforcement for concrete Work shall include all reinforcement shown or scheduled in Drawings, including all reinforcement required by typical details and general notes. Provide minimum percentages of reinforcing steel required by ACI Code where such reinforcement exceeds that stipulated in Drawings.
    b. Reinforcement shall be spliced in strict accord with ACI 318. Where practical, stagger splices of adjacent bars.
    c. Unless shown specifically to the contrary, all reinforcement shall be spliced and all splices shall develop the full tensile capacity of the reinforcement. No reduction in splice length or development requirements may be taken because supplied reinforcing is larger than that required under the Contract.
    d. Lapped bars may be detailed to be placed in contact and securely wired together or may be separated in accord with ACI 318 to permit embedment of the entire surface of each bar in concrete.

10. Field Work Drawings: Prepare Field Work Drawings depicting all field work required to accommodate field conditions. Submit to both Architect and to Structural Engineer.
11. Contractor shall coordinate and cross-check for accuracy, completeness and correct relationship to the Work of other Sections, each Shop Drawing prepared for the Work of this Section, including each Shop Drawing prepared by accepted subcontractors. Pay particular attention to areas of congestion of reinforcement and to areas where reinforcement and other embedded items combine to cause congestion. Contractor's check shall include a verification of compliance with the Contract Documents and shall be performed prior to submission and resubmission of each Shop Drawing. The personally inscribed initials of the person(s) preparing each shop drawing as well as the detailing agency's supervisor and chief checker shall be included in the title block or similarly prominent location.
12. Substitutions: Should Contractor desire a Substitution or Deviation from the Drawings or Specifications, or both, Contractor shall submit the specific request in writing prior to the submittal of Shop Drawings showing the Substitution or Deviation. Requests for Substitutions or Deviations shall be submitted on Contractor's letterhead. Substitutions and Deviations not identified, or identified only in letters of transmittal or in Shop Drawings, or both, without the required written description on Contractor's letterhead, may not be accepted and shall be sufficient cause for the rejection and the return of such Shop Drawings without further action.

    a. Acceptance of Shop Drawings including Substitutions and Deviations not detected during Shop Drawing review, shall not relieve Contractor from responsibility to conform strictly to the Contract Documents. Substitutions and deviations will be allowed only where permitted in writing.

b. Architect is the sole judge of the suitability of Contractor-proposed substitutions. Review of Contractor-proposed substitutions and deviations is subject to the compensation provisions of Article 1.12.

13. Shop Drawing Review: Only Shop Drawings marked "No Exceptions Taken" or "Make Corrections Noted - Resubmission Not Required" may be used by Contractor in the Work. Shop Drawings marked "Make Corrections Noted - Resubmit" shall be corrected or completed (or both) as required and shall be resubmitted. This process shall be repeated the number of times required to achieve the mark "No Exceptions Taken" or "Make Corrections Noted - Resubmission Not Required". An example of Structural Engineer's Shop Drawing review stamp is shown here for reference.

    a. Nonconformities and errors detected during review will be noted in Shop Drawings returned to Contractor upon completion of review. Acceptance of Shop Drawings including Substitutions and Deviations not detected during review will not relieve Contractor from sole responsibility to provide Work conforming strictly to the Contract Documents.
    b. Shop Drawing review includes engineering calculations only to the extent deemed necessary to ascertain that Contractor's Shop Drawings have been prepared by competent personnel. Contractor alone is responsible for the accuracy and the completeness of Contractor's engineering calculations.
    c. Review of Contractor's Shop Drawings does not include a review of bills of materials and the like. Accordingly, information required for the review of Shop Drawings shall be contained outside of bills of materials and the like.

14. Resubmission of Shop Drawings: Prior to resubmission of Shop Drawings with additions, deletions, or corrections, Contractor shall cloud and identify all changes from the prior issue. Drawings submitted without each change both clouded and identified clearly will be returned and shall be resubmitted as though the original submittal had been rejected. Each submittal, whether or not accepted or rejected, shall contain a unique revision number, clearly identified.
15. Shop Drawing Log: Contractor shall number Shop Drawings, and revisions to Shop Drawings, in a form acceptable both to Contractor and to Architect/Structural Engineer. Structural Engineer will provide to Contractor in its letters of transmittal both the log-in and the log-out date of each Shop Drawing. Further, on request of Contractor, Structural Engineer will provide to Contractor aged listings of each Shop Drawing remaining in the office of Structural Engineer.

C. Product Data: Submit printed manufacturer's literature for each manufactured item specified under Part 2 - Products, along with test data as may be requested. Include detailed instructions for application and installation.

D. Names of Manufacturers/Suppliers: Where to be used, submit for acceptance the names of following products along with certification that the products conform in all respects to the requirements of the Contract Documents:

1. cement
2. aggregates
3. admixtures
4. silica fume (microsilica), fly ash, blast furnace slag, and other natural pozzolans

5. fibrous reinforcement
6. ready-mix concrete
7. form faces
8. form sealers and release agents
9. form-ties
10. reinforcing bars
11. non-shrink grout and epoxy grout
12. bonding compound and epoxy adhesive
13. polymer patching/feathering compound
14. post-installed anchors
15. polyurethane sealant
16. joint filler and compressible filler
17. cellular glass and cellular polystyrene
18. bond breaker
19. moisture-retaining covers
20. curing and sealing, strippable curing compound, and liquid/sealer densifier
21. evaporation retarder
22. waterproofing and chloride ion screen
23. concrete cleaning/finishing solution
24. other products, material and fixtures, as specified herein

E. Mill Tests: Submit certified mill test reports for cement, for steel reinforcement, including bars, welded wire fabric and dowels,. Provide also to governing agencies having jurisdiction.

1. Mill test reports shall state clearly the governing ASTM specification and shall be certified and notarized by Contractor as conforming in all respects to that specification.

F. Reinforcing Bar Mechanical Connections: Obtain from manufacturer and submit a certified affidavit indicating compatibility of reinforcement, including bar deformations, with mechanical connection assemblies.

G. Certification for Curing Compounds and Sealers, Hardeners, Dustproofing, etc.: Submit certificate of compatibility with concrete and with materials to be applied to concrete surface.

H. Certification for Admixtures: Submit notarized document of compatibility of each admixture with all other concrete ingredients and with each applicable concrete surface treatment.

I. Design Mixes as provided in Part 2 of this Specification. Submit proposed mix designs for both concrete and grout on the Mix Design Submittal Form included with this specification. Submit test results and other supporting data on each mix design.

J. Post-Installed Anchor Certificates: Submit approved independent testing report per ACI 355 (ICC-ES report), Manufacturer's Printed Installation Instructions, letter describing installation procedures, and installer qualifications including certification for horizontal and overhead adhesive installation where applicable.

K. Protective Measures: Contractor's construction procedures shall be typewritten and shall include charts and diagrams, as applicable and necessary, to explain fully the proposed procedures, methods, equipment and operations in order to allow review, assist the Testing Agency's evaluation of the Work, and to allow Contractor's personnel to perform Work in full conformance to the Contract Documents. Submit procedures for the following:

1. Both hot, normal and cold weather concreting procedures shall be submitted not less than four weeks before beginning the Work of this Section, regardless of the need for the immediate implementation of such procedures. Procedures shall include hot weather cooling systems, cold weather heating systems, insulation, enclosures, and the like. Finishing procedures and timing and duration of curing shall be described.
2. Protection of concrete against injury due to mechanical contact and construction operations.
3. Protection of Work by other trades.
4. Formwork removal and reshoring procedures. Procedures unique to hot and cold weather conditions shall be identified. Shoring and reshoring drawings and calculations shall be prepared under the supervision of and signed and sealed by Contractor's Professional Engineer.
5. Procedures for curing mass concrete shall include such insulating and cooling techniques as are required to limit the temperature differential between the warmest and the coolest parts of a hydrating section to no more than 45°F (25°C). Describe the methods to be employed for monitoring concrete temperatures.
6. Procedures for placing, finishing, curing and protecting flat work concrete shall include procedures for protecting that concrete from drying and plastic shrinkage cracking during placing and finishing processes, include procedures for curing and technical literature for proposed equipment.

L. As-Built Shop Drawings: In a format acceptable to each, and at the completion of the Work, provide to Owner, to Architect and to Structural Engineer, one complete digital set of all Shop Drawings (including field changes, Field Work Drawings, and the like), so as to provide as-built drawings of finished and completed Work under this Section.

M. Governing Agencies: Provide all drawings, tests, inspections, reports, affidavits, manufacturer's certifications, certification of compliance with VOC limits, and other requirements and data to governing agencies having jurisdiction.

1.6 MEASUREMENTS AND TOLERANCES

A. Measurements:

1. Field Measurements: Obtain all field measurements required for proper fabrication and installation of Work covered by this Section. Submit, prior to installation, all measurements indicating discrepancies from the Drawings. Describe in writing and, where applicable, by sketches proposed methods of correcting discrepancies. Measurements are the responsibility of Contractor.
2. Lay out each part of the Work in strict accordance with the Architectural, Structural, Mechanical, Electrical, Plumbing and all other Drawings and be responsible for correct location of same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.

B. Allowable Tolerances: Conform to the requirements listed below and as given in ACI 117, whichever is more stringent; provide more restrictive tolerances where required to meet job conditions and *Building Code*. Tolerances indicated shall apply to the full height of the building. Variations from grade and flatness of Work may be measured prior to removal of supporting formwork or shores and shall be taken as either plus or minus from a true line.

1. Level Alignment:

   a. Elevation of top of slab-on-ground, 3/4 inch (20 mm).

2. Relative Alignment:

   a. Stairs

      1) Difference in height between adjacent risers, 1/8 inch (3 mm).
      2) Difference in width between adjacent treads, 1/4 inch (6 mm).

3. Sleeves and Openings: Variations of the sizes and locations of sleeves, openings and the like shall not exceed minus 1/4 inch (-6 mm) or plus 1 inch (+25 mm) from size and 1/2 inch (13 mm) from centerline locations given in accepted Shop Drawings.
4. Anchors and Inserts: Variations in the location of anchors shall not deviate more than 3/8 inch (10 mm) vertically nor 1/4 inch (6 mm) horizontally from positions shown in accepted Shop Drawings.
5. The thicknesses of slabs and walls shall not deviate from theoretical by more than the following:

   a. for dimensions of12 inches (300 mm) or less..... +3/8 in.(+10 mm), -0 in.(-0 mm)
   b. for dimensions of more than12 inches (300 mm) but not over 36 inches (900 mm) ..... +1/2 in.(+13 mm), -3/8 in.(-10 mm)
   c. for dimensions over36 inches (900 mm) ..... +1 in.(+25 mm), -3/4 in.(-19 mm)

6. Wall forms shall be braced during the forming, concrete placement and curing stages so as to produce wall straightness and vertical alignment which does not deviate from theoretical position by more than specified tolerances.

1.7 TESTING AND INSPECTION

A. Owner's Testing Agency: All Work is subject to Special Inspection as required by *Building Code*. Subject to acceptance by Architect, Owner will engage and pay for the services of an independent testing agency (Testing Agency) as outlined in Section 014000, Inspection and Testing. The selected Testing Agency will meet the requirements of ASTM E 329. Contractor alone is responsible for the achieving of the required level of quality, both in the shop and in the field. Testing Agency will rely heavily on reviewed Shop Drawings, as described earlier in this Specification, in its examination of as-constructed Work. Contractor shall not retain Owner's Testing Agency for its own Work but may, subject to acceptance, contract through Owner for such work.

B. Responsibilities and Duties of Testing Agency: Testing Agency will perform the following functions, inspections and tests:

1. On instructions and at locations selected by Architect, Testing Agency may sample materials taken from the as-erected Work.
2. Take steps to ascertain that concrete is proportioned and mixed in accordance with the requirements of the Drawings and this Specification.
3. Maintain a presence at the project site during the placing of concrete.
4. Examine formwork for general conformance with the requirements of this Specification.
5. Examine as-placed reinforcing steel for general conformance with the requirements of the Drawings and of this Specification.
6. Receive and review concrete batch/truck tickets at time of delivery and prior to discharging concrete. Review of batch tickets shall include the comparison of actual material and quantities batched to mix design target values.
7. Monitor the methods of conveying concrete from the mixer to the point of placement in the Work.
8. Make, perform and evaluate testing of concrete cylinders in accord with this Specification, with ASTM C 31 and ASTM C 39, and as provided in Section 01 40 00. Capping for concrete cylinders shall be in accordance with either ASTM C 617 (bonded caps) or ASTM C 1231 (unbonded caps).

    a. For each class and strength of concrete take the minimum cylinders indicated below, for each day's work, but not less than for each 100 cubic yards (75 cubic meters) of concrete nor less than for each 4300 square feet (400 square meters) of surface area for slabs or walls. Cylinders shall be tested in the schedule listed below. Where 28 days cylinders fail to conform to the requirements of this Specification, cylinders will be held and tested at 56 days;

Cylinder Size	Total Cylinders	Cylinder Testing Schedule			
		@7 days	@28 days	@56 days	@90 days
4" x 8"	7	1	3	3	0
6" x 12"	5	1	2	2	0

    b. Where, after sampling any third portion of a truck load, the elapsed time exceeds 30 minutes, a set of 5 test cylinders will be taken from each third of the load taken at intervals greater than 30 minutes;
    c. Monitor protection systems for test cylinders; and
    d. Identify all test cylinders as to placement date and location, concrete mix type and designation number, concrete batch ticket serial number, and other pertinent data.

9. Perform slump tests in accord with ASTM C 143.

    a. Take one test at the beginning of each placement, both at the truck and at the point of discharge, one test at the taking of test cylinders and such other tests as are deemed appropriate by Testing Agency, by Construction Manager, or by Architect.

10. Perform air entrainment tests in accord with ASTM C 231 (ASTM C 173 for concrete with lightweight or high absorption aggregates).

a. Take one test at the beginning of each placement, one test at the taking of test cylinders and such other tests as are deemed appropriate by Testing Agency, by Construction Manager, or by Architect.

11. Determine the temperature of freshly mixed concrete on a random basis during concrete placement in accord with ASTM C 1064.
12. Perform drying shrinkage tests in accord with ASTM C 157 and with Part 2 of this Specification.
13. For self-consolidating concrete, perform filling, passing, and segregation-resistance workability tests in accord with ACI 237R and ACI 212.3R-16, Chapter 18, "Admixtures for Self-Consolidating Concrete". Testing personnel shall have been trained and/or had previous experience in the testing of self-consolidating concrete.

    a. For each concrete truck, take one test minimum in accordance with ASTM C1611 including visual stability index and T50 measurements as outlined in Apendix X1 of ACI 237R. Where truck is redosed with HRWR or VMA after the first test, testing shall be repeated.
    b. For the first concrete truck and every 25 cubic yards thereafter, take one test minimum in accordance with ASTM C1621. Where truck is redosed with HRWR or VMA after first test, testing shall be repeated.
    c. For the first concrete truck and every 25 cubic yards thereafter, take one test in accordance with ASTM C1712.

14. Testing Agency may visit the batch plant as often as weekly, more or less often where directed. Each visit will involve one or more of the following operations:

    a. Examine aggregates for grading, cleanliness, moisture content, and the like;
    b. Examine plant operation and equipment such as stock piles, bunker loading, scales, mixer, cement, water and admixture dispensing;
    c. Review proportioning of mix, particularly for free moisture and the like; and
    d. Truck loading.
    e. For self-consolidating concrete, testing agency should visit the batch plant before the first truck is batched and conduct the operations listed below.

        1) Where moisture probes or meters are used with automatic mixing water adjustment systems, testing agency shall conduct a moisture confirmation test in accordance to ASTM C 70 or C 566. Samples shall be taken as close as possible to the area where the probe is located.
        2) Where moisture probes or meters are not used with automatic mixing water adjustment systems, testing agency shall determine the aggregate moisture content before the first truck is batched. Thereafter, the aggregate moisture content shall be determined once every 4 hours have elapsed after the first batch while self-consolidating concrete is being mixed.

15. Perform physical testing of mechanical connections for reinforcement. In accordance with ASTM A 370, record the failure mode (bar fracture, coupler fracture, bar pull-out, etc...), maximum stress at yield, maximum load, ultimate tensile strength, elongation at failure, modulus of elasticity, diameter and area of reinforcement, and other pertinent data.

16. Test floor slab finished surface for flatness and levelness in accord with ASTM E 1155 and with this Specification.

    a. The Floor Flatness/Levelness Inspector shall be certified by the Face Companies of Norfolk, Virginia as being competent in F-Number measurement using the Dipstick Floor Profiler. This person shall have tested not less than 250,000 square feet (23,000 square meters) of floor surface using ASTM E 1155 and the F-number system.
    b. Measure slab elevations with a device capable of measuring and recording slab elevation changes of 0.002 inches (50 μm). Use Dipstick by Face Companies, F-meter by Allen Face & Company, or other accepted device.
    c. Where the area of slab surface which falls within 24 inches (600 mm) of construction joints exceeds 25 percent of the slab surface, the entire surface shall be tested, including those areas within 24 inches (600 mm) of construction joints.
    d. Complete testing within 24 hours of placement and before shores are removed, and submit results, including a key plan showing area tested, data sheets and all results required by ASTM E 1155, within 48 hours of placement. Identify clearly all defective areas. Submit to Owner, Architect and Contractor.

17. Maintain a copy of ACI 311.1R - ACI Manual of Concrete Inspection, ACI 311.4R - Guide for Concrete Inspection and ACI 311.5R - Batch Plant Inspection and Field Testing of Ready-Mixed Concrete.
18. All test reports indicating non-compliance shall be emailed immediately to all participants listed on the distribution list and the hard copy shall be sent on different colored paper.
19. Not less than monthly, provide a summary report in graphical format of all test data taken for the project separated by class of concrete for the following:

    a. Compressive strength (also group by age of concrete at time of test);
    b. Slump or spread; and
    c. Water content (both as determined from batch tickets and from microwave tests)

20. Perform Special Inspection of post-installed anchors in accordance with the Building Code, Manufacturer's Printed Installation Instructions, approved independent testing report per ACI 355, Contract Documents and approved shop drawings. As a minimum, provide continuous inspection of adhesive anchors installed in horizontal, or upwardly inclined orientations, supporting tension loads; and periodic inspection of all other conditions of post-installed anchors. Special Inspectors shall be qualified (via experience, training, ACI/CRSI certification, etc.) with the installation and inspection of post-installed anchors. Special Inspections shall include but are not limited to the following:

    a. Verify installer qualifications as required per the Contract Documents;
    b. Verify anchor type, material, size, length, and condition;
    c. Verify minimum concrete age, temperature, strength, and dry condition;
    d. Verify drilling method, hole cleaning, preparation per Manufacturer's Printed Installation Instructions; and
    e. Verify anchor position, setting, and installation method

C. Authorizations: Owner's Testing Agency will not be authorized to:

1. Authorize or accept deviations or substitutions from the Contract Documents.
2. Assume any of the responsibilities of Contractor; for example, Testing Agency may not advise formally or informally on any aspect of construction means, methods, techniques, sequences or procedures, or safety precautions and programs in connection with the Work.
3. Accept Shop Drawings or samples.
4. Approve or issue a Certificate of Payment, a Change Order, or issue verbal or written instructions which modify the Contract between Owner and Contractor.

D. Responsibilities and Duties of Contractor:

1. Performance or waiving of inspection, testing or surveillance by Testing Agency for a given portion of the Work will not relieve Contractor from responsibility to conform strictly to the requirements of the Contract Documents.
2. Notice: To facilitate and to assist testing and inspection, Contractor shall cooperate by providing proper notice of the initiation of Work. Provide 24 hours minimum notice of each concrete placement or other operation requiring plant or job site testing or inspection.
3. Access to Documents, Facilities and Materials: Furnish one copy of each accepted Shop Drawing and of each mill test certificate to Testing Agency. Provide reasonable office, desk and file space at each location of the Work and at the site to allow Testing Agency to work conveniently with and to maintain project records and drawings. Provide authorized personnel convenient and free access to all parts, locations and areas of Work, including storage areas. Provide hoisting, turning and moving of materials and reasonable quantities of scaffolding, power, casual labor, and other provisions and assistance necessary to allow quality and effective inspection and testing of Work.
4. Provide suitable and adequately sized storage and initial curing facilities for concrete test cylinders. Conform fully to the requirements of ASTM C 31. Provide all necessary job site facilities required to allow and assist Testing Agency to perform its tests and inspections in full conformance to all applicable standards, codes, and provisions of this Specification.
5. Secure and deliver to Contractor's independent testing laboratory without additional cost to Owner, representative samples of each material or ingredient required to be tested and certified prior to submittal for acceptance.
6. Reimburse Owner for the actual cost of all tests performed exclusively for the Contractor's convenience (such as job cured cylinders for early stripping of formwork) and for all tests and retests made necessary by initial nonconformance to Contract Documents.
7. Cost of Owner's Tests by Testing Agency will be borne by Owner. However, where additional tests are deemed necessary by Construction Manager or by Architect on account of failure to pass tests, the cost of additional testing will be deducted from payments to Contractor so as to reduce the Contract price.

1.8 QUALITY ASSURANCE

A. Source Quality Control: Contractor's material control procedures shall be effective and shall assure that all Work fulfills the requirements of the project as well as the applicable provisions of the Contract Documents. All materials shall be tested in accord with the requirements of *Building Code*, of Building Department, of governing authorities having jurisdiction and of this Specification.

B. Shop and Construction Site Quality Control: Contractor shall maintain, on staff, sufficient office, field engineering, and field supervision staff to assure that all data and layout drawings for Work of other Sections is transmitted to detailers to allow proper detailing of holes, penetrations, chases, and the like and to assure proper execution of the Work in the field.

C. Minimum Qualifications: Fabricator, installer and detailer of reinforcing steel shall each have experience with at least five buildings of the type of this work.

1. The reinforcing steel detailing firms shall be subject to acceptance. Detailing firms shall demonstrate in-house quality control procedures to the satisfaction of Construction Manager and of Architect. Acceptance of reinforcing steel detailer is provisional and may be withdrawn where detailing is not of sufficient quality to meet project requirements.

D. Concrete Strength: Evaluation and acceptance of concrete strength shall conform to the requirements of ACI 318. Where laboratory cured cylinder test results do not satisfy these requirements, Contractor shall make sufficient and appropriate changes to concrete proportions for the remaining Work in order to assure acceptable strength test results. Where required, Contractor shall provide also reshoring and additional curing of concrete slow in attaining design strength. Additionally, at its sole discretion, Construction Manager or Architect may permit or require core tests in accord with ASTM C 42. Load tests shall not be performed without Construction Manager's or Architect's specific concurrence, and then only after acceptance of comprehensive, detailed procedures prepared by, signed and sealed by Contractor's Professional Engineer, and submitted in writing.

1. Core tests may be required of Contractor where:

   a. the average of one or more sets of three consecutive strength tests falls below f'c;
   b. one or more individual strength tests falls below f'c by more than 500 psi (3500 kPa);
   c. strength tests of field-cured cylinders, accomplished at the designated age, fall more than 15 percent below strength tests of companion laboratory-cured cylinders;
   d. samples of concrete for acceptance test cylinders are not representative of concrete in place in the structure.

2. Perform all tests, and all corrective and restorative measures at no expense to Owner. Construction Manager and Architect shall be sole interpreter of the need for additional tests, and Construction Manager's and Architect's judgment shall be binding on Owner and Contractor alike.
3. Laboratory cured cylinders shall not be used for evaluating either compressive strength or acceptable condition of concrete suspected of being frozen, or for determining strength of concrete for early stripping of formwork.

4. Should core specimens be taken, Contractor shall plug all core holes solid with matching concrete or non-shrink grout as directed. All such plugging shall be Contractor's responsibility and shall be performed at no expense to Owner. All such work shall be subject to acceptance and to correction by Contractor, where not in conformance with the Contract Documents.

E. Qualifications: Contractor shall determine, shall warrant and shall certify that producers, epoxy coating applicator, reinforcing steel detailer, fabricator and installer, formwork constructor, concrete placer, finisher and all others involved in the Work, along with their personnel, are experienced, qualified and adequately staffed to undertake the specific Work required under this Section.

F. Post-Installed Anchors shall be installed by workers with experience and training with installing the specified anchors. Installation of adhesive anchors in horizontal or upwardly inclined orientations supporting tension load shall be performed by installers certified through the ACI/CRSI adhesive anchor installer certification program, or approved equivalent.

G. Documentation of Contract Conformance: Perform quality control functions required to achieve and to document that Work conforms to the Contract Documents. Provide access to Contractor's quality control documents and reports upon request. Provide reasonable numbers of copies of specific quality control reports on request.

H. Purchase Orders: Each purchase order shall identify the end use of the purchased material. Contractor shall ensure that manufacturer or vendor understands fully the intended use of the material in the Work.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Original Containers: Materials shall be delivered to the site, ready for use, in the manufacturer's original and unopened containers and packaging, bearing original labels as to type of material, brand name, and manufacturer's name. Delivered materials shall be identical to accepted samples.

B. Storage: Materials shall be stored under cover in dry, weathertight, adequately ventilated and clean locations off the ground. Storage methods shall also provide for free and rapid drainage of rainwater and shall prevent collection of water on or within stored materials. Post-installed anchors shall be stored in accordance with manufacturer’s requirements.

C. Protect reinforcing steel and mesh from scaling, oil, grease and distortion. Reinforcing steel and mesh that has rusted to the extent of scaling will be rejected and may be placed in the Work only after proper cleaning, and shall be subject to acceptance.

D. Aggregates to be used in field mixed concrete or grout shall be stockpiled in separate bins or piles in a manner suitable to minimize segregation and contamination of aggregates. Field mixing is not encouraged and will be allowed only with specific written permission.

E. Removal: Delivered materials which are damaged or otherwise not suitable for installation, shall be removed from the job site and replaced with acceptable materials.

1. Construction Manager and Architect shall be the sole judge of the suitability of such materials and neither Owner nor Contractor may challenge Construction Manager's or Architect's decisions as to acceptability.

F. Batch/Truck Tickets: Provide a copy of each batch ticket for each batch of concrete discharged and used in work. Batch tickets shall be submitted to Owner or Owner's inspection agency prior to discharging concrete. Contractor shall retain duplicate tickets until such time as Owner has received a Certificate of Occupancy. Tickets need indicate the following:

1. Ready-mix batch plant name and location.
2. Project identification number, name and location.
3. Serial number of ticket.
4. Truck number.
5. Mix type and designation number.
6. Date and time of first mixing of cement and aggregates.
7. Actual material and quantities batched, both at plant and site, including total free water and admixtures. Total free water includes free water on the aggregates, water in each admixture, water and ice.
8. Amount of concrete batched.
9. Signature of plant quality control supervisor and, if water and/or admixtures are added at the site, site quality control supervisor.

1.10 JOB CONDITIONS

A. Contractor's Responsibility: Contractor shall be solely responsible for the correctness of dimensions and quantities and for the fitting to other Work; for Work to be confirmed and correlated at the site; for information pertaining to the fabrication procedure or to the means, methods, techniques, sequences and procedures of construction; and for the coordination of the Work of this Section with the Work of all other trades. The verification of the physical interrelationships of elements of the Work from Contract Documents and in the field is solely Contractor's responsibility. Review of Contractor's submissions does not relieve Contractor from these responsibilities.

B. Contractor's Coordination: Contractor shall coordinate and schedule the Work of this Section with the Work of other Sections of this Specification in order to optimize quality and to avoid delay in overall job progress.

C. Rejection of Work: Testing Agency may inspect and test materials at the source before shipment as well as at the site before, during or after installation in the Work. Construction Manager and Architect reserve the right, at any time before final acceptance of the completed Work, to reject material not conforming with specified requirements, regardless of previous tests, inspections, acceptances, or inclusion in certificates of payment.

D. Provisions for Other Work: The Work under this Section shall include required cutting, forming, reinforcing steel and all else required for the passing through and attachment of other Work.

1.11 DEFICIENT WORK

A. Repairing, Patching, Cleaning: Contractor shall correct all Deficiencies in the Work of this Specification including areas where Testing Agency reports, or Construction Manager's or Architect's rejections have indicated that Work is not in full compliance with the Contract Documents. Perform, at no expense to Owner, all additional tests that Construction Manager or Architect deems necessary to reconfirm noncompliance of the original Work and perform, at no expense to Owner, all tests and inspections which may be necessary to show compliance of corrected Work.

B. Defective and Nonconforming Work: Defective Work, unsuitable Work, or Work otherwise failing to conform to the Contract Documents shall be made good by Contractor at no change in the amount of or the time of the Contract. Contractor shall prepare appropriate details and procedures for bringing such Work into conformance with the Contract Documents and shall submit such details and procedures for acceptance. Corrective Work, including materials, shall conform strictly to accepted details and procedures. Nonconforming Work may be rejected at any time, regardless of prior acceptance in Shop Drawings, prior inspection, inclusion in inspection or test reports, or inclusion in certificates of payment.

C. Deficiencies: Where Work exhibits any one or more of the following deficiencies, or where Work otherwise fails to conform to the requirements of the Contract Documents or to the requirements of *Building Code*, for any reason or combination of reasons, such Work shall be considered Deficient and not in conformance with the requirements of the Contract:

1. Low cylinder strength at 28 days, as defined by this Specification.
2. Excessive or deficient water, air, cement, admixture, or any other material.
3. Slump and slump-flow not in accord with this Specification.
4. Unauthorized addition of water.
5. Spalling, honeycombing or the like.
6. Unauthorized cutting, chopping, construction joints, cold joints and so forth.
7. Workmanship not in accord with the Drawings, with this Specification, with accepted samples, or with referenced codes or standards.
8. Cracking, surface defects, or improper consolidation.
9. Exceedance of tolerances, lack of alignment, and incorrect forming.
10. Floor flatness/levelness F-numbers (either FF, FL or both) which measure less than specified minimum values.
11. Evidence of freezing, improper curing and the like.
12. Contact with aluminum or with aluminum alloys except where specifically permitted under this Specification.
13. Post-installed anchors not set in accordance with Manufacturer’s Printed Installation Instructions, adhesive anchors not set with insufficient adhesive (no overfill visible).
14. Use of non-conforming materials or systems.

D. Replacement or Repair: Where Construction Manager or Architect, at its sole discretion, finds any of the above deficiencies or other Work not in accord with the requirements of the Contract Documents, Construction Manager or Architect may order that the affected Work be replaced or repaired at Contractor's expense.

1. Contractor shall reimburse Owner for the actual amount of the fees of Testing Agency for the reinspection and the retesting of Work deemed defective by Construction Manager or by Architect.

E. Cost: The cost of all other activities and procedures associated with defective Work shall be paid by Contractor.

1.12 PROFESSIONAL FEES AND COSTS

A. Scope: Contractor shall compensate Architect, Structural Engineer and Architect's other consultants for services incurred because of Contractor-proposed deviations (including substitutions), extra submittals of Shop Drawings, deficient and defective Work and the like. Compensation will be at the rates given in the standard time-and-expense billing policy of the firm. Architect will notify Owner, Construction Manager and Contractor prior to the commencement of services associated with each item under this Article.

B. Substitutions and Deviations: Contractor-proposed Substitutions and Deviations will be evaluated and reviewed where requested by Contractor.

C. Shop Drawings: The review of the first and the second submittals of each Shop Drawing are normal services, but the review of the third and all subsequent submittals of each Shop Drawing will be considered an extra service and subject to the compensation provisions of this Article.

D. Deficient Work: The evaluation, review and design and all other activities associated with Deficient Work are subject to the compensation provisions of this Article.

E. Expediting: Where Contractor requests special handling of submittals, such costs are subject to the compensation provisions of this Article.

PART 2 - PRODUCTS

2.1 CONCRETE MIXTURES

A. Contractor Furnished Mix Designs: For each type and strength of concrete mixture and grout mixture required in the Work, Contractor shall submit for Architect's acceptance a mix design. Each mix design shall conform to the applicable provisions of this Specification and *Building Code*. Mix designs shall be established by Contractor's Professional Engineer licensed in the project's jurisdiction on the basis of field experience and or trial mixes prepared by Contractor and both monitored and tested by an independent testing laboratory retained and paid by Contractor. Mix designs in current use, documented by current test reports, may be submitted for acceptance in accord with ACI 301. All mix designs shall be submitted on the Mix Design Submittal Form included in this specification. This form is available electronically for Contractor's use.

1. Contractor shall be fully responsible for conformance to all mix design and control provisions of this Specification and for the strength, consistency, and handling of concrete. Concrete supplier, and admixture manufacturer(s) shall state and certify that the proposed concrete mixes and placing procedures will produce the strengths, finishes, densities and like qualities required by this Specification.
2. Mix designs may be adjusted by Contractor to suit minor variability of materials, job conditions, weather, test results and other data, subject to acceptance and provided there is no change in the amount of the Contract; laboratory data for revised mix designs shall be submitted and accepted prior to use in the Work.
3. Contractor shall pay all costs associated with preparing, testing, documenting and submitting design mixes for each concrete mix design used in the Work.
4. Contractor shall provide notification of the time and location where each trial mix will be prepared and/or tested.

B. Concrete Mix Requirements: Proportions for each mix shall provide for homogeneous, cohesive, workable and dense concrete, suitable in all respects for its intended purpose. Concrete mixes shall be selected to provide for requirements not less than those required by Table 2.1-1. All concrete shall have a maximum shrinkage of 0.04% at 28 days, unless otherwise noted, when tested in accordance with ASTM C157, 7-day moist cure. Slab on ground concrete shall have a lower maximum shrinkage limit of 0.02%.

TABLE 2.1-1

Nominal Strength f'c @ 28 days psi (MPa) Note 1	Type of Concrete	Minimum Cementitious Content Lbs. Per CY (Kg per CM) Note 2	Maximum Water-Cementitious Material Ratio Note 3
Structural Concrete			
5,000 (34)	normal weight	635 (377)	0.42
4,000 (28)	normal weight	540 (320)	0.50
4000 (28)	lightweight	560 (356)	Note 4
2000 (14)	lean concrete	300 (178)	Note 4
Slab Concrete			
4000 (28)	nw, slab on ground and topping slab (interior)	575 (340)	0.50

Note 1: f'c in accord with ACI 318 Articles 5.3.2 and 5.3.3.

Note 2: Minimum cementitious means total weight of cementitious material as permitted by this Specification (cement, slag, fly ash, and silica fume).

Note 3: Maximum water-cementitious material ratio will be reviewed for conformance to ACI 318 paragraph 5.3.3.2 (f). Field documented mix designs shall be responsive to this requirement.

Note 4: Maximum water content, minimum cement content and maximum allowable slump shall be those reported in the accepted mix design

1. Each mix shall be proportioned to fulfill the water-cementitious material ratio at the maximum permitted slump. Self-consolidating concrete mixes shall be proportioned to fulfill the required workability criteria range and the water-cementitious material ratio and shall be established on the basis of full scale testing at the plant or site as well as trial mixes and mock-ups. In designing the mix, the size and the form of the structure, the dimension and density of reinforcement and cover should be taken in consideration.
2. Contractor may use fly ash or other pozzolans to replace not more than 30% by weight, pound for pound, of required cement. Contractor may use slag to replace not more than 40% by weight, pound for pound, of required cement. Fly ash or slag may not be used to substitute for cement conforming to ASTM C 595, (i.e., for pozzolan modified cement). Silica fume may be used to replace not more than 10% by weight, pound for pound of required cement.
3. Use admixtures as required by this Specification and as recommended by admixture manufacturer for the specific climatic conditions at the time of placement.
4. Slump of less than 3 inch (75 mm) at point of discharge will not be permitted except where allowed specifically in this Specification.
5. Slab on ground and topping slab concrete and built-up slab shall be macro synthetic fiber reinforced concrete. Minimum dosage shall be 4 lbs/cy unless otherwise noted.

C. Air-Entrainment: Concrete shall be air-entrained in accord with Table 2.1-2 except that entrained air is not required for concrete for footings, interior slabs on ground to receive steel troweled finish, where such concrete will not be subject to freeze/thaw. Lightweight concrete shall be air-entrained in accordance with Table 2.1-2.

TABLE 2.1-2

TOTAL AIR CONTENT*

Maximum Aggregate Size No.**	Maximum Nominal Size	Required Air Content (Percent)
# 467	1-1/2 (38 mm)	4.5 $\pm$ 1.5
# 57	1 (25 mm)	5.0 $\pm$ 1.5
# 67	3/4 (19 mm)	6.0 $\pm$ 1.5
# 7	1/2 (13 mm)	7.0 $\pm$ 1.5
# 8	3/8 (10 mm)	8.0 $\pm$ 2.0

* Interior slabs on ground, to receive steel troweled finish, shall have an air content not to exceed 2.0% ± 1%. No air entraining admixture permitted.

** Size designations per ASTM C 33 or C 330.

D. Slump and Slump-Flow: Concrete that is not self-consolidating shall be proportioned and produced to provide slump, at the point of delivery into the work, as tabulated in Table 2.1-3. A tolerance of not more than 1 inch (25 mm) additional will be allowed for one batch within each five consecutive batches of each mix design.

TABLE 2.1-3

Type of Concrete	Maximum Slump inches *
Normal Weight	4 (100 mm)
Lightweight	4 (100 mm)
Slab on Ground	4 (100 mm)
Topping Slab	3 (75 mm)
Pumped	Note 1
Ramps and Sloping Surfaces	3 (75 mm)

* Increased slump may only be achieved by the used of the specified HRWR admixture.

Note 1: All pumped concrete shall contain the specified HRWR admixture. Slump loss shall not be more than 2" from the pump to the point of deposit.

1. Self-Consolidating Concrete Slump-Flow and Workability: Self-consolidating concrete shall be proportioned and produced to provide a slump flow from 22 inches (560 mm) to 30 inches (760 mm). Actual slump-flow and other workability test criteria shall be determined based on the requirements of the particular self-consolidating concrete application using trial mixes and full-scale test placements on site in accordance with ACI 237R, Self-Consolidating Concrete and other applicable standards.

E. Water-Reducing Admixture shall be incorporated into all concrete (not required for mixes designed for superplasticized and self- consolidating concrete) at a minimum dosage of 3.5 fluid ounces per CWT (230 cm^3/100 kg) of cement, in strict conformance with manufacturer's directions. Contractor shall consult with admixture manufacturer and shall propose increased dosage rates as appropriate to achieve optimum workability, cohesiveness and uniformity of concrete mixtures as placed in the Work.

1. Use non-corrosive, accelerating admixture in concrete slabs and in other thin concrete work where concrete is placed at ambient temperatures below 50°F (10°C).

F. Superplasticized (HRWR) Concrete: Use in all pumped concrete and concrete with a water/cementitious ratio below 0.50 and in all locations where required to meet the requirements of the contract documents. Prepare with a high-range, water-reducing admixture (HRWR). Contractor's mix design shall also include written descriptions of Contractor's methods for mixing, placing and conveying concrete and shall also include design procedures to be used for the formwork.

1. HRWR mixes may be prepared to provide concrete with 9-inch (225 mm) maximum slump and intended slump of 8.0 +1 inch (200±25 mm) in lieu of the slump maximums specified herein, while adhering to the water-cementitious material ratio maximums specified. Alternatively, HRWR admixture may be used to provide concrete mixtures conforming to the specified maximum slump and water- cementitious material ratio values.
2. HRWR admixtures shall be incorporated into the concrete mixtures at the batch plant or in the field through an approved dispensing unit. Water content of this concrete will be verified on the job site by use of the specified microwave test.

3. Self-consolidating concrete shall always use a high-range, water-reducing admixture.

G. Self-Consolidating Concrete shall be proportioned in accordance with ACI 237 and shall be subjected to trial mixes and placements. Self-consolidating concrete mixes shall include high-range, water-reducing (HRWR) and viscosity modifying (VMA) admixtures. In addition to the mix design submission requirements for normal concrete, self-consolidating concrete mixtures shall include:

1. Slump-flow, visual stability index, and T50 test results in accordance with ASTM C 1611. The slump-flow should meet the value tabulated in Table 2.1-3.2. The visual stability index should be 0.
2. Passing ability test results in accordance with ASTM C 1621. Acceptable passing ability is where the J-ring test is within 2" of the slump-flow test, unless more stringent criteria apply.
3. Stability test results in accord with ASTM C 1712. Acceptable penetration depth is less than ½".
4. The level of slump flow or water content at which the mixture becomes unstable shall be determined and reported. Successive amounts of high range water reducing admixture or water shall be added to the trial mix and slump flow, visual stability index and T50 shall be measured. The level of slump flow or water content at which the mix becomes unstable shall be submitted.
5. Due to the sensitivity of self-consolidating concrete to changes in batching quantities, resiliency tests must be conducted and submitted for each design mix to ensure robustness of the mix within allowable lab tolerances. The strength and workability tests results for these resiliency tests shall fall within allowable tolerances. Tests shall include at a minimum:

    a. One batch test where the powder content of the design mix is increased 2% and the water content is decreased 2%.
    b. One batch test where the powder content of the design mix is decreased 2% and water content is increased 2%.

H. Drying Shrinkage Limitations: All concrete placed above grade, except footings, shall comply with the following drying shrinkage requirements:

1. Prior to placement of concrete, a trial batch of mix designs requiring shrinkage control shall be prepared using aggregates, cement and admixtures proposed for each class. From each trial batch, at least 3 specimens for determining the Drying Shrinkage shall be prepared in addition to 6 compression test specimens.
2. The Drying Shrinkage specimens shall be 4 x 4 x 11 inch (100 x 100 x 280 mm) prisms, fabricated, moist cured, air dried and measured in the manner provided in ASTM C 511 and as modified herein. Specimens shall be air dried after moist curing for 7 days and shall be measured at an age of 14, 21, 28, and 35 days. The effective gauge length of the specimens shall be 10 inches (254 mm).
3. Compression test specimens shall be fabricated, cured and tested in accordance with ASTM C 192. Three specimens shall be tested at an age of 7 days and three at the age of 28 days.

4. During construction, Drying Shrinkage specimens of each shrinkage class of concrete will be taken to insure continued compliance with these Specifications. For each shrinkage class of concrete, at least one set of three specimens will be taken from each 1000 cubic yards (765 cubic meters) of concrete placed, but in no case less than three sets of specimens (i.e., nine specimens) will be taken for each class.
5. The average Drying Shrinkage of the laboratory test specimens after 28 days of drying shall not exceed 0.040 percent or 0.020 percent where noted in the Contract Documents. Considering the variations in concrete properties and in testing, a tolerance of 30 percent in the above figure will be accepted for field cast specimens.

I. Water-Cementitious Material Ratio: Calculate water-cementitious material ratio by dividing the weight of total free water (including water found in each admixture) in the concrete, per unit volume, by the number of pounds of cementitious material per unit volume. Total free water shall be taken as the total free water content of the mix when proportioned to produce the maximum allowable slump. Cementitious material is defined as cement, silica fume, fly ash and other natural pozzolans, and blast furnace slag. Water-cementitious material ratio shall be the decimal rounded to two significant figures obtained by dividing the total free water weight per cubic yard (meter) by the total weight of cementitious material per cubic yard (meter).

J. Lightweight Concrete shall be measured in accordance with ASTM C 567, shall provide an air-dry unit weight of not less than 110 pcf (1760 kg/cubic meter) nor more than 115 pcf (1840 kg/cubic meter). All measurements shall be taken at points of discharge into the Work. Shrinkage shall not exceed 0.03 percent at 28 days when measured in accord with ASTM C 157.

K. Cement Grout shall be composed of 1 part Portland cement and 3 parts fine aggregate, by volume, with minimum water to produce a stiff, but workable mix.

L. Source Changes: Should the source of an ingredient change, for any of the concrete products specified herein, Contractor shall redesign the affected mix and shall resubmit, all prior to incorporating such material into the Work.

M. Test Report Requirements: Contractor's test reports and Testing Agency test reports shall be prepared in a format as given in this Specification.

1. Mixes shall be designated by a number (Mix No. 1, Mix No. 2,...etc).
2. Individual samplings of a particular mix shall be designated by a number, with the first sample given the number 100 (Sampling 100, Sampling 101,...etc).
3. Test cylinder numbers shall be provided using the sample number and a letter (102A, 102B,...etc).
4. Contractor's Professional Engineer licensed in the project’s jurisdiction shall review and shall sign each concrete test cylinder report indicating that the test shows conformance with the requirements of the Contract Documents.
5. Deviations from project requirements shall be identified clearly by circling non-conforming data and by overprinting in 1/2 inch (13 mm) high red letters "NON-CONFORMING."
6. For self-consolidating concrete mixes, provide, in addition, all workability test criteria reports attached to this Specification format.

SPACE FOR LABORATORY LETTERHEAD

REPORT OF CONCRETE COMPRESSIVE STRENGTH TESTS
BBP 334 FURMAN STREET BUILDING

FIELD DATA: Date: _____ Time: _____ Normal Wt. ( ) Lightweight ( )

Contractor: _____ Placement _____
Concrete Supplier: _____ Locations _____

Conveyance Method:
Bucket( ) Pump( ) Chute( ) Buggy( ) Tremie( ) Other _____

MIX NUMBER:			Cylinder Field Cure Data			Technician's Name:
Slump,	inches		Time,	days		
Air Content,	%		Min Temp,	°F		Tests by:
Concrete Temp,	°F		Max Temp,	°F		
Ambient Temp,	°F		Curing Box	( )		Cylinders by:
Fresh Unit Wt,	pcf		Other			

MIX PROPORTIONS:		Batch Quantities Per Cubic Yard	Materials and Sources
Cement	(lb)		
Water - Batched	(gal)		
Water - Added	(gal)		
Fine Aggregate	(lb)		
Coarse Agg.	(lb)		
Admixture	(fl. oz)		
Admixture	(fl. oz)		
Fly Ash or Slag	(lb)		
Silica Fume	(lb)		
Chloride Ion	(%by wt.of cem)		
Macro Synthetic Fibers	(lb/cy)		

TEST RESULTS:

Cylinder Number	Cylinder Weight	Age (Days)	Comp. Strength (psi)	Split Strength (psi)
Specified:				

Remarks

For lightweight concrete:
Air-dry weight per ASTM C 567 _____ Pcf.

P.E.
Seal and Signature

2.2 CONCRETE INGREDIENTS

A. Cement: Provide an accepted, single source, standard brand Portland cement, conforming to ANSI/ASTM C 150, Type I, II or III or ANSI/ASTM C 595, Type IP. Cement shall be from a single domestic source.

1. Use Type I or Type II cement except where another cement is herein specified and except where permitted.
2. High-early strength, Type III, or other special cement, may be used in the Work only where permitted. The specified non-chloride admixture may be used.

B. Aggregate: Fine and coarse aggregates shall be regarded as separate ingredients. All aggregates shall meet the requirements listed below except that, where accepted by *Building Code*, non-conforming aggregates will be considered in accordance with the provisions of the Contract Documents.

1. Coarse Aggregate: shall conform to ANSI/ASTM C 33, and shall consist exclusively of sound and durable gravel or crushed stone, having clean, uncoated, hard and strong particles, free from soft, thin, elongated or laminated particles, and from deleterious materials such as alkali, organic, soft or expansive matter. ASTM Grade Size #67 (19 to 4.8 mm), #57 (25 to 4.8 mm) or #467 (37 to 4.8 mm). Aggregates in excess of 3/4 inch (19 mm) shall not be used except in footings and pile caps, except where required specifically by this Specification or by the Drawings and except where accepted in writing. Water absorption of dry aggregate shall not exceed 1 percent.
2. Lightweight Coarse Aggregate: shall be a rotary kiln product of expanded shale or slate, conforming to ANSI/ASTM C 330, ASTM Grade Size #67 (19 to 4.8 mm) or ASTM Grade Size #8 (9.5 to 2.4 mm), and shall conform also to all requirements for Coarse Aggregate.
3. Fine Aggregate: shall conform to ANSI/ASTM C 33, consisting exclusively of natural sand or crushed stone screenings, having clean, uncoated, hard and strong particles, free from clay, shale, lumps, salt and flaky particles, and from deleterious materials such as alkali, organic, soft or expansive matter. Fine aggregate shall be evenly graded from fine to coarse, with a fineness modulus not less than 2.30, nor more than 3.10.
4. Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18 % for large top size aggregates (1 ½ in.) or 8%-22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.
5. Concrete Topping: Coarse aggregate shall conform to ANSI/ASTM C 33 or C 330 as appropriate, ASTM Grade Size #7 or #8 (12 mm to 4.8 mm or 9.5 mm to 2.4 mm) and shall conform also to all requirements for Coarse Aggregate given above. Fine aggregate shall conform to all requirements for Fine Aggregate as given above.
6. Cement Finish: Aggregates shall be graded from 1/8 (3 mm) to 3/8 inches (10 mm), with not less than 95 percent of aggregate weight passing the 3/8 inch (10 mm) sieve.

7. Cleanliness of Aggregate: Aggregates shall have a minimum C.V. (cleanliness value) and a minimum S.E. (sand equivalent) of 75.0. Three samples shall be taken from the weight hopper and the average of the results of the three individual tests shall be the accepted value. Tests shall be taken throughout the course of the Work. Deviation from the accepted value will be the cause of rejections of the material.

C. Water: Mixing water for concrete shall be clean, fresh, free from injurious amounts of oil, acid, alkalis, salts, organic materials and other deleterious materials and shall conform to ASTM C1602. Antifreeze agents may not be used unless accepted in writing. In case of uncertainty, water shall be potable.

D. Admixtures listed below by name and by brand are accepted for use in the Work. Other admixtures will be considered for use but are subject to acceptance. Admixtures contributing to chloride, fluoride, sulfide or nitrate ions, or to other substances detrimental to the ingredients of the concrete or to reinforcing steel, will not be permitted in the Work.

1. Water-Reducing Admixture shall conform to ASTM C 494, Type A.

   a. Pozzolith 322-N or Polyheed 997, by BASF.
   b. WR-91, or Plastol Series, by Euclid Chemical Co.
   c. Plastocrete 161 or Sikament HP, by Sika Corp.
   d. WRDA with HYCOL or Daracem 55, by W.R. Grace Construction Products.
   e. Other accepted admixture.

2. Retarding Admixture shall conform to ASTM C 494, Type B.

   a. Delvo ESC, by BASF.
   b. Eucon Retarder 100, by Euclid Chemical Co.
   c. Other accepted admixture.

3. Non-corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C 494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Type C Admixtures are:

   a. Pozzutec 20+, by BASF.
   b. Accelguard 80, 90 or NCA by Euclid Chemical Co.
   c. Sika Rapid-1, by Sika Corp.
   d. Polarset, by W.R. Grace Construction Products.
   e. Other accepted admixture.

4. Water-Reducing, Retarding Admixture shall conform to ASTM C 494, Type D.

   a. Pozzolith 100 XR or 300 R, by BASF.
   b. Eucon Retarder 75 or 100, by Euclid Chemical Co.
   c. Plastiment or Plastocrete 161MR, by Sika Corp.
   d. Daratard 17, by W.R. Grace Construction Products.

e. Other accepted admixture.

5. Non-Corrosive, Water-Reducing, Accelerating Admixture shall conform to ASTM C 494, Type E.

   a. Polyheed FC100, by BASF.
   b. Accelguard 80, 90, or NCA, by Euclid Chemical Co.
   c. Plastocrete 161FL, by Sika Corp.
   d. Other accepted admixture.

6. High-Range Water-Reducing Admixture (Superplasticizer) shall conform to ASTM C 494, Type F.

   a. Rheobuild 1000, by BASF.
   b. Eucon 37/1037, or Plastol Series by Euclid Chemical Co.
   c. Sika ViscoCrete 2100, by Sika Corp.
   d. ADVA 140M, by W.R. Grace Construction Products.
   e. Other accepted admixture.

7. High-Range Water Reducing, Retarding Admixture (Superplasticizer) shall conform to ASTM C 494, Type G.

   a. Eucon Retarder 75, by Euclid Chemical Co.
   b. Daracem 100, by W.R. Grace Construction Products.
   c. Other accepted admixture.

8. Air-Entraining Admixture shall conform to ANSI/ASTM C 260.

   a. Micro-Air or MB AE 90, by BASF.
   b. AEA-92 or Air Mix, by Euclid Chemical Co.
   c. Sika AER or Sika AEA-15, by Sika Corp.
   d. Daravair 1000 or Darex II AEA, by W.R. Grace Construction Products.
   e. Other accepted admixture.

9. Prohibited Admixtures: Calcium chloride thiocyanates and admixtures containing more than 0.05% chloride ions are not permitted.
10. Calcium Nitrite Based Corrosion Inhibitor Admixture shall contain a minimum of 30 percent of calcium nitrite by weight.

    a. Rheocrete 222+, by BASF.
    b. Eucon CIA, by Euclid Chemical Co.
    c. DCI S, by W.R. Grace Construction Products.
    d. Other accepted admixture.

11. Shrinkage-Reducing Admixture.

    a. Tetraguard AS 20, by BASF.http://www.masterbuilders.com/
    b. Eucon SRA or Conex, by Euclid Chemical Co.
    c. Sika Control 40, by Sika Corp.
    d. Eclipse, by W.R. Grace Construction Products.
    e. Other accepted admixture.

12. Viscosity Modifying Admixture for Self-Consolidating Concrete.
    a. Rheomac VMA 362 and 450, by BASF.
    b. Eucon DS or Eucon Stasis, by Euclid Chemical Co
    c. Sika Stabilizer 300 SCC, by Sika Corp.
    d. V-Mar 3, by W.R. Grace Construction Products.
    e. Other accepted admixture.

E. Chloride Ion: It is understood that certain admixtures do contain a concentration of calcium chloride. Design mix shall contain a summary of total calcium chloride concentration, including the content of admixtures. Total concentration in excess of that listed in ACI 318 Table 4.4.1 will be rejected without further review. Concentrations less than those listed in ACI 318 Table 4.4.1 may be accepted where, in the sole opinion of Construction Manager or of Architect, such concentration will not be detrimental to the Work. The amount of calcium chloride shall be determined by the method described in ASTM C 1218.

F. Fly Ash shall conform to ASTM C 618, Class C or F except that loss on ignition shall not exceed 3 percent and maximum percentage retained on the #325 (45 μm) sieve shall not exceed 20 percent. Fly ash shall be from a single, accepted source.

G. Natural Pozzolans, such as calcined clay, calcined shale, and metakaolin, shall conform to ASTM C618, Class N.

H. Silica Fume (microsilica) shall contain a silicon dioxide (SiO_2) content not less than 92%, shall be of either dry densified or slurried form, conforming to ASTM C 1240, and shall come from a single, accepted source:

1. Rheomac SF 100, by BASF.
2. Eucon MSA, by Euclid Chemical Co.
3. Sikacrete 950DP, by Sika Corp.
4. Force 10,000D, by W.R. Grace Construction Products.
5. Other accepted microsilica based admixture.

I. Blast Furnace Slag shall conform to ASTM C 989, Grade 120.

J. Fibrous Reinforcement shall conform to ASTM C 1116 Type III.

1. Synthetic Macro-Fibers: Structural fibers shall be a coarse monofilament, self-fibrillating, polypropylene/ polyethylene blend in accordance with ASTM C1116, Paragraph 4.1.3, Type III. Structural fiber shall have a minimum tensile strength of 73 to 80 ksi and a minimum length of 1.5 inches. To be used for slabs-on-ground and topping slabs. .

    a. Tuf-Strand SF, by Euclid Chemical Co.
    b. Strux 90/40, by W.R. Grace Construction Products.
    c. Other accepted fiber reinforcement.

2.3 FORMWORK MATERIALS

A. Form Contact Faces:

1. For Surfaces Not Exposed To View:

   a. Lumber shall be stress grade lumber described and used in accord with the National Design Specification for Wood Construction. Lumber shall be dressed on three sides and ends for a tight fit.
   b. Plywood for formwork shall be in accordance with U.S. Product Standard PS-1, Structural 1 "B-B (Concrete Form) Plyform", Exterior Grade, mill oiled and edge-sealed, not less than 9/16 inch (14 mm) thick. Field cut edges shall be resealed with a solvent-based sealant. Each piece shall bear the legible inspection trademark.
   c. Chamfer Strips for outside corners in forms may be of wood, metal or PVC at Contractor's option. Rubber chamfer strips may be used only where not exposed to view.
   d. For self-consolidating concrete formwork, care shall be taken to ensure the forms are water-tight.

2. For Surfaces Exposed to View and for Multiple Reuse Applications:

   a. Plywood for formwork shall be in accordance with U.S. Product Standard PS-1, Structural 1" B-B (Concrete Form) Plyform", Douglas Fir, Exterior Grade, High Density Overlay (HDO) thermo-set resin-impregnated, mill oiled and edge-sealed, not less than 9/16 inch (14 mm) thick. Field cut edges shall be resealed with a solvent-based sealant. Each piece shall bear the legible inspection trademark. Provide Pourform-HDO by Savona Specialty Plywood, or other accepted form.

3. Form Gaskets (for sealing form panel joints): Gaskets shall be closed cell, completely skinned, foam rubber or neoprene, with pressure sensitive paperbacked adhesive on surfaces to be bonded to forms. Gaskets shall be of sufficient thickness, widths, and compressibility for specific use.
4. Reveal Formers and Reformers: Sealed (polyurethane) milled fir (dressed and sanded), for straight reveals; and or extruded or molded vinyl, rubber or neoprene of 75 Durometer hardness for special and circular profiles, as required. Reformers shall be reveal strips specified with gasket applied between reveal and concrete.

B. Form Sealers and Release Agents shall be guaranteed by manufacturer to be non-grain raising, non-staining and to not impair the natural bond of paint, waterproofing and other surface coatings.

1. Form Sealer for Lumber Surfaces and Plywood Edges: Polyurethane, clear coating.
2. Form Release Agents: Provide chemically reactive, non-staining, non-toxic, commercially blended form release agents that are compatible with material subsequently applied and free from deleterious effects on final concrete surfaces or applied coatings and finishes. Products containing castor oil shall not be used in the Work. Special care need be taken with self-consolidating concrete to ensure that the form release agent has been applied to clean, smooth forms in a uniform and appropriate thickness.

a. General Purpose Form Release Agents

1) Formshield Pure, by Euclid Chemical Co.
2) Debond Form Coating, by L&M Construction Chemicals, Inc.
3) Nox-Crete Form Coating 250, by Nox-Crete, Inc.
4) Other where accepted.

C. Form Ties:

1. For Surfaces Not Exposed to View: Ties shall be of standard manufacture, factory fabricated, designed specifically for use in concrete formwork. Non-fabricated wire and similar accessories shall not be used. Sizes shall be appropriate for the wall, beam, or other element formed. Ties shall be readily removable leaving no metal within 1 inch (25 mm) measured from the concrete surface and shall be free of lugs, cones, washers, or other devices that will leave a hole larger than 1 inch (25 mm). Use Williams Form Engineering Corp. or Dayton Superior coil ties, with cones or accepted snap ties with cones, except where ties of another design or manufacture are accepted.

D. Other: Formwork materials not given herein or identified in Drawings shall be subject to acceptance.

2.4 REINFORCEMENT MATERIALS

A. Reinforcing Bars, etc.: Except where more stringent requirements are given in the Drawings or required by *Building Code*, provide ASTM A 615, new billet steel, deformed. Rail, axle, or rerolled steel shall not be used.

1. Provide Grade 60 unless otherwise given in the Drawings or in this Specification.
2. Steel wire shall conform to ASTM A 82, plain, cold-drawn steel.

B. Tie Wire: 18 gauge (1310 µm) or heavier, black annealed wire, conforming to ANSI/ASTM A 82. Tie wire in concrete at exposed surfaces shall be non-corrosive; stainless steel, monel, or plastic coated.

C. Bolsters, Chairs, Spacers, and other devices for spacing supporting and fastening reinforcing bars and welded wire fabric:

1. Accessories shall be all-plastic or shall be plastic coated metal. Metal may not extend closer than 1/8 inch (3 mm) to concrete surface. Plastic color shall match finished concrete color. Conform to CRSI requirements.
2. Precast concrete blocks furnished for reinforcement support shall be produced specifically for intended purpose; brick, stone, wood and other materials will not be permitted. Precast concrete blocks three inches (75 mm) or larger shall have the same compressive strength as the structural concrete in which they are used. Precast blocks smaller than three inches (75 mm) shall be 6,000 psi (41 MPa) at time of use.
3. For slabs-on-ground, use precast concrete blocks or supports with base plates or with horizontal runners at all locations where base materials will not properly support the legs of chairs.

2.5 MISCELLANEOUS MATERIALS

A. Non-Shrink Grout shall be natural aggregate grout pre-mixed and bagged by manufacturer. Non-shrink grout shall conform to ASTM C 1107 Grade B or C when tested at a fluid consistency of less than 30 seconds per ASTM C 939 at temperature extremes of 40°F and 90°F (7°C and 32°C) and an extended working time of 30 minutes. The corresponding minimum compressive strength of the grout at 28 days, based on ASTM C 942, shall be 7500 psi. The grout shall exhibit no measurable bleed when tested in accordance with ASTM C 940.

1. Sure-Grip High Performance Grout, by Dayton Superior.
2. Hi-Flow Grout, by Euclid Chemical Co.
3. Five Star Fluid Grout 100, by Five Star.
4. Masterflow 928 Grout, by MBT Technologies and Repair.
5. Other where accepted.

B. Epoxy Grout shall be non-shrink, 100% solids, 3-component, moisture tolerant grout.

1. E3-F, by Euclid Chemical Co.
2. Five Star Epoxy Grout, by Five Star.
3. Masterflow 648 CP, by MBT Technologies and Repair.
4. Sikadur 42, by Sika Corp.
5. Other where accepted.

C. Bonding Admixture shall be Latex type, non-redispersable, modified sand cement mortar conforming to ASTM C 1059, Type II.

1. Day-Chem Ad Bond, by Dayton Superior Corp.
2. Flex-Con or SBR Latex, by Euclid Chemical Co.
3. Everbond, by L&M Construction Chemicals, Inc.
4. Strong Bond, or Sure Bond (EVA), by Symons Corp.
5. Other where accepted.

D. Epoxy Adhesive shall conform to ASTM C 881, and shall be a two-component, 100% solids material, suitable for use on both dry and wet surfaces. Acceptable materials:

1. Sure-Anchor Epoxy, by Dayton Superior Corp.
2. Dural #452 Series or Duralprep AC, by Euclid Chemical Co.
3. Concresive Standard Paste LVI, by MBT Technologies and Repair.
4. Sikadur 32 Hi-Mod or Sikadur 32 Hi-Mod LPL, by Sika Corp.
5. Rezi-Weld 1000, by W.R. Meadows, Inc.
6. Other where accepted.

E. Anti-Corrosive, Epoxy/Cementitious Adhesive: The adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time). Provide one of the following or approved equal:

1. Duralprep AC by Euclid Chemical Company.
2. Armatec 110 by Sika Corporation.

F. Polymer Repair Mortar: These patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Structural Engineer is required.

1. Polyfast FS, by Dayton Superior.
2. Thin Top Supreme or Concrete Top Supreme (horizontal repairs), Verticoat or Verticoat Supreme (vertical and overhead repair),by Euclid Chemical Co.
3. Sikatop 121 & 122 (horizontal repair), Sikatop 123 (vertical and overhead repairs), by Sika Corp.
4. Other where accepted.

G. High Strength Flowing Repair Mortar for forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate. The product shall achieve 9000 psi @ 28-days at a 9-inch slump.

1. Eurococrete, or Euco Speed MP (Cold Weather) by Euclid Chemical Co.
2. Polyfast LPL, by Dayton Superior.
3. Emaco S77 CI, by MBT Protection and Repair.
4. Other where accepted.

H. Post-Installed Mechanical Anchors shall be either expansion or undercut type. Where substitutions are requested, the alternate anchor shall be similar in type to that specified in the Contract Documents and be designed in accordance with substitution requirements.

1. Standard Wedge-Type Expansion Anchors:

   a. Kwik Bolt 3 and TZ, by Hilti Corp.
   b. Power-Stud+ SD1 and SD2, by Power Fasteners Inc.
   c. Strong-Bolt 2, by Simpson Stront-Tie
   d. Other where accepted

2. Heavy-Duty Wedge-Type Expansion Anchors:

   a. HSL 3 Heavy Duty Sleeve Anchor, by Hilti Corp.
   b. Power-Bolt, by Powers Fasteners Inc.
   c. Other where accepted

3. Undercut Expansion Anchors:

   a. HDA Undercut Anchor, by Hilti Corp.
   b. Atomic+, by Powers Fasteners Inc.
   c. Torq-Cut, by Simpson Strong-Tie
   d. Other where accepted

4. Galvanizing *shall conform to ASTM B 695, Class 50 or to ASTM B 633, SC1.*
5. *Stainless steel for studs and washers shall conform to AISI Grade 304 or Grade 316 and to ASTM F 593, Group 1 or Group 2, Condition SH. Nuts shall be of stainless steel conforming to ASTM F 594, Group 1 or Group 2, Condition SH.*

I. Post-Installed Adhesive Anchors shall be either acrylic or epoxy, injectable type. Where substitutions are requested, the alternate adhesive shall be similar in type to that specified in the Contract Documents and be designed in accordance with substitution requirements.

1. Acryllic or Vinylester Adhesive:

    a. HY200, by Hilti Corp.
    b. AC100+ Gold, by Powers Fasteners Inc.
    c. Other where accepted

2. Epoxy Adhesive:

    a. Hilti RE 500 V3, by Hilti Corp
    b. PE1000+, by Powers Fasteners Inc.
    c. SET-XP, by Simpson Strong-Tie
    d. Other where accepted

3. Galvanizing shall conform to ASTM B 695, Class 50 or to ASTM B 633, SC1.
4. Stainless steel for studs and washers shall conform to AISI Grade 304 or Grade 316 and to ASTM F 593, Group 1 or Group 2, Condition SH. Nuts shall be of stainless steel conforming to ASTM F 594, Group 1 or Group 2, Condition SH

J. Polyurethane Sealant shall be Eucolastic I by Euclid Chemical Co., Dymonic by Tremco, Inc., Sikaflex-1a by Sika Corp., or other accepted sealant. Sealant shall conform to ASTM C920. Color shall be accepted by Architect. Backer rod shall be as recommended by sealant manufacturer.

K. Joint Filler:

1. Unless otherwise noted, use non-staining, non-extruding, compressible and resilient joint filler of sponge rubber conforming to ASTM D 1752, Type I. Joint fillers which contain or have been treated with oil, grease or bituminous materials are prohibited. Test joint fillers for compatibility with proposed primers and sealants.
2. Acceptable preformed joint filler: FF-3 Sponge Rubber, by Progress Unlimited, Inc.; Cementone Sponge Rubber, by Tamms Industries; or other accepted filler.
3. Provide compatible joint sealing compound.

L. Cellular Polystyrene shall conform to ASTM C 578, Type IV or better and shall be sufficiently hard and dense and/or shall be sealed so as to preclude completely the dispersing of Styrofoam particles into the plastic concrete. Acceptable cellular polystyrene: Styrofoam Cavitymate Plus, by The Dow Chemical Co., or other acceptable cellular polystyrene.

M. Bond Breaker shall be 4 mil (100 µm) thick polyethylene sheet.

N. Moisture-Retaining Cover Conforming to ASTM C171: A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stablizers to resist degradation from ultraviolet light. Acceptable Moisture-Retaining Cover: Hydracure S-16 by PNA Construction or Transguard 4000 by Beef Industries.

O. Crushed Stone:

1. Under slabs-on-ground shall consist of clean, hard, durable, natural rock, free of organic matter, rock dust and other contaminants, and shall be well graded within the requirements of ASTM C 33, Size #467.

a. Material conforming to AASHTO Specification M80 will be accepted for use in the Work.

2. Bridging rock where required to span over softer areas of the underlying soils shall consist of a coarse granular mixture of rock fragments having a maximum particle size of 6 inches (150 mm). It is anticipated that quarry run or crusher run materials will be satisfactory. The material shall be well graded between the maximum and minimum sizes with no more than l5 percent passing the U.S. Standard Number 200 sieve (75 μm).

P. Compactible Fill under slabs-on-ground shall be composed of well graded gravel or crushed stone, 1½" maximum size. "Crusher run" material is satisfactory. Do not use sand except with prior approval of the Architect. Fill shall be free-draining, free from clay, shale, lumps, salt, organic matter, rock dust and other contaminants, and shall consist of hard, clean and durable particles.

Q. Pachometer (reinforcing bar locator): Use James R-Meter by James Instruments or other accepted pachometer.

2.6 SURFACE TREATMENTS

A. Clear Curing and Sealing Compound VOC Compliant, 350 g/l, shall be a liquid type membrane-forming curing compound, complying with ASTM C 1315, Type I, Class A, 25% solids content minimum. Moisture loss shall be not more than 0.40 kg/m2 when applied at 300 sq. ft./gal. Compound shall be compatible with all subsequent finishes and toppings, shall chemically combine fully with the concrete in 30 days or less, shall leave no surface residue, and shall preclude secondary reactions within concrete as well as materials applied to the concrete surface. Manufacturer's certification is required. Subject to project requirements, provide one of the following products:

1. Super Diamond Clear VOX, by Euclid Chemical Co.
2. Lumiseal WB Plus, by L&M Construction Chemicals, Inc.
3. Kure 1315, by Sonneborn Products.
4. Other where accepted.

B. Dissipating/Non-residue Forming (Strippable) Curing Compound (VOC Compliant, 350 g/l) shall be a liquid membrane-forming compound conforming to ASTM C 309, Type 1 or 1-D that chemically breaks down and wears off after curing is complete. Install in strict accordance with the manufacturer's recommendations. Manufacturer's certification is required.

1. Kurez DR VOX, by Euclid Chemical Co.
2. L&M Cure R, by L&M Construction Chemicals, Inc.
3. Kure-N-Harden, by Sonneborn Products.
4. 1100-Clear Series, by W. R. Meadows, Inc.
5. Other where accepted.

C. Evaporation Retarder/Finishing Aid:

1. Eucobar, by Euclid Chemical Co.
2. E-Con, by L&M Construction Chemical, Inc.

3. Confilm, by MBT Protection and Repair.
4. SikaFilm, by Sika Corp.
5. Other where accepted.

D. Liquid Densifier/Sealer: The liquid densifier compound shall be a siliconate based sealer which penetrates concrete surfaces, increases abrasion resistance and provides a "low-sheen" surface that is easy to clean and eases the problem of tire mark removal. The compound need contain a minimum solids content of 20%, of which 50% is siliconate.

1. Euco Diamond Hard, by Euclid Chemical Co.
2. Ashford Formula, by Curecrete Chemical Co., Inc.
3. Seal Hard, by L & M Construction Chemicals, Inc.

E. Waterproofing and Chloride Ion Screen: Silane water repellent and chloride ion shield shall contain not less than 40 percent solids and shall provide not less than 90 percent chloride ion screening capability when tested in accordance with NCHRP 244.

1. Weather Worker S-40 J-29 WB, by Dayton Superior.
2. Euco-Guard VOX, by Euclid Chemical Co.
3. Hydrozo Silane 40-VOC, by Hydrozo.
4. Aquapel, by L & M Construction Chemicals, Inc.
5. Masterseal SL 40 VOC, by MBT Protection and Repair.
6. Other where accepted.

F. Concrete Cleaning/Finishing Solution: General surface cleaner shall be a commercial concrete cleaner containing solvents, stain removers, detergents and a maximum of 2 percent chloride acid. Accepted cleaner: Light Duty Concrete Cleaner by ProSoCo, Inc., or other accepted compound.

PART 3 - EXECUTION

3.1 CONTRACTOR'S INSPECTION

A. Examination of Field Conditions: Examine all surfaces, features and facilities to which Work must be attached or applied, abut or clear. Notify Construction Manager and Architect in writing of all conditions which are or will be detrimental to proper and expeditious installation of Work. Starting of Work shall represent acceptance by Contractor of surfaces and of conditions as suitable and correct for performing Work as specified.

B. Field Measurements: Contractor shall verify, by measurements at the job site, all dimensions affecting the Work of this Section. Field dimensions at variance with those in accepted Shop Drawings shall be reported in writing by Contractor. Decisions regarding corrective measures shall be subject to acceptance and acceptance shall be obtained before starting fabrication of items affected. The starting of Work shall represent acceptance by Contractor of all dimensions affecting the Work of this Section as suitable and correct for the performing of all Work under this Section.

3.2 FORMWORK

A. Reference Standards: Formwork shall conform to ACI 347R, except where more stringent requirements are given in the Drawings or in this Specification.

B. General: Contractor shall be solely responsible for the design, engineering, construction, completeness, safety and adequacy of all concrete formwork. Provide removable formwork for all concrete not indicated specifically to be formed by other means. Provide for anchorages and inserts, blocking, bulkheads, chamfers, keys and keyways, ledges, moldings, offsets, openings, recesses, reglets, screeds and all else to complete the Work.

1. Formwork shall be designed and constructed to withstand all forces imposed upon the formworkincluding all construction dead and live loads, horizontal loads from equipment, wind and earthquake forces, and forces due to vibration of plastic concrete. Shoring shall be adequate in strength and in position so that loads of successive parts of the structure will be transmitted directly through the falsework without the creation of shearing or bending stresses in the concrete Work.
2. Formwork shall be tight to prevent leakage of mortar from the concrete so as to provide concrete free of honeycombs, shall be of adequate rigidity and strength, and shall be adequately braced to produce true lines, free of bulges and unsightly depressions, to accurate elevations and correct alignments. Joints between form face edges shall be tight and strongly backed to provide joints that are flush and true. Provide inspection of all formwork for conformance with this Specification and with form drawing design, both prior to, during and after concreting.
3. Fabricate for easy removal, without prying or hammering against concrete surfaces. Provide crush or working plates where stripping may damage concrete surfaces.
4. Clean-Out and Access Panels: Provide readily removable and securely replaceable panels in column forms, wall forms, and other types of formwork as needed to permit ready access for cleaning formwork totally free from standing water, dust, dirt and other debris, allow inspection of condition of formwork, reinforcement, and concrete bonding surfaces, and as needed to allow proper access for concrete placement and vibration. Locate removable panels to minimize exposure to view, except where more exposed locations are accepted.
5. Provide top forms at all inclined surfaces where slope is too steep to place concrete with bottom form only.

C. Self-Consolidating Concrete Formwork:

1. Self-consolidating Concrete: Due to the fluid nature of self-consolidating concrete, higher pressures than conventional concrete should be expected and accounted for in formwork design. Where noted in the contract documents that self-consolidating concrete shall be pumped from the bottom of the forms, consideration shall be given to the additional pressure on the formwork from pumping.
2. Store forms such that they will not be damaged due. Ensure forms are clean and free of surface defects prior to erection.
3. Coat contact surfaces of formwork with form-release agent according to manufacturer’s written instructions. Agent should be applied minimally and evenly to avoid puddling.

4. Coating should take place as close as possible to concrete pour, and formwork should be protected from water and other deleterious substances. Before concrete placement, forms shall be reinspected and form release agent reapplied or fixed where required.

D. Construction and Erection of Forms:

1. Brace forms securely against lateral forces and to prevent lateral deflections.
2. Build into the formwork and otherwise make necessary provisions in formwork to accommodate the Work of other Sections of this Specification. Obtain required information and materials from affected trades. Install inserts, sleeves, edge and corner angles, steel frames and the like securely in the formwork to allow sound embedment of their anchorage devices, without displacement, and to provide the required alignment to the formed and finished concrete faces and surfaces. Provide boxouts for items to be provided at a later date. Seal, or fill with readily removable filler all voids in embedded items and sleeves in order to prevent complete or partial filling by intrusion of concrete paste.
3. Provide material with sufficient thickness so that newly placed concrete does not bow, distort or deflect formwork.
4. Concrete Surfaces Not Exposed to View: Contractor may use plywood, lumber, metal and other materials included under this Specification.
5. Reuse of Form Material: Clean thoroughly and repair forming materials prior to reuse. Damaged material which cannot be properly reconditioned to produce Work conforming to this Specification shall be discarded. Formwork may be reused only the number of times which will assure that concrete surfaces produced will meet the provisions of this Specification. Condition of formwork and use or reuse of formwork shall be subject to acceptance. Where reuse of forms is permitted or accepted, withdraw all nails, clean forms, and repair damaged surfaces by replacement of damaged boards or units. Formwork materials rejected shall be removed promptly from the site.
6. Protect Soft Materials such as Styrofoam from contact by vibrators and other equipment. Evidence of dispersion of such materials into concrete will be considered as evidence for rejection of that concrete.

E. Cellular Polystyrene panels shall be installed with staggered joints and shall be bonded with adhesives recommended by the manufacturer.

F. Form Release Treatment: Clean and treat all removable forms with form release agent prior to placing reinforcement and embedded items. Remove excess form release agent and do not allow agent to come in contact with previously placed concrete or reinforcing steel.

G. Clean and Tighten all forms immediately prior to casting concrete. Retighten formwork after placing concrete to account for concrete shrinkage and the like and to minimize mortar leakage.

H. Horizontal and Sloped Concrete Surfaces below finish grade which will not be exposed to view, where permitted and where shown in Drawings, may be formed by the use of clean cut trenches in lieu of forms.

1. Provide 3 inches (75 mm) minimum cover to reinforcement at all surfaces formed by earth, rock, or geotextile fabric.

I. Mud Slabs shall be a minimum of 3" (75 mm) thick and shall be provided at all locations where shown in the Drawings and at other locations where needed to protect adequately the bearing surface.

3.3 FABRICATION AND PLACEMENT OF REINFORCEMENT

A. Reinforcing Steel shall be Shop Fabricated in strict accord with the Shop Drawings, certificates, and other submitted and accepted data. All Work shall conform to the applicable Standards as given herein and as need apply to the Work. Workmanship shall be of the best practice of relevant trades and shall be performed by skilled mechanics making use of modern tools and equipment which are in good condition. To the extent practical, Work shall be accomplished in the shop and not in the field.

B. Reinforcing Steel, whether existing or provided under this contract, shall be free from paint, oil, dirt, scale, ice, frost, loose rust, grease, clay or other soil, and other substances or coatings which could reduce bond with concrete.

C. Placing Reinforcing Steel: Comply with the more severe of ACI, CRSI, *Building Code* and this Specification.

D. Reinforcing Bar Supports shall be appropriate to the intended use, of sufficient number, spacing, rigidity and strength to prevent displacement of reinforcing and to hold reinforcing accurately in correct position both before and during concrete placement. Do not place reinforcing bars more than 2 inches (50 mm) beyond the last leg of continuous bar supports. Do not use bar supports as support for runways, conveying equipment or for any purpose other than for supporting reinforcing bars.

1. Use plastic or hot-dip galvanized supports.
2. Securely tie and support reinforcement to prevent displacement by construction traffic and casting of concrete. Neither top nor bottom bars shall be allowed to sag below tolerances specified by Building Code or required by the Contract Documents. Concrete cover shall be uniformly maintained. Displacement of reinforcing steel and embedded items shall be corrected immediately and additional supports provided to prevent recurrence. Conform explicitly to Article 7.6, ACI 318. Separate adjacent layers of parallel bars with short lengths of #8 (25 mm) rebars placed transverse to and securely tied to separated bars of #8 (25 mm) or smaller size; separator bars for #8 (25 mm) and larger bars shall be of the largest bar size separated.

E. Tie wires, where applicable, shall be tied to and bent behind bars in such a manner that concrete placement will not force the wire ends toward the exposed concrete surfaces. At exposed concrete surfaces, tie wire ends shall not fall within required clear concrete cover.

F. Tack Welding of reinforcing steel bars or mesh is prohibited. Reinforcement damaged by arc strikes or arc welding shall be replaced. Welding of reinforcing bar intersections is prohibited.

G. Coordination Detailing and Erection: Reinforcement shall be coordinated, detailed and erected to provide a clear passage for the positioning of tremie trunks in required locations. These openings shall be free of bars, bar ends, wire, ties, or obstructions which could hamper insertion and removal of the trunk.

H Macro Synthetic Fibers: Provide where specified for slabs-on-grade and toppingslabs. Shall be added at a dosage of 4 lbs/cy or higher as required to achieve a minimum equivalent residual strength fe3 of 200 psi when measured in accordance with ASTM C1609.

I. After-Set Inserts or Post-Installed Anchors: At wall and slab surfaces to receive after-set inserts or post-installed anchors, with written acceptance, it may be possible to place reinforcing steel. Whether or not permission is obtained, Contractor shall not cut or damage reinforcing steel in setting of after-set inserts or post-installed anchors or for any other reason.

J. Lap Splices: Reinforcing bars may be lapped in contact splices wired together or by lap lengths separated by spacing shown or noted in the Shop Drawings or permitted by this Specification.

K. Straightening: Once bent, the shop straightening of reinforcing bars is not permitted. The field straightening of bars that have been embedded in concrete is permitted only where authorized specifically.

1. For field bending, acceptance will require generally that larger bars be heated to 1200°F (700°C) maximum and that concrete be protected by insulation blankets. After straightening, acceptance will require that bars be insulated and cooled slowly.

3.4 JOINTS

A. Construction Joints:

1. Construction joints shall be made and located so as to least impair the strength and appearance of the structure. Construction joints shall be made only at locations shown in the Contract Drawings or accepted specifically. Construction joints shall conform to the *Building Code* and to ACI 318, Article 6.4. Location of all construction joints not shown in the Drawings shall be submitted for acceptance.

a. All construction joints shall be keyed not less than 1-1/2 inches (40 mm) deep. Wood box-outs treated with a form release agent or cellular polystyrene box-outs shall be used for keying concrete; the chipping of keys after concrete placement as a construction methodology is prohibited. Continue all reinforcing steel across construction joints. Contractor shall supply, fabricate, and place additional reinforcing steel where location of construction joint in any way weakens the construction.
b. Horizontal construction joints will not be permitted in slabs except where shown in the Drawings. Horizontal construction joints in walls will not be permitted except where shown in the Drawings or in accepted Shop Drawings.
c. Where terrazzo, pavers, stone or other overlay finishes are required, locate slab construction joints accurately at locations directly below expansion joints in the overlay material. Waiver of this requirement will not be given except that, for sand-bedded finishes, alternative proposals will be considered.

2. Spacing of Construction Joints: Conform to and do not exceed maximum distance between construction joints as shown or noted in the Drawings and in this Specification.
3. Special Roughened Construction Joints (SRCJ): For construction joints noted in the Drawings, in addition to keying, the hardened concrete joint face shall be cleaned totally free from laitance either by applying a spray-on surface retarder to the fresh concrete and water blasting or by bush hammering. Provide a rough, sound surface with a roughness amplitude not less than 1/4 inch (6 mm) between projecting aggregate faces and recessed sand-cement matrix. Other construction joint roughening means and procedures are subject to acceptance.

B. Joint Filler: Joint filler shall be installed where indicated in the Drawings. Joint filler shall be full depth of joint and shall be set flush with exposed concrete surface, except where sealant or a reveal is indicated, in which case the joint filler shall be set back as detailed in the Drawings.

3.5 EMBEDDED WORK

A. General: Locate, set and build into the Work such embedded items as are required by the Work of this Section and by the Work of other Sections and Divisions of this Specification.

1. All embedded items required for adjoining Work or for its support shall be placed prior to placing of concrete and, where practicable, prior to placing reinforcing steel.
2. All other trades whose Work is related to cast-in-place concrete Work or whose work must be supported by cast-in-place concrete shall be given ample notice and opportunity to install or furnish embedded items before the affected concrete is placed.
3. Obtain setting diagrams and instructions from the supplier of item to be set and follow instructions implicitly.
4. Provide templates, set accurately to line and to level by transit and/or by laser level and anchor securely so as to not displace during placing and compaction of concrete.
5. Seal, temporarily pack and protect inserts and sleeves from intrusion of concrete or concrete mortar during concrete placement operations.
6. Aluminum: No aluminum shall be embedded in or shall be installed in contact with concrete Work unless provided with an accepted protective coating.

B. Post-Installed Anchors shown in the Drawings, or accepted in writing, shall be installed in strict accord with Manufacturer's Printed Installation Instructions. Anchors may be placed in block or brick work only where voids within 9 inches (230 mm) of the anchor have been filled solidly, with grout. Set perpendicular to concrete surface. Drilled holes shall be cleaned thoroughly with compressed air or water jet.

C. Pipes and Conduit: Location and spacing of piping and of electrical conduit embedded in structural concrete shall conform to Contract Documents, accepted Shop Drawings, to ACI 318, and to *Building Code*. Do not place pipes or conduits in concrete Work except where shown in accepted Shop Drawings.

3.6 MIXING AND DELIVERY OF CONCRETE

A. Ready-Mixed Concrete: All concrete shall be ready-mixed concrete. Measure, mix and deliver in accordance with ANSI/ASTM C 94, *Specification for* Ready-*Mixed Concrete*, and ACI 304R, Chapters 2, 3, 4, and 5 *Guide for Measuring, Mixing, Transporting and Placing Concrete*.

1. Plant equipment and facilities shall conform to the Check List Certification of Ready-Mix Concrete Production Facilities of the National Ready Mixed Concrete Association.
2. Ready mix equipment shall be completely automated.

    a. Computerized batch/truck ticket printouts shall be delivered to the Owner or Owner's inspection agency at time of concrete delivery to job site.

3. Provide site equipment in sufficient time to permit inspection, calibration, adjustment and repair as may be required before start of concrete Work.
4. Admixtures shall be measured and inserted into the mix at the plant except where written exceptions are obtained. The concrete producer shall provide a redosage chart for the high range admixture. This procedure assures a slump or slump flow is in the approved envelope.
5. Self-consolidating concrete should not be batched in quantities greater than 80% of the concrete truck capacity to prevent spillage during transit. Concrete truck operators should keep the revolving drum turning in the mixing mode direction while in transport.
6. If accepted by Structural Engineer, subject to the following conditions, water and/or admixtures may be added to the concrete at the site:

    a. Water shall not be added during transit, on site, or during placement to self-consolidating concrete.
    b. Design mixes indicate water and/or admixtures to be added at the site.
    c. Batch/truck tickets indicate the maximum amount of water and/or admixtures that can be added without exceeding the maximum specified water/cementitious ratio or admixture dosage.
    d. Water and/or admixtures are added in a manner to control volume.
    e. Concrete is properly remixed after addition of water and/or admixtures.
    f. Dosage and time of addition at the site are reported on batch/truck tickets and signed by Contractor's site quality control supervisor.

B. Hand-Mixed Concrete shall be used only where accepted specifically. Such concrete shall be mixed only in watertight containers, with dry materials measured by loose volume, sand and cement mixed together dry prior to adding coarse aggregate. Water, when added, shall be applied slowly with the entire mass turned to provide for an even mixture at all times.

C. Hot and Cold Weather: Comply with ACI 305 for hot weather and with ACI 306 for cold weather concreting.

1. Where air temperature is between 85°F (30°C) and 90°F (32°C), reduce the mixing and delivery time from 1-1/2 hours to 1-1/4 hours; where air temperature exceeds 90°F (32°C), reduce mixing and delivery time to 60 minutes.

2. Where air temperature is below 40°F (4°C), uniformly heat both water and aggregates to obtain a concrete mixture with a temperature both above 50°F (10°C) and below 80°F (27°C) at all times of mixing, transportation and placement.
3. Use accelerating admixture in concrete for slabs placed at ambient temperatures below 50°F (10°C).
4. Freeze resistant concrete design mixes are acceptable for use provided they have been submitted and approved prior.
5. Self-consolidating concrete placement shall be prohibited during cold weather conditions as defined in ACI 306, *Cold Weather Concreting*.
6. Self-consolidating concrete placement shall be prohibited during hot weather conditions as defined in ACI 305, *Hot Weather Concreting*.

D. Cement: At its own expense, Contractor will be required to test or to retest cements which may be contributing to nonconforming concrete, may have been damaged in transit or storage or may have been retained at mixing plant for 30 days or longer.

3.7 PLACING CONCRETE

A. Codes: Concrete shall be placed in accordance with ACI 304R, *Guide for Measuring, Mixing, Transporting and Placing Concrete*, and shall be handled with due care to prevent deterioration due to delay or handling. Concrete shall be consolidated in accordance with ACI 309R.

B. Clean Reinforcement, whether existing, previously placed, or placed for the pour, to a condition not less clean than is required by this Specification, including referenced, cited and stipulated Codes and Standards.

C. Clean and Seal Formwork: Formwork shall be clean and free from frost, papers, sawdust, dirt and debris immediately prior to and during the time concrete is placed thereon.

D. Concrete Pumping: Subject to the provisions of this Specification, ACI 304R - Chapter 9 and ACI 304.2R, concrete may be conveyed and placed by pumping. Concrete shall be pumped through lines 5 inches (125 mm) in diameter or larger. Pumped concrete mix should provide the maximum practicable coarse aggregate content. Lightweight aggregate, where proposed for pumping, shall contain optimum moisture content for pumping, but not less than 16 percent absorbed moisture, based on the oven-dry weight of the lightweight aggregate. Pump lines shall be properly lubricated per ACI 304.2 prior to commencement of concrete placement.

E. Slump and Slump-Form: Concrete with slump or slump-flow exceeding the limits specified herein shall not be placed in the Work. Concrete with excessive slump shall be removed immediately from the site or may be used as lean concrete.

F. Conveying of Concrete: This Specification contemplates movement of fresh concrete from the point of receipt to the location of final deposit by concrete pumps, chutes, concrete bucket, pneumatic-tired buggies and combinations of the foregoing methods. Canvas or rubber "elephant trunks" of appropriate lengths shall be used to limit free fall of concrete. Chutes shall not be used to transport concrete for distances in excess of 30 feet (9 m) nor shall chutes be sloped greater than 1 vertical to 2 horizontal. Baffle plates shall be provided and other means shall be taken to prevent segregation. All devices used for conveying concrete shall be watertight, shall not allow concrete to come in contact with uncoated aluminum or with aluminum alloys and shall be cleaned thoroughly prior to use.

G. Protect formwork from damage by conveying equipment and systems

H. Clean, Tighten, Soak and Bonding Compound: Prior to placing fresh concrete, retighten forms against previously placed concrete. Existing and previously cast concrete surfaces shall be first cleaned of laitance and deleterious materials, the surfaces shall be then roughened so as to remove all loose or damaged material that may be present. Finally, concrete surfaces shall be soaked with water. Standing water shall be removed. In addition to soaking with water, apply the specified bonding compound wihin a 24 open hour time frame in accordance with manufacturer's printed instructions to the following:

1. Vertical surfaces along slab-to-slab, slab-to-wall, and beam-to-beam joints.
2. Horizontal surfaces along slab-to-wall joints.
3. Other surfaces where indicated in the Drawings.

Contractors procedures shall recognize that substantial shearing stresses in the horizontal plane are carried across most construction joints.

I. Coordination of Concrete Placement: The batch plant, transit, conveying and placing operations shall be coordinated so that all concrete is in its final position within 1-1/2 hours from the time the mix is charged with water. Do not place concrete warmer than 90°F (32°C) except as provided in this Specification; for Architectural Concrete, the acceptable temperature of deposited concrete shall be between 50°F (10°C) and 86°F (30°C); for slab-on-ground concrete, the acceptable temperature of deposited concrete shall be between 50°F (10°C) and 70°F (21°C). The batching plant shall either provide chilled batch water or substitute crushed ice for part of the mixing water if required to satisfy specified concrete placing temperatures. Coordination shall be performed so that every deposit placed in the forms shall be covered by a subsequent deposit and consolidated within 15 minutes and in a continuous manner. Truck delivery, truck charging, crane positions, bucket size, tremie numbers and locations, lift heights, etc., shall be planned and directed toward achieving homogeneous and consistent placements.

J. Placement of Concrete: Do not begin until all reinforcing has been placed, secured, and inspected. Partially hardened or retempered concrete shall not be used in the Work. Concrete placement shall be carried out in a continuous manner between construction joints and at such a rate that freshly deposited concrete may be uniformly integrated and made homogeneous at all contact surfaces with preceding deposits of concrete which shall remain both plastic and properly workable by vibration.

1. Placement of concrete elements supported by columns, walls, piers and the like, shall not commence until the supporting concrete is no longer plastic and, in any event, not before a 4 hour waiting period is fully expired.

2. Concrete shall be deposited as near as practicable and possible to its final position in the structure. Placement procedures shall avoid segregation due to rehandling or due to the lateral flowing of concrete induced by gravity or by vertical dropping. To minimize segregation, concrete may not be dropped between reinforcing steel curtains and cages, nor through successive reinforcement grids. Without special acceptance, vertical free fall of concrete shall be limited to 4 feet (1200 mm).
3. Procedures which cause or contribute to excessive segregation of aggregates or cause non-uniform concrete mixtures shall not be used and will be rejected.
4. Place concrete at slumps and using procedures which will produce a homogeneous, properly compacted concrete with uniform finished surfaces.
5. Concrete shall not be placed onto or under water except where permitted specifically by the Drawings or by this Specification.

K. Placement of Self-Consolidating Concrete: See section *Placement of Concrete* above for additional requirements for self-consolidating concrete.

1. Self-consolidating concrete shall be placed by pump. Where shown in the drawings or noted in these specifications, self-consolidating concrete shall be pumped from the bottom of the formwork.
2. When pumping, self-consolidating concrete shall be used to prime the pump. The self-consolidating concrete used to prime the line shall not be placed in the work.
3. Self-consolidating concrete shall be deposited as near as practicable and possible to its final position in the structure and in no case shall exceed a maximum 30 feet of flowing distance.
4. Self-consolidating concrete shall not be allowed to free fall. The discharge point shall be fully submerged in the placed concrete.
5. Self-consolidating concrete should be poured continuously, without breaks, lifts, or construction joints.
6. Self-consolidating concrete shall not be vibrated.
7. When placing self-consolidating concrete around box-outs or other obstructions, ensure that concrete is placed from one side only and allowed to fill around the entire obstruction.

L. Cold Joints are defined as joints wherein concrete on one side has hardened sufficiently so that fresh concrete does not mix thoroughly with that concrete. Cold joints, should they occur, shall result in the immediate stoppage of all placement operations. Detailed drawings showing remedial measures, including removal of material, the drilling-in of dowels and anchors, the construction of keys and specially roughened construction joints by bush hammering and all else will be required prior to placing contiguous concrete.

M. Layering: Concrete may not be placed in layers exceeding 2 feet (600 mm) in depth. Each layer shall be vibrated to the extent necessary to remove voids, honeycombing and the like.

N. Vibration: In accordance with ACI 309R, with the exception of self-consolidating concrete shall be compacted thoroughly by vibrating to produce a dense, homogeneous mass without voids or pockets and shall be accomplished only by experienced operators. Internal vibrators shall be placed in the concrete vertically and shall penetrate at least 3 to 4 inches (75 to 100 mm) into the preceding lift in order to thoroughly blend adjacent layers. Vibrating techniques shall assure that the matrix is thoroughly and uniformly distributed around all coarse aggregate, including at form faces, thereby providing uniform dense concrete throughout the entire concrete volume. Vibration shall not be used as a means of transporting concrete. Work concrete thoroughly around embedded items.

1. At exposed concrete faces, take care not to damage face of formwork.
2. Self-consolidating concrete does not require vibration.

O. Pinholes: Voids or holes larger than 1/4 inch (6 mm) in largest dimension shall be repaired under the provisions of this Section.

P. Epoxy Injection: Place concrete at a slump and consistency which will result in dense, waterproof in-place concrete without shrinkage cracks. Should cracking occur, repair by epoxy pressure injection using an accepted injection procedure and low viscosity, 100% solids, moisture insensitive, non-shrink, two-component epoxy.

Q. Superplasticized Concrete: Note that hydraulic pressures against formwork may be increased substantially with the use of a HRWR and with self-consolidating concrete. Use at all locations where concrete will not flow readily around embedded reinforcement and/or other items, at locations given in the Drawings or in this Specification, at all locations where chloride resistance is required, and as follows:
1. Use for all concrete with a water cementitious ratio below 0.50.

R. Slopes to Drains: Lay out screed lines and finish top of concrete surfaces to provide sloped surfaces as shown in the Drawings and as required to produce free-draining surfaces.

3.8 OTHER CONCRETE WORK

A. Cement Grout:

1. Grout all items indicated in the Drawings. Grout openings in concrete around conduit, piping and other Work passing through concrete except where non-shrink grout is specified or shown. Mix, place and cure as provided by this Specification.

B. Non-Shrink Grouting: Provide formwork for grouting, install flowable non-shrink grout, cure, remove grout forms and seal and protect exposed grout edges, all in strict accord with the printed instructions of the grout manufacturer.

C. Curbs: Strip formwork while still green and steel-trowel surfaces to a hard, dense finish. Provide corners, intersections and terminations that are slightly rounded.

D. Topping Slabs shall be lightweight, 4000 psi (28 MPa), unless given otherwise in the Drawings or in this Specification.

1. Clean surfaces under topping slab of all oil, debris, laitance and other material which could reduce bond between the topping slab and the underlying materials. Moisten thoroughly, where surface is concrete; do not leave standing water.
2. Place 4 mil (250 μm) or thicker polyethylene slip sheet over all surfaces which are not concrete. Then place 10 mil slip sheet over the lower 4 mil slip sheet. Lap and seal slip sheet used as a vapor barrier. Take all precautions needed to protect waterproofing systems and other underlying materials.
3. Reinforce with macro-synthetic fiber reinforcement at a dosage of 4 lbs/cy unless otherwise noted. Maximum shrinkage shall be less than 0.02% at 28 days.
4. Convey and place so as to secure positive compaction and consolidation of topping slab, resulting in uniform, homogeneous concrete, free from segregation. Provide and use appropriate vibrating screeds.
5. Finish Cure and Seal in accord with the requirements contained in the Drawings and in this Specification.

3.9 CONCRETE FINISHES AND TREATMENTS

A. General: Bring surface to level with screeds and strike off. Smooth the resulting surface with bull floats or darbies to remove both high points and low points. Do not add water to or disturb the plastic surface prior to finishing. Accomplish all finishes in accord with ACI 301, except where more stringent requirements are given in this Specification.

1. Unless otherwise provided under this Specification, all flatwork shall receive a monolithic steel troweled concrete finish.
2. Where finished floor is located above the top of the structural slab, provide all required fill and cement finish required to bring floor to final grade or to underside of final finish, as appropriate.

B. Flatwork Finishes: Apply the following finish types as required by the Drawings and by this Specification:

1. Float Finish: Required for concrete flatwork surfaces which will receive trowel finish, roofing, waterproofing membrane, insulation, sand-bedded terrazzo and similar finishes, composition troweled floor finish, or "floating slabs". After the concrete has been placed, struck off, consolidated and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the water sheen has disappeared and/or when the mix has stiffened sufficiently to permit the proper operation of a power-driven float. The surface shall then be consolidated with power-driven floats. Hand floating with wood or cork faced floats shall be used in locations inaccessible to the power-driven machine. Immediately after leveling, the surface shall be refloated to uniform, smooth, granular texture. Wet cure for seven days.
2. Troweled Finish: Required for all concrete flatwork surfaces which will be exposed, or which will receive resilient flooring, carpeting, thin-set floor covering, paint and other thin-film finishes, waterproofing and roofing systems, and any other floor covering requiring a smooth base slab. First, achieve a float finish, and then:

a. After the concrete has been placed, struck off, consolidated, screeded and floated, and as soon as the condition of the slab permits, and before it has hardened appreciably, all water film and foreign material which may work to the surface shall be removed by means of lutes.
b. Prior to removal of screed, the surface shall be checked for flatness and levelness, and filled or cut down where necessary. Rough finishing shall be repeated with straightedge and float.
c. The surface shall be troweled at least twice to a smooth dense finish.
d. The first troweling after power floating shall be done by a power trowel and shall produce a smooth surface which is relatively free of defects but which may still contain some trowel marks.
e. Where required, additional troweling shall be done after the surface has hardened sufficiently. The finished surface shall be dense and smooth, free of any trowel marks, uniform in texture and appearance. On surfaces intended to receive floor covering, defects that would show through the floor covering shall be removed by grinding.
f. Concrete surfaces to receive membrane waterproofing shall receive a trowel finish which leaves the surface smooth and dense, free of voids, projections or ridges.
g. These surfaces shall be wet cured for seven days, unless a strippable curing compound is used.

3. Exposed Float Finish: Required for where indicated in the Drawings and for the tops of all exposed curbs. Use "troweled finish" with a wood or cork float. Wet cure for seven days.
4. Scratched Finish: Required for concrete flatwork surfaces which will receive concrete or cement fill or which will receive finish material which will be bonded with cement mortar. After the concrete has been placed, struck off, consolidated and leveled, the surface shall be roughened with stiff brushes or rakes before final set. Wet cure for seven days.

C. Floors: Thoroughly clean all waste material from floors as soon as each segment of Work is completed, and protect Work which may be damaged by this operation in an accepted manner. Be responsible for fallout and for protecting persons, adjacent work and property. Comply with requirements of the *Building Code* and all agencies having jurisdiction.

D. Deicing Chemicals: In a freezing environment, it is anticipated that Contractor may need to provide or may be required to provide deicing chemicals for use on slab surfaces. The storage and the use of such chemicals is subject to the following requirements:

1. Contractor's attention is drawn to the fact that such chemicals have led to the destructive corrosion of reinforcing steel and to other problems in structures such as this one (including apartments, laboratories, office buildings, schools, and the like).
2. Storage of such chemicals shall be provided with a complete and an effective barrier to the supporting concrete.
3. Where such deicers are placed on slabs, they shall be swept up at the earliest practical moment. Where directed, sweeping shall be followed by a wash-down operation.
4. Deicing chemicals and barrier systems shall be fully compatible with all subsequent finishes and toppings.

5. Formwork, reinforcement, and construction joints shall be protected from all deicing chemicals used on site. Deicing chemicals should never be used to remove ice from reinforcement or formwork.

E. Structural Repairs: Conform to Section 5.3.7 of ACI 301, *Specifications for Structural Concrete*, and to accepted procedures. Use the specified polymer repair mortars and epoxy adhesives. Proposed structural repairs need be submitted and approved prior to performing the repair.

F. Out-of-Form Concrete: Achieve the following finish as required by the Drawings, and by this Specification:

1. It is the intent of this Specification that all painted concrete and all exposed unpainted concrete be cleaned and dressed. Offsets shall be leveled and ground where necessary. In the event remedial action is required, it shall consist of cutting and patching. Causes for remedial action include rock pockets, honeycomb and spalling.
2. Clean shall mean the removal of all stains, laitance, transferred form oil, curing compound residue, and dirt from the surface in a manner which avoids staining, scarring or scratching the surface. Surfaces to be painted shall be cleaned ready to receive paint. Coordinate with Paint Section of this Specification.

    a. Apply cleaning/finishing solution in an even manner, break-to-break or joint-to-joint, on surface; allow to set before flushing with a pressure spray. Accomplish in a consistent manner throughout project.
    b. Treatment shall produce a "matte" surface by removing just the surface of the cement-paste skin.

3. Dress shall mean removal of all runs, splatters, fins and projections in a manner which avoids scarring, staining or scratching the surface.
4. Cutting and Patching shall mean the removal of unsound concrete, the wetting of the affected area, the application of a fine aggregate (#30 screen) and cement matrix matching the in-place concrete, to repair surface voids, honeycomb, rock pockets and spalling and the filling of tie holes, and the application and curing of the applied matrix. Patches shall be compacted thoroughly, screeded a little high, and finished flush with float or trowel. Patches shall be kept continuously moist for not less than 7 days.

G. Waterproofing and Chloride Ion Screen: Apply two coats to exposed concrete surfaces. Apply after cleaning, but prior to patching. Use airless spray and apply in strict accord to manufacturer's printed instructions. Apply consistently, working joint-to-joint and break-to-break.

H. Hole Cutting in Hardened Concrete:

1. It is the intent of these Specifications that hole cutting in hardened concrete will not be required. In the event that hole cutting is required, Contractor shall prepare appropriate details and procedures to accomplish the work and shall submit such details and procedures for acceptance. Cutting holes in the hardened concrete shall conform strictly to accepted details and procedures.

2. Prior to cutting holes, use a pachometer to locate all potentially affected reinforcing bars, conduits and pipes. Perform coring to avoid touching, cutting or damaging existing reinforcement. Cut reinforcement or embedded items only in accord with accepted details and procedures.

3.10 CURING, SEALING, HARDENING, DENSIFYING AND PROTECTION

A. Curing Formed Concrete: Conform to all applicable recommendations of ACI 305, ACI 306, and ACI 308.

1. Protect newly placed concrete against rain wash, low and high temperature effects and against premature loss of moisture.
2. Heating of concrete for curing in cold weather shall be by means and methods which do not cause carbonization effects in the concrete. Erect wind breaks and weather protection when and where required.

B. Wet Curing shall be for at least seven days at a temperature of at least 50°F (10°C) by continuous fog spray, immersion in water-tight covering of polyethylene to retain moisture or other accepted means. Do not use chemical curing on surfaces to be wet cured without specific acceptance.

C. Curing Compounds: Concrete may be cured with the specified curing compound providing the following requirements can by met:

1. All exposed interior slabs, not receiving a liquid densifier, and troweled slabs receiving mastic applied adhesives or “shake-on” hardeners shall be cured with the specified curing and sealing compound. Exterior slabs, sidewalks, curbs, and concrete not receiving a penetrating sealer, may be cured with the specified clear, non-yellowing curing and sealing compound. Maximum coverage shall be 400 ft^2/gallon on steel troweled surfaces and 300 ft^2/gallon on floated or broomed surfaces for the curing/sealing compound.
2. Strippable Curing Compound: All slabs, where indicated on the drawings or where approved, shall be cured with the specified strippable curing compound applied in strict accordance with the manufacturer’s recommendation.
3. Compounds which diminish bond or adhesion of finish materials, topping slabs, mortars and the like to concrete surfaces shall not be used or shall be totally removed prior to installation of affected Work. Contractor shall coordinate respective subcontractors and shall be solely responsible to determine and to assure compatibility of curing compound with both concrete and with overlying materials.

D. Polymer Repair Material for Leveling Low Spots shall be mixed, applied, cured and finished in strict accordance with the recommendations and instructions of the manufacturer.

E. Protection: Protect concrete Work from overloading and from defacement of any nature during construction operations.

F. Waterproofing and Chloride Ion Screen: Apply compound where specified and where shown in Architectural or Structural Drawings. Follow explicitly manufacturer's printed instructions.

3.11 FORM REMOVAL AND RESHORING

A. General: Forms shall be removed only after the supported concrete has achieved sufficient strength to allow the structure to support the weight of concrete plus all superimposed live loads and lateral forces including construction live loads to be placed thereon, without damage to the structure, overstress or excessive deflection. Contractor shall perform, at no expense to Owner, all tests and calculations needed to show when forms, formwork supports, shores and reshores can be removed without endangering the structure, subject to the following limitations:

1. Contractor shall be solely responsible for proper removal of forms and maintenance of safe working conditions for personnel.

B. Vertical forms may be removed 24 hours after concrete is placed contingent upon concrete having been maintained throughout that period at temperatures in excess of 50°F (10°C), upon achieving concrete strength adequate for stripping, and provisional on the implementation of effective curing procedures.

END OF SECTION 03 30 00

SECTION 00 31 26
EXISTING HAZARDOUS MATERIAL INFORMATION

PART 1 - GENERAL

1.01 EXISTING HAZARDOUS MATERIAL INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. An existing asbestos report for Westchester County Airport- Building 1 Rehabilitation, prepared by Omega Environmental Services, dated 10/28/2026, is available for viewing as part of the bid documents.

C. An existing lead report for Westchester County Airport- Building 1 Rehabilitation, prepared by Omega Environmental Services, dated 10/28/2026, is available for viewing as part of the bid documents.

D. An existing mold report for Westchester County Airport- Building 1 Rehabilitation, prepared by Omega Environmental Services, dated 10/28/2026, is available for viewing as part of the bid documents.

E. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.

END OF SECTION

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SECTION 04 01 10 - MASONRY CLEANING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Coordinate work of this Section with Section 099725 – Mineral-Based Coatings.

1.2 SUMMARY

A. Section includes cleaning the following:
   1. Masonry cleaning surfaces include brick, CMU, parging, and patched masonry on the exterior façade to prepare for the application of potassium silicate mineral paint finishes.
   2. Localized removal of existing paint or coatings where present.

B. Work includes:
   1. Removal of atmospheric soiling, dirt, organic deposits, and surface contaminants.
   2. Removal of loose, flaking, peeling, or incompatible existing paint from limited areas.
   3. Low-pressure water washing, steam cleaning, and non-ionic neutral-pH cleaning.

C. Prohibited Methods
   1. Cleaning methods or chemicals that leave residues incompatible with potassium silicate mineral paints are not permitted.

1.3 ALLOWANCES

A. Allowances for cleaning masonry are specified in Section 012100 "Allowances."

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to cleaning masonry including, but not limited to, the following:
      a. Verify masonry-cleaning equipment and facilities needed to make progress and avoid delays.
      b. Materials, material application, and sequencing.
      c. Cleaning program.
      d. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform masonry-cleaning work in the following sequence:
   1. Remove plant growth.
   2. Inspect for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
   3. Remove paint.
   4. Clean masonry surfaces.
   5. Do not apply any water repellent treatments prior to or after mineral paint installation.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to masonry repair Sections. Patch holes in mortar joints according to masonry repointing Sections.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Cleaners, neutral-pH gel cleaners, and proposed paint-removal materials.
   2. Water-spray equipment and pressure-control devices.
   3. Include material descriptions and application instructions.
   4. Include test data substantiating that products comply with requirements.

B. Cleaning Program:
   1. Written description of cleaning methods, pressures, dwell times, rinsing durations, protection measures, paint-removal methods, pH and conductivity testing procedures.

C. Preconstruction Testing Reports:
   1. Cleaning test results confirming compatibility with mineral paint adhesion requirements.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer of neutral-pH cleaning and paint-removal products.

1.8 QUALITY ASSURANCE

A. Manufacturer of neutral-pH cleaning agents and residue-free paint removal materials.: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

B. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, and equipment to be used; protection of surrounding materials; and control of runoff during operations. Include provisions for supervising worker performance and preventing damage.
   1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add a written description of such materials and methods, including evidence of successful use on comparable projects and demonstrations to show their effectiveness for this Project.

C. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Cleaning: Clean an area approximately 25 sq. ft. (2.3 sq. m) for each type of masonry and surface condition.
      a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
      b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.
   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.9 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage one or more chemical-cleaner and paint-remover manufacturers to perform preconstruction testing on masonry surfaces.
   1. Surface pH after cleaning shall be between 7.0 and 9.0.
   2. Rinse water conductivity shall match potable water ±10%.

3. Masonry moisture content before coating shall not exceed 12%.
4. Use test areas as indicated and representative of proposed materials and existing construction.
5. Propose changes to materials and methods to suit Project.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry-cleaning work to be performed according to product manufacturers' written instructions and specified requirements. Do not clean masonry under high winds or conditions causing overspray onto adjacent surfaces.

B. Clean masonry surfaces only when air temperature is 40 deg F (4 deg C) and above and is predicted to remain so for at least 48 hours after completion of cleaning.

PART 2 PRODUCTS

2.1 APPROVED CLEANING MATERIALS

A. Potable Water.

B. Neutral-pH Non-Ionic Cleaners:
1. pH range: 6.5–8.5.
2. Must rinse fully without residue.
3. Shall not impair vapor permeability.
4. Use for general soiling and mineral paint preparation.

C. Neutral-pH Gel Cleaners:
1. For isolated, stubborn staining; must be fully rinsable and residue-free.

D. Steam Cleaning Equipment:
1. Live steam at low pressure (< 90 psi at nozzle).

2.2 PAINT REMOVAL MATERIALS

A. Approved Materials:
1. Neutral-pH, non-ionic cleaners.
2. Neutral-pH gel systems specifically formulated for mineral-paint-compatible surface preparation.
3. Manual scraping tools (non-metallic where possible).

B. Prohibited Materials:
1. Acid-based cleaners (hydrofluoric acid, muriatic acid, ammonium bifluoride).
2. Alkaline paste strippers (sodium or potassium hydroxide).
3. Solvent-based gel or chemical paint removers.
4. Bleach, chlorine-based cleaners.
5. Phosphate-based cleaners including trisodium phosphate (TSP/TSPP).
6. Hydrophobic coatings, silicone materials, waxes, or film-forming products.
7. High-pressure washing above 300 psi.

PART 3 EXECUTION

3.1 PROTECTION

A. Protect adjacent surfaces, building materials, and occupants from exposure to cleaning solutions and rinse water. Prevent cleaning solutions and wash water from contacting people,

vehicles, landscaping, glazing, and building surfaces that could be harmed by moisture or residue.

B. Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.
   1. Provide temporary rain drainage during work to direct water away from building.

3.2 CLEANING MASONRY, GENERAL

A. Use lowest effective pressure and least aggressive methods.

B. Keep masonry damp during all cleaning operations to minimize absorption of contaminants.

C. Clean uniformly to avoid a patchy appearance.

D. Cleaning Sequence:
   1. Remove vegetation or biological growth.
   2. Rinse loose dirt and debris.
   3. Perform low-pressure water washing or steam cleaning.
   4. Apply non-ionic cleaner for stubborn soiling.
   5. Rinse thoroughly.
   6. Allow masonry to dry before repairs and coating.

3.3 WATER-BASED CLEANING METHODS

A. Cold Water Washing:
   1. Low-pressure spray: 100–250 psi maximum.
   2. Maintain nozzle at minimum 12-inch standoff distance.
   3. Wash from bottom up; rinse from top down.

B. Hot Water Washing:
   1. 100–200 psi maximum.
   2. Water temperature: 140–160°F.
   3. Follow with potable-water rinse.

C. Steam Cleaning:
   1. Pressure: 30–90 psi.
   2. Move nozzle continuously to prevent overheating.
   3. Rinse thoroughly.

3.4 NON-IONIC CLEANER APPLICATION

A. Pre-wet masonry thoroughly.

B. Apply cleaner by brush or low-pressure pump.

C. Allow dwell time per manufacturer instructions.

D. Agitate with natural or nylon bristle brushes.

E. Rinse until:
   1. pH 6.7–7.5.
   2. Conductivity matches potable water ±10%.
   3. No foaming visible.

F. Allow masonry to dry fully.

3.5 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking
    a. Remove only loose, peeling, or incompatible paint.
    b. Use manual scraping and low-pressure water.
    c. Where required, use neutral-pH, residue-free gel cleaners only.
    d. Do not use solvent-based or alkaline paint removers.
3.
    a. Carefully remove asphalt and tar with manual scraping and non-metallic tools.
    b. Where necessary, apply a neutral-pH gel cleaner approved for mineral-paint-compatible preparation.
    c. Do not use solvent-based, acidic, or alkaline removers.
    d. Rinse thoroughly.

3.6 PAINT REMOVAL - ISOLATED AREAS, SEE FACADE RESTORATION (FR) DRAWINGS

A. Remove all loose, peeling, flaking, or incompatible paint from localized areas.

B. Use manual scraping and low-pressure water.

C. Chemical paint removal shall use only neutral-pH, residue-free formulations approved for use under potassium silicate paint.

D. Perform adhesion test patches after cleaning where directed.

3.7 FIELD QUALITY CONTROL

A. Perform pH and conductivity testing of rinse water.

B. Additional rinsing shall be performed if residues persist.

C. Test masonry moisture content before painting.

3.8 FINAL CLEANING

A. Clean adjacent nonmasonry surfaces of spillage and debris using methods appropriate to the material being cleaned. Prevent detergents, solvents, or other incompatible cleaners from contacting masonry substrates to receive mineral paint.

B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

C. Remove masking materials, leaving no residues that could trap dirt.

D. Leave substrate free of contaminants that impair mineral paint adhesion.

END OF SECTION 04 01 10

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SECTION 04 01 20 - MASONRY RESTORATION

PART 1 - GENERAL

1.1 SCOPE

A. Provide all labor, materials, equipment, and services required for masonry restoration work as indicated on the Drawings and specified herein.

B. Work includes, but is not limited to:
1. Removal and replacement of deteriorated masonry units.
2. Repointing of existing masonry joints.
3. Installation of helical anchors.
4. Removal and replacement of lintels at openings.
5. Installation of precast concrete sills.
6. Selective demolition and reconstruction of existing masonry chimney.

C. Provide all incidental work required to complete the above, including cutting, patching, temporary support, and protection.

1.2 REFERENCES

A. Perform work in accordance with the latest editions of the following:
1. ASTM C67, C144, C150, C207, C216, C270.
2. TMS 602 / ACI 530.1 – Specification for Masonry Structures.
3. Brick Industry Association (BIA) Technical Notes.

B. Comply with all applicable codes and regulations of authorities having jurisdiction. Where conflicts occur, the more stringent requirements shall govern.

1.3 SUBMITTALS

A. Submit the following:
1. Product data for all materials.
2. Brick samples showing full range of color and texture.
3. Mortar samples for color matching.
4. Manufacturer data for helical anchors, lintels, and precast units.

B. Submit restoration procedures including sequencing, protection, and repair methods.

1.4 QUALITY ASSURANCE

A. Contractor shall have a minimum of three (3) projects of similar scope and complexity.

B. Materials shall be obtained from a single source for each type to ensure consistency.

C. Provide mockups for brick replacement and repointing as required to establish standard of workmanship.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials off ground and protect from moisture, contamination, and damage.

B. Handle masonry units to prevent chipping or breakage.

1.6 PROJECT CONDITIONS

A. Perform work only when ambient temperature is between 40°F and 90°F unless otherwise permitted.

B. Protect adjacent construction and finishes from damage and staining.

C. Provide temporary protection of work at the end of each workday and during inclement weather.

D. Verify existing conditions prior to commencing work. Notify Engineer of any discrepancies or unforeseen conditions.

E. Do not remove masonry elements that may affect stability without providing temporary support.

1.7 WARRANTY

A. Provide a one (1) year warranty for materials and workmanship.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide materials compatible with existing construction and suitable for intended service conditions.

B. All materials shall be new unless otherwise noted.

C. Match existing masonry in color, texture, size, and appearance unless otherwise indicated.

2.2 BRICK UNITS

A. Brick for replacement shall match existing in:
   1. Size
   2. Color range
   3. Texture
   4. Finish

B. Provide face brick conforming to ASTM C216, Grade SW.

C. Salvaged brick, where suitable, may be reused subject to acceptance.

2.3 MORTAR MATERIALS

A. Mortar shall conform to ASTM C270.

B. Mortar Type:
   - Type N, unless otherwise indicated.

C. Mortar for repointing shall:
   1. Match existing mortar in color and texture.
   2. Be compatible with existing masonry.
   3. Not exceed the strength of the existing mortar.

D. Use pre-blended mortar or controlled mix to ensure consistency.

2.4 HELICAL ANCHORS

A. Provide stainless steel helical anchors designed for masonry stabilization.

B. Acceptable manufacturers:
   1. Spira-Lok by Hohmann & Barnard
   2. Heli-Tie by Simpson Strong Tie
   3. Approved equal

C. Anchors shall be:
   1. Austenitic stainless steel (minimum Type 304; use Type 316 where exposed to weather).
   2. Sized and spaced as indicated on the Drawings.

D. Installation materials (grout or resin) shall be as recommended by manufacturer.

2.5 STEEL LINTELS (RELIEVING ANGLES)

A. Provide steel lintels (relieving angles) at masonry openings and other locations as indicated on the Drawings

B. Lintels shall include:
   1. Steel angles or other structural shapes supporting masonry over openings.

2. Shelf angles or relieving angles supporting masonry at floor lines or similar conditions.

C. Material:
1. Structural steel conforming to ASTM A36 unless otherwise noted.

D. Finish:
1. Hot-dip galvanized for exterior exposure.

2.6 PRECAST CONCRETE SILLS

A. Provide precast concrete sills conforming to ASTM C150 (cement) and applicable PCI standards.

B. Sills shall:
1. Match existing profiles unless otherwise indicated.
2. Include drip edges where exposed.
3. Be reinforced as required for handling and service.

C. Finish:
- Smooth, uniform appearance free of defects.

2.7 ACCESSORIES

A. Flashing, sealants, and miscellaneous materials required for a complete installation shall be compatible with adjacent materials.

B. Provide corrosion-resistant accessories for exterior conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine existing conditions prior to commencement of work.

B. Verify locations and extent of masonry deterioration.

C. Notify Engineer of conditions that differ from those indicated on the Drawings or that may affect performance of the Work.

D. Do not proceed with work in areas of unstable or unsupported masonry without providing temporary support.

3.2 PREPARATION

A. Protect adjacent construction, finishes, and surrounding areas from damage and staining.

B. Provide temporary bracing and shoring as required to maintain stability of masonry during removal and installation.

C. Carefully remove existing masonry as required to perform the Work without damaging adjacent materials to remain.

3.3 BRICK REPLACEMENT

A. Remove deteriorated or damaged brick units to the full depth of the unit.

B. Saw cut joints where required to avoid damage to adjacent masonry.

C. Clean existing surfaces of loose material prior to installation of new units.

D. Install replacement brick to match existing coursing, joint thickness, and appearance.

E. Tool joints to match existing profile.

3.4 REPOINTING

A. Remove existing mortar to a minimum depth of 2 times the joint width, but not less than 3/4 inch.

B. Use hand tools or low-impact methods. Do not use methods that damage masonry units.

C. Clean joints of dust and debris prior to repointing.

D. Pre-wet joints as required to prevent rapid drying.

E. Install mortar in layers, compacting fully into joints.

F. Tool joints to match existing profile and finish.

G. Protect repointed areas from rapid drying and adverse weather.

3.5 HELICAL ANCHOR INSTALLATION

A. Install anchors at locations and spacing indicated on the Drawings.

B. Drill holes in accordance with manufacturer’s requirements.

C. Clean drilled holes of dust and debris prior to installation.

D. Install anchors using manufacturer-recommended tools and procedures.

E. Provide minimum embedment as indicated on the Drawings.

F. Do not install anchors into deteriorated or unsound masonry. Notify Engineer if encountered.

G. Patch and repair installation locations to match adjacent masonry.

3.6 STEEL LINTELS (RELIEVING ANGLES)

A. Provide temporary support of masonry prior to removal of existing lintels.

B. Remove existing lintels as required without disturbing adjacent masonry to remain.

C. Install new lintels level and properly bearing as indicated.

D. Provide corrosion protection as specified.

E. Restore masonry above openings to match existing conditions.

3.7 PRECAST CONCRETE SILLS

A. Remove existing sills without damaging adjacent masonry.

B. Prepare bearing surfaces to provide full and uniform support.

C. Install sills level and properly aligned.

D. Provide proper slope for drainage.

E. Seal joints between sill and adjacent masonry as required.

3.8 CHIMNEY WORK

A. Perform selective demolition and reconstruction of chimney as indicated on the Drawings.

B. Provide temporary support as required during demolition.

C. Reconstruct masonry to match existing in material, coursing, and appearance.

D. Coordinate with Drawings for extent and configuration of reconstruction.

3.9 CLEANING

A. Clean exposed masonry surfaces upon completion of work.

B. Do not use cleaning methods that damage masonry.

C. Remove debris and leave site in clean condition.

END OF SECTION

SECTION 04 01 20.64 - BRICK MASONRY REPOINTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Repointing joints with mortar.
   2. Repointing joints with sealant.

1.3 ALLOWANCES

A. Allowances for repointing brick masonry are specified in Section 012100 "Allowances."

B. Preconstruction testing is part of testing and inspecting allowance.

C. Repointing masonry is part of brick masonry repointing allowance.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
   1. Unit prices apply to authorized work covered by quantity allowances.
   2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi (2757.90 kPa) ; 4 to 6 gpm (0.25 to 0.4 L/s).

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to repointing brick masonry including, but not limited to, the following:
      a. Verify brick masonry repointing specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
      b. Materials, material application, sequencing, tolerances, and required clearances.
      c. Quality-control program.
      d. Coordination with building occupants.

1.7 SEQUENCING AND SCHEDULING

A. Order sand and gray portland cement for pointing mortar immediately after approval of Samples. Take delivery of and store at Project site enough quantity to complete Project.

B. Work Sequence: Perform brick masonry repointing work in the following sequence, which includes work specified in this and other Sections:
   1. Remove plant growth.
   2. Inspect masonry for open mortar joints and permanently or temporarily point them before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
   3. Remove paint.
   4. Clean masonry.

5. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
6. Repair masonry, including replacing existing masonry with new masonry materials.
7. Rake out mortar from joints to be repointed.
8. Point mortar and sealant joints.
9. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
10. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

C. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to Section 040120.63 "Brick Masonry Repair." Patch holes in mortar joints according to "Repointing Masonry" Article.

1.8 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

B. Shop Drawings:
1. Include plans, elevations, sections, and locations of repointing work on the structure.
2. Show provisions for expansion joints or other sealant joints.
3. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

C. Samples for Initial Selection: For the following:
1. Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches (152.4 mm) long by 1/4 inch (6.35 mm) wide, set in aluminum or plastic channels.
a. Have each set contain a close color range of at least three samples of different mixes of colored sands and cements that produce a mortar matching existing, cleaned mortar when cured and dry.
b. Submit with precise measurements on ingredients, proportions, gradations, and source of colored sands from which each Sample was made.
2. Sand Type Used for Pointing Mortar: Minimum 8 oz. (240 mL) of each in plastic screw-top jars.
3. Sealant materials.
4. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following:
1. Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches (152.4 mm) long by 1/4 inch (6.35 mm) wide, set in aluminum or plastic channels.
a. Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.
2. Sealant materials.
3. Accessories: Each type of accessory and miscellaneous support.

1.9 INFORMATIONAL SUBMITTALS

A. Qualification Data: For brick masonry repointing specialist.

B. Preconstruction Test Reports: For existing masonry units and mortar.

C. Quality-control program.

1.10 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

1. Field Supervision: Brick masonry repointing specialist firms shall maintain experienced full-time supervisors on Project site during times that brick masonry repointing work is in progress.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas as directed by Architect in field, each approximately 36 inches (914.4 mm) high by 48 inches (1219.2 mm) wide for each type of repointing required, and repoint one of the areas.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.12 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repointing work to be performed according to product manufacturers' written instructions and specified requirements.

B. Temperature Limits, General: Repoint mortar joints only when air temperature is between 40 and 90 deg F (4 and 32 deg C) and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

C. Cold-Weather Requirements: Comply with the following procedures for mortar-joint pointing unless otherwise indicated:
   1. When air temperature is below 40 deg F (4 deg C), heat mortar ingredients and existing masonry walls to produce temperatures between 40 and 120 deg F (4 and 49 deg C).
   2. When mean daily air temperature is below 40 deg F (4 deg C), provide enclosure and heat to maintain temperatures above 32 deg F (0 deg C) within the enclosure for seven days after pointing.

D. Hot-Weather Requirements: Protect mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F (32 deg C) and above unless otherwise indicated.

PART 2 PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain each type of material for repointing brick masonry (cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.
   1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

D. Mortar Cement: ASTM C 1329/C 1329M.

E. Mortar Sand: ASTM C144.
   1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
   2. Color: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.3 ACCESSORY MATERIALS

A. Sealant Materials:
   1. Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics indicated below and according to applicable requirements in Section 079200 "Joint Sealants."
      a. Type: Single-component, nonsag urethane sealant.

2. Colors: Provide colors of exposed sealants to match colors of mortar adjoining installed sealant unless otherwise indicated.
3. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the No. 100 sieve.

B. Joint-Sealant Backing:
1. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by sealant manufacturer for preventing sealant from adhering to rigid, inflexible, joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

C. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

D. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:
1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.4 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.
1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.
1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required.

2. Pointing Mortar by Type: ASTM C270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.
3. Pointing Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.

PART 3 EXECUTION

3.1 PROTECTION

A. Prevent mortar from staining face of surrounding masonry and other surfaces.
   1. Cover sills, ledges, and other projecting items to protect them from mortar droppings.
   2. Keep wall area wet below pointing work to discourage mortar from adhering.
   3. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

B. Remove gutters and downspouts and associated hardware adjacent to masonry and store during masonry repointing. Reinstall when repointing is complete.
   1. Provide temporary rain drainage during work to direct water away from building.

3.2 MASONRY REPOINTING, GENERAL

A. Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 50 feet (1524 cm) away by Architect.

3.3 REPOINTING MASONRY

A. Rake out and repoint joints to the following extent:
   1. All joints in areas indicated.
   2. Joints indicated as sealant-filled joints.
   3. Joints at locations of the following defects:
      a. Holes and missing mortar.
      b. Cracks that can be penetrated 1/4 inch (6.35 mm) or more by a knife blade 0.027 inch (0.69 mm) thick.
      c. Cracks 1/16 inch (1.59 mm) or more in width and of any depth.
      d. Hollow-sounding joints when tapped by metal object.
      e. Eroded surfaces 1/4 inch (6.35 mm) or more deep.
      f. Deterioration to point that mortar can be easily removed by hand, without tools.
      g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:
   1. Remove mortar from joints to depth of joint width plus 1/8 inch (3.18 mm), but not less than 1/2 inch (12.7 mm) or not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches (50.8 mm) deep; consult Architect for direction.
   2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
   3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:
   1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
   2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch (9.52 mm) until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
   3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch (9.52 mm). Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
   4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
   5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
   6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Pointing with Sealant: Comply with Section 079200 "Joint Sealants." and as follows:
   1. After raking out, keep joints dry and free of mortar and debris.
   2. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
   3. Fill sealant joints with specified joint sealant.
      a. Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
      b. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
      c. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:
         1) Fill joints to a depth equal to joint width, but not more than 1/2 inch (12.7 mm) deep or less than 1/4 inch (6.35 mm) deep.
      d. Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.
      e. Sanded Joints: Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Lightly retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.

f. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.4 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water applied by low-pressure spray.
   1. Do not use metal scrapers or brushes.
   2. Do not use acidic or alkaline cleaners.

B. Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

C. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

D. Remove masking materials, leaving no residues that could trap dirt.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

C. Notify inspectors in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until inspectors have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 04 01 20.64

SECTION 04 05 11 - MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mortar for masonry.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 - Unit Masonry: Installation of mortar and grout.

1.3 REFERENCE STANDARDS

A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.

B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2025.

C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.

D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.

E. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2024.

F. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

G. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

H. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

I. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.

J. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.7 FIELD CONDITIONS

A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT APPLICATIONS

A. At Contractor's option, mortar and grout may be field-mixed from packaged dry materials, made from factory premixed dry materials with addition of water only, or ready-mixed.

B. Mortar Mix Designs: ASTM C270, Property Specification.

1. Masonry below grade and in contact with earth: Type S.
2. Exterior, Loadbearing Masonry: Type N.

3. Exterior, Non-loadbearing Masonry: Type N.

C. Grout Mix Designs: See Structural Drawings

2.2 MATERIALS

A. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
   1. Type: Type N.
   2. Color: match existing

B. Portland Cement: ASTM C150/C150M.
   1. Type: Type I - Normal; ASTM C150/C150M.
   2. Color: Standard gray.

C. Masonry Cement: ASTM C91/C91M.
   1. Type: Type N; ASTM C91/C91M.

D. Hydrated Lime: ASTM C207, Type S.

E. Quicklime: ASTM C5, non-hydraulic type.

F. Mortar Aggregate: ASTM C144.

G. Grout Aggregate: ASTM C404.

H. Water: Clean and potable.

I. Bonding Agent: Latex type.

2.3 MORTAR MIXING

A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.

B. Maintain sand uniformly damp immediately before the mixing process.

C. Do not use anti-freeze compounds to lower the freezing point of mortar.

D. If water is lost by evaporation, re-temper only within two hours of mixing.

2.4 GROUT MIXING

A. Mix grout in accordance with ASTM C94/C94M.

B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

PART 3 EXECUTION

3.1 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

B. Plug clean-out holes for grouted masonry with brick masonry units. Brace masonry to resist wet grout pressure.

3.2 INSTALLATION

A. Install mortar to requirements of section(s) in which masonry is specified.

B. Work grout into masonry cores and cavities to eliminate voids.

3.3 FIELD QUALITY CONTROL

A. An independent testing agency will perform field tests, in accordance with provisions of Section 01 40 00 - Quality Requirements.

END OF SECTION 04 05 11

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SECTION 04 20 00 - UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete Masonry Unit partitions.

B. Brick façade restoration, including:
   1. Selective brick removal and replacement.
   2. Selective demolition of damaged brick units.
   3. Installation of new brick to match existing.
   4. Repointing of existing brick masonry.
   5. Cleaning of existing and new masonry.

C. Helical masonry anchors for stabilization of existing brick wythe to CMU backup: refer to FR drawings

D. Steel Lintel removal and replacement

E. Precast concrete sill removal and replacement.

F. Mortar and grout.

G. Masonry accessories, reinforcement, anchors, ties, and flashings.

1.2 RELATED REQUIREMENTS

A. Section 04 05 11 - Masonry Mortaring and Grouting.

B. 047200 - Cast Stone Masonry

C. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

D. Section 06100 - Rough Carpentry

E. Section 055000 - Metal Fabrications

1.3 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

C. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction; 2022.

D. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.

E. ASTM C129 - Standard Specification for Dry-Cast Nonloadbearing Concrete Masonry Units; 2025.

F. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale); 2022.

G. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

H. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers, Architect, Structural Engineer, Owner.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.

C. Helical Anchor Submittals: Embedment, torque values, testing standards.

D. Samples: Submit four samples of facing brick units to illustrate color, texture, and extremes of color range.

E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

G. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 60 00 - Product Requirements, for additional provisions.

I. Mockups
   1. Brick replacement mockup, minimum 4 ft by 4 ft.
   2. Repointing mortar mockup, minimum 2 ft by 2 ft.

1.6 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Mason shall have minimum 10 years façade restoration experience.

C. Fire Rated Assemblies: Comply with applicable code for _____ requirements for fire rated masonry construction.

D. Anchor pull tests: see Drawings

E. Brick Matching: Required for size, texture, and color.

F. Mortar shall match original in color, aggregate size, tooling profile, and compressive strength compatible with existing mass masonry.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depths as indicated on drawings for specific locations.

2. Load-Bearing Units: ASTM C90, normal weight.
   a. Hollow block, as indicated.
3. Nonloadbearing Units: ASTM C129.
   a. Hollow block, as indicated.

2.2 BRICK UNITS

A. Manufacturers, Subject to matching existing color/texture:
   1. Belden Brick: www.beldenbrick.com/#sle.
   2. Endicott Clay Products Co; Face Brick - FBX: www.endicott.com/#sle.
   3. General Shale Brick: www.generalshale.com/#sle.
   4. Meridian Brick LLC; Athens Architectural Series: www.meridianbrick.com/#sle.
   5. Yankee Hill Brick Mfg. Co: www.yankeehillbrick.com/#sle.

B. Hollow Facing and Building Brick: ASTM C652, Grade SW; Type HBS; Class H40V.
   1. Color and texture to match existing.
   2. Nominal size: to match existing.

2.3 MORTAR AND GROUT MATERIALS

A. Mortar and Grout: As specified in Section 04 05 11.

2.4 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
   1. 3GEN Masonry Products; _____: www.3genmp.com.
   2. Blok-Lok Limited; _____: www.blok-lok.com/#sle.
   3. FERO Corporation; FERO FAST Soffit Concealer: www.ferocorp.com/#sle.
   4. Hohmann & Barnard, Inc; X-Seal Anchor: www.h-b.com/#sle.
   5. TruFast Walls, a division of Altenloh, Brinck & Co. US, Inc; Thermal-Grip MVA: www.trufastwalls.com/#sle.
   6. WIRE-BOND: www.wirebond.com/#sle.

B. Strap Anchors: Bent steel shapes, 1-1/2 inch (38 mm) width, 0.105 inch (2.7 mm) thick, 24 inch (610 mm) length, with 1-1/2 inch (38 mm) long, 90 degree bend at each end to form a U or Z shape or with cross pins, hot dip galvanized to ASTM A153/A153M Class B.

C. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
   1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
   2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
   3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

D. Helical Anchors: Stainless steel, torque-controlled installation, see FR drawings.
   1. Installation: Torque-controlled installation only; hammer-set or expansion anchors not permitted unless shown on drawings.

2.5 FLASHINGS

A. Metal Flashing Materials:
   1. Copper Flashing: ASTM B370, 060 soft annealed; 20 oz/sq ft (0.7 mm) thick; natural finish.

2. Stainless Steel Flashing: ASTM A666/A666M, Type 304, soft temper; 26 gauge, 0.0187 inch (0.48 mm) thick; finish 2B to 2D.

B. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.

2.6 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.7 PRECAST SILLS

A. See 047200 - Cast Stone Masonry

B. Coordinate sill installation with flashing and sealant requirements in this section.

C. Coordinate sill installation with sill flashing shown on drawings and specified here-in.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 SELECTIVE BRICK REMOVAL

A. Remove only designated brick per drawings

B. Remove full bricks only at perimeter.

C. Hand tools for mortar removal (1/8 in. max disc thickness).

D. Clean cavities.

3.3 BRICK REPLACEMENT

A. Refer to drawings

B. Match coursing, bed thickness, tooling.

C. Blend new brick with existing.

D. Full head and bed joints.

E. Tool joints to match existing profile.

3.4 REPOINTING

A. Refer to drawings

B. Remove mortar to minimum 2.5× joint width.

C. Dampen joints.

D. Tool to match existing.

E. Mortar shall be packed in layers not exceeding 3/8 inch per lift.

3.5 HELICAL ANCHOR INSTALLATION

A. Drill per manufacturer's instructions.

B. Install to required torque.

C. Perform verification tests.

D. Patch holes with matching mortar.

3.6 PRECAST SILL REPLACEMENT

A. See drawings

B. Remove existing sills.

C. Install new sills on mortar bed.

D. Flash below sill.

E. Seal perimeter.

3.7 CMU INTERIOR PARTITIONS

A. Build to lines indicated.

B. Install joint reinforcement and vertical bars.

C. Tool joints smooth.

3.8 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.9 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:

D. Brick Units:

1. Bond, Coursing and Joints: Match Existing

3.10 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.

3.11 LINTELS

A. See Drawings

B. Provide temporary shoring.

C. Remove existing full bricks and lintels.

D. Install new galvanized lintels.Integrate flashing and weeps.

3.12 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.13 PARGING

A. Dampen masonry walls prior to parging.

B. Scarify each parging coat to ensure full bond to subsequent coat.

C. Parge masonry walls in two uniform coats of mortar to a total thickness of 3/4 inch (19 mm).

D. Steel trowel surface smooth and flat with a maximum surface variation of 1/8 inch per foot (1 mm/m).

E. Strike top edge of parging at 45 degrees.

3.14 CLEANING

A. Remove excess mortar and mortar droppings.

B. Clean soiled surfaces with cleaning solution.

3.15 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION 04 20 00

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Architectural cast stone.
   1. Cast stone units matching the existing precast concrete trim, including but not limited to:
      a. Window sills
      b. Parapet / roof coping units
      c. Other architectural trim elements where indicated in the drawings
   2. Accessories, anchorage, mortar, sealers, and installation requirements.

1.2 RELATED REQUIREMENTS

A. Section 04 05 11 - Masonry Mortaring and Grouting: Mortar for setting cast stone.

B. Section 04 20 00 - Unit Masonry: Installation of cast stone in conjunction with masonry.

C. Section 07 92 00 - Joint Sealants: Sealing joints indicated to be left open for sealant.

1.3 REFERENCE STANDARDS

A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).

B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.

C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2024.

D. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2025.

E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.

F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

G. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.

H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.

I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.

J. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023, with Editorial Revision (2024).

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Test results of cast stone components made previously by the manufacturer.

C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers. Show mortar bed interface and jointing layout coordinated with masonry.

D. Mix design, cement type, aggregates, integral water-repellent product.

E. Reinforcing details for each sill and coping type.

F. Mortar Color Selection Samples to match existing.

G. Field-applied sealer product data

H. Cast Stone Samples:
   1. Minimum 12" length cast stone samples to match existing and showing:
      a. Color
      b. Texture
      c. Finish
      d. Aggregate exposure
      e. Water-repellent inclusion

I. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. A firm with a minimum of 5 years experience producing cast stone of types required for project.
   2. Current producer member of the Cast Stone Institute or the Architectural Precast Association.
   3. Manufacturer's production facility currently holds a Plant Certification from the Cast Stone Institute or the Architectural Precast Association.
   4. Facilities equipped to provide reinforced cast stone to ASTM C1364.
   5. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.

B. Installer Qualifications: Masonry contractor experienced in installing cast stone or precast trim with combined mortar-setting and dowel anchorage systems.

C. Preinstallation Conference:
   1. Include review of anchorage, dowel locations, reinforcing, lifting/handling procedures, mortar bedding, sealant joints, and airport-site logistics.

1.6 MOCK-UPS

A. Provide full size cast stone components for installation in mock-up of exterior wall.

B. At least one full sill unit installed in the mockup wall assembly.

C. Accepted mockup establishes aesthetic standard.

D. See Section 01 40 00 - Quality Requirements for additional requirements.

E. Remove mock-up not incorporated into the work and dispose of debris.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.

B. Number each piece individually to match shop drawings and schedule.

C. Store cast stone components and installation materials in accordance with manufacturer's instructions.

D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.

E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.

F. Store mortar materials where contamination can be avoided.

G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

H. Prevent loose debris, straps, wrapping, pallet fragments, or chips from becoming Foreign Object Debris (FOD) per Airport Operations requirements.

1.8 WARRANTY

A. Manufacturer shall provide a minimum 2-year warranty covering manufacturing d}efects, spalling, delamination, and improper reinforcing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Continental Cast Stone
   2. StoneCast, Inc.
   3. Architectural Cast Stone Producers Association members
   4. Or approved equal meeting ASTM C1364

2.2 ARCHITECTURAL CAST STONE

A. Wet-Cast Cast Stone conforming to:
   1. ASTM C1364 physical properties
   2. Compressive strength: 6,500 psi minimum
   3. Absorption: 6% maximum
   4. Freeze–thaw: 300 cycles minimum durability
   5. Air entrainment: 5–7% for exterior units
   6. Maximum water/cement ratio: 0.36

B. Integral Water-Repellent Admixture:
   1. Incorporate Euclid, Grace, or BASF integral water repellent at manufacturer’s recommended dosage.

C. Reinforcement:
   1. Provide mild steel reinforcement in all sill and coping units.
   2. Minimum reinforcing: One #3 longitudinal bar unless structural conditions require more.
   3. Reinforcing cover per ACI 318 for exposure to severe weather and de-icing chemicals.

D. Anchorage / Dowel Components:
   1. Stainless steel dowels, Type 304 or 316.
   2. Sizes as required to match existing structural detail and withstand handling loads.

E. Cast Stone:
   1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
   2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
   3. Surface Texture: to match existing rough-grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).

4. Color: Match existing trim units as established by mockup.
5. Remove cement film from exposed surfaces before packaging for shipment.

F. Shapes: Provide shapes indicated on drawings.
1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
2. Unless otherwise indicated on drawings, provide:
a. Wash or slope of 1:12 on exterior horizontal surfaces.
b. Drips on projecting components, wherever possible.
c. Raised fillets at back of sills and at ends to be built in.

G. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

2.3 MATERIALS

A. Portland Cement: ASTM C150/C150M.
1. For Mortar: Type I or II, except Type III may be used in cold weather.

B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.

C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

D. Admixtures: ASTM C494/C494M.

E. Water: Potable.

F. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed bars, galvanized.
1. Galvanized in accordance with ASTM A767/A767M, Class I.

G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.

H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.

I. Mortar: Portland cement-lime, as specified in Section 04 05 11 ; do not use masonry cement.

J. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

K. Field-Applied Water Repellent: 40% silane or siloxane breathable sealer, VOC compliant, used on all exposed cast stone surfaces after installation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.

B. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 20 00.

B. Mechanically anchor cast stone units indicated; set remainder in mortar.

C. Setting:
1. Drench cast stone components with clear, running water immediately before installation.
2. Set units in a full bed of mortar unless otherwise indicated.
3. Fill vertical joints with mortar.
4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

3.3 TOLERANCES

A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
1. Rake mortar joints 3/4 inch (19 mm) for pointing.
2. Remove excess mortar from face of stone before pointing joints.
3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
4. Leave the following joints open for sealant:
a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
b. Joints in projecting units.
c. Joints between rigidly anchored units, including soffits, panels, and column covers.
d. Joints below lugged sills and stair treads.
e. Joints below ledge and relieving angles.
f. Joints labeled "expansion joint".

B. Installation Tolerances:
1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.
3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.4 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).

B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.

C. Repair methods and results subject to Architect 's approval.

3.5 CLEANING

A. Keep cast stone components clean as work progresses.

3.6 PROTECTION

A. Protect completed work from damage.

B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

END OF SECTION 04 72 00

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SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS

A. Comply with Contract Documents: All Work of this Section shall comply with the requirements of the Conditions of the Contract (General, Supplementary, and Special), with all Sections of Division 1 - General Requirements, with this Section of the Specification, with the Drawings and with all other Contract Documents.

B. Flammable Materials or materials not conforming in all respects to the fire resistive and fire safety provisions of governing regulations shall not be left in place in the Work.

C. Disposition of and Exposure to Materials: Contractor remains fully responsible for the disposition of and for the exposure to persons of all materials, whether or not hazardous.

D. Volatile Organic Compounds (VOC): Contractor remains fully responsible for the supplying of products and materials complying to the VOC limitations set forth by the *Building Code* and by governing agencies having jurisdiction.

E. Metrication: For convenience of Contractor, S.I. units are provided in this Specification. In the event of conflict between the basic unit and the S.I. unit, the basic unit shall prevail.

1.2 WORK INCLUDED

A. Scope: Contractor shall examine all of the Contract Documents for the extent of the Work of this Section of the Specifications. That Work shall include all labor, materials, devices, plants, tools, equipment, appliances and services necessary to complete the Work as shown in the Structural Drawings, as specified herein, as required by job conditions, and as required by governing authorities having jurisdiction, including but not limited to the following:

1. Base plates and bearing plates.
2. Furnishing but not installing embedded items such as anchor bolts and the like.
3. Angles, plates and the like to support metal deck.
4. Galvanizing, shop and field painting, and field touch-up.
5. Field surveying of as-erected structural steel and re-plumbing as required.
6. Shop applied stud shear connectors.
7. Shop applied concrete anchors.
8. Bracing, guying and plumbing of structural steelwork.
9. Protection of Work of this Section.
10. Protection of other Work from activities under this Section.
11. Determination of detail dimensions, member locations and the like from information provided in the Architectural and Structural Drawings and/or as provided by Architect.
12. Connection design by Contractor's Professional Engineer.

13. Review and development of Construction Sequence as proposed by or implied from the Contract Documents.
14. Review of Contractor-prepared Construction Sequence by Contractor's Professional Engineer.
15. Shop Drawings, samples and submittals.
16. Provisions for other Work, including holes through structural steel for other Work.
17. Cooperate with Owner, with Construction Manager, with Architect and with Testing Agency in all aspects of quality assurance and in all other activities related to the Work of this Section.
18. The safe handling and disposition of materials related to the Work of this Section, whether or not hazardous.
19. All other labor, materials and Work given in the Drawings, specified herein or required to make the structural steel Work complete.

B. Work Installed as Specified Elsewhere: Contractor shall examine all of the Contract Documents for the extent of Work to be installed under this Section.

1.3 RELATED WORK

A. Related Work Specified Elsewhere, Amplified Elsewhere or Included in Other Contracts:

1. Submittals: Section 01 30 00.
2. Owner's shop and field testing and inspection of Work by Testing Agency engaged and paid for by Owner: Section 01 40 00.
3. Installing anchor bolts and embedded plates in concrete: Section 03 30 00.
4. Non-shrink grouting for structural steel base plates: Section 03 30 00.
5. Cast-In-Place Concrete: Section 03 30 00.
6. Miscellaneous Metals: Section 05 50 00.

1.4 APPLICABLE CODES AND STANDARDS

A. General: Except as modified or voided by requirements specified herein or by details or notes included in the Drawings, Work specified under this Section shall conform to all applicable provisions of the codes, specifications, standards and other reference documents cited in this Specification and/or noted in the Drawings. In the event of conflict between provisions of stipulated reference documents and of this Specification or of another stipulated reference document, Contractor shall report in writing the details of the conflict. Decisions regarding applicability of provisions of this Specification and provisions of reference documents applied independently or as supplemented, modified or voided, will be provided in writing and shall be final. Resolution of conflicts shall conform to the procedures set forth in the General Conditions of the Contract.

B. Codes: All Work under this Section shall conform to the requirements of New York City Building Code, hereinafter referred to as *Building Code*, and to the regulations of all governmental authorities having jurisdiction. Where more stringent, the following codes, standards and specifications, latest edition and revision, shall apply to the Work, all as modified herein or by *Building Code*:

1. *Specification for Structural Steel Buildings, AISC 360,* by the American Institute of Steel Construction (*AISC*).
2. *Code of Standard Practice for Steel Buildings and Bridges*, published by the American Institute of Steel Construction (*AISC Code*). Sections 6, 7, 8 and 10, only, shall apply to the Work, except as modified in this Specification; the remainder being specifically excluded.
3. *Structural Welding Code - Steel*, AWS D1.1.
4. *Specification for Structural Joi*nts Using ASTM A325 or A490 Bolts, approved by the Research Council on Structural Connections of the Engineering Foundation (RCSC Specification). Endorsed by the American Institute of Steel Construction, and the Industrial Fasteners Institute.
5. *Standard Symbols for Welding, Brazing, and Nondestructive Examination*, AAWS A2.4.

C. Reference Documents: To the extent that the best quality of Work is provided, Work shall conform to the examples, procedures and recommendations listed below, latest edition and revision. Where provisions of the *Building Code,* this Specification, or codes, standards, manuals and specifications cited by this Specification are more restrictive or provide increased quality, the combination of provisions, examples, procedures and recommendations which provide both best quality and *Building Code* conformance shall control the Work.

1. *Steel Construction Manual*, Fifteenth Edition, by American Institute of Steel Construction (*AISC Manual*). Contractor shall keep at least one full copy in the field office at all times.
2. *Detailing for Steel Construction*, by the American Institute of Steel Construction.
3. SSPC *Steel Structures Painting Manual*, *Volume 1, and Volume 2*, by Steel Structures Painting Council.
4. *Guide for the Visual Inspection of Welds, ANSI/AWS B1.11.*
5. *Qualification of Post-Installed Mechanical Anchors in Concrete*, ACI 355.2.
6. *Qualification of Post-Installed Adhesive Anchors in Concrete*, ACI 355.4

D. ASTM (American Society for Testing and Materials) Specifications cited in this Specification or cited in reference documents shall be the year of adoption or tentative adoption and revision listed in the latest edition of the Annual Book of ASTM Standards*, Index*, except that, should a specific year of adoption or revision be cited by the Contract Documents, by *Building Code*, or be proposed by Contractor and accepted by Structural Engineer, that edition shall apply to and shall control the Work.

E. Conformance to Regulations: Work of this Section shall conform to all applicable federal, state, and local laws and regulations.

1.5 SUBMITTALS

A. General: Submit samples, Shop Drawings, product data, test reports and data, manufacturer's names, certifications, procedures, methodology statements, and the like as stipulated. With the exception of samples, submittals shall be in PDF format and transmitted electronically, unless otherwise accepted.

1. Review of Contractor's submittals is only for the limited purpose of the examination of submittals for conformance with the design concept of the project and to assist Contractor in ascertaining that the information given in the submittals conforms to the requirements of the Contract Documents.
2. Review of Contractor's submittals is not conducted for the purpose of determining the accuracy or the completeness of the submittal, for dimensions or quantities, or for installation or performance of the system or the piece(s) being submitted.
3. Submittals by Contractor implies that Contractor has checked the submittal with care. Where by error or other cause, Contractor's check has not been accomplished, Contractor shall not rely on review but shall first check and shall then resubmit such material as though the submittal had been rejected.

B. Samples: Submit for acceptance prior to purchase, fabrication or delivery:

1. Post-installed anchors; each type.
2. Substitute Products, Materials and Fixtures, where requested by Contractor, shall be accompanied by sample(s) of an acceptable size.
3. Other Products, Materials and Fixtures, where requested in writing.

C. Shop Drawings:

1. General: Shop Drawings, as the term is used under this Section, are not Contract Documents, but are intended to demonstrate the way that Contractor intends to conform to the requirements provided in the Contract Documents. Contractor may wish to use these same drawings as a part of the instructions given to craftpersons for the accomplishment of the Work.
2. Best Standards: Shop Drawings furnished under this Section shall conform to the best standards of the construction industry and shall be not less complete than indicated by the applicable procedures shown in AISC's *Detailing for Steel Construction*. Shop Drawings shall be prepared by and under the supervision of competent engineering personnel. Prior to preparation, Contractor shall retain a Professional Engineer, accepted by Construction Manager and by Structural Engineer and registered in the State of this project, to supervise the preparation of and to check each Shop Drawing for compliance with the requirements of the Contract Documents.

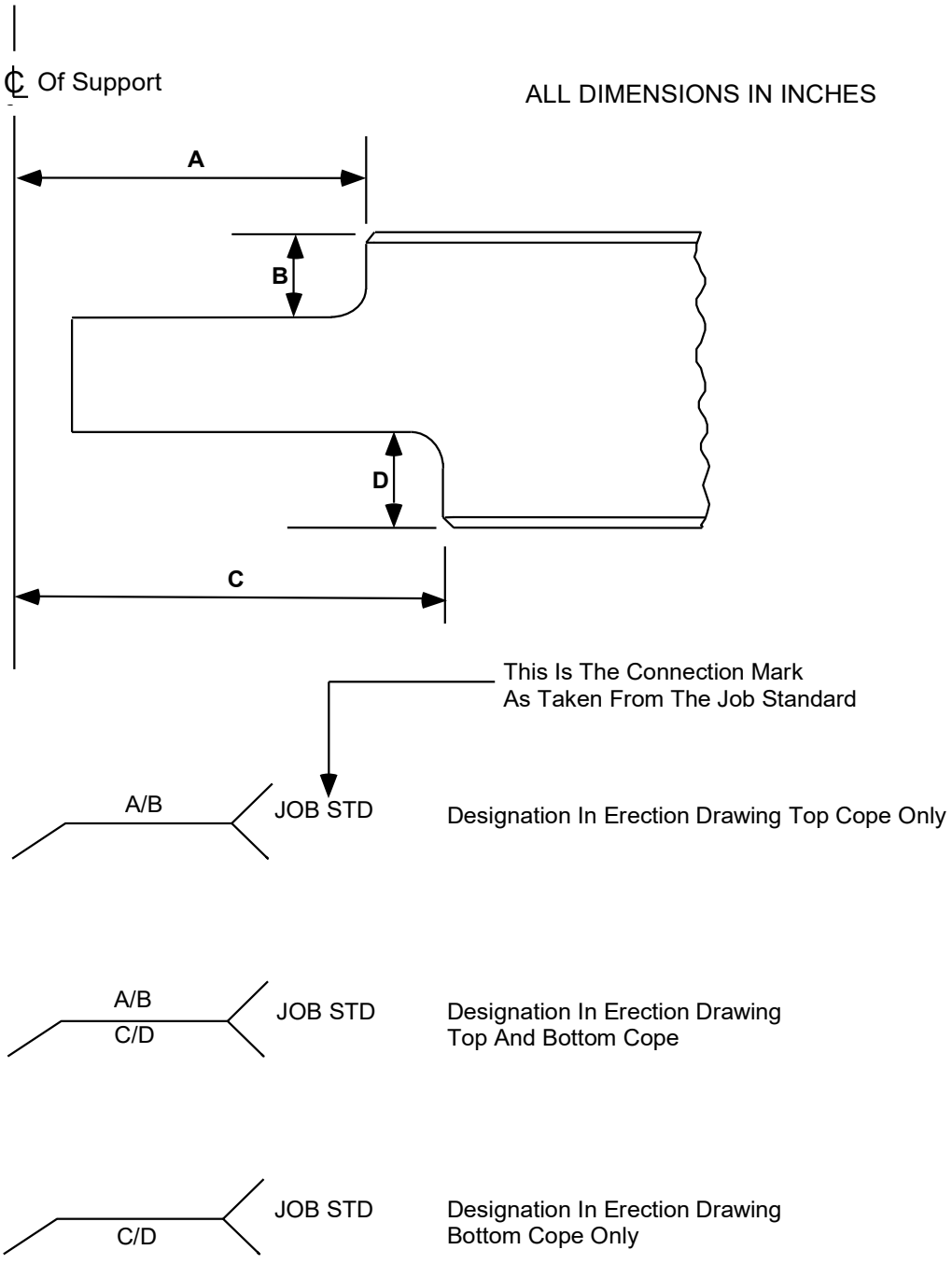
    a. Shop Drawings shall be prepared under the direction of personnel completely familiar with Architectural, Mechanical, Plumbing, Electrical and other building trades Drawings
    b. Contractor shall provide detailer with tool clearances needed for both shop and field bolted connections.

3. Shop Drawings shall be submitted for review and to governing agencies having jurisdiction for acceptance in accordance with the provisions of the Contract Documents.
4. Shop Drawings shall be submitted in parts as follows:

    a. Job Standards
    b. Erection Drawings
    c. Index Sheets
    d. Piece Drawings
    e. Field Work Drawings

5. Job Standards are intended to assist Contractor by developing the set of repetitive details, whether shop or field, welded or bolted. Job Standards shall be accepted prior to the commencing of dependent Work for Piece Drawings. Provide supporting calculations on request. The "name" or designation of the appropriate Job Standard connection shall be given in the Erection Drawings for each piece carrying a Job Standard connection. Job Standards are a vital and an essential part of the overall Shop Drawing submittal.
6. Erection Drawings shall show clearly the size, grade and location of each member. To the extent desired by Contractor, the Structural Drawings may be used for this purpose. In addition to basic information given in the Structural Drawings, Erection Drawings shall contain (for each piece) the erection mark, the job standard connection mark, beam copes and blocks as given in the next page of this Specification, the location, size and reinforcing of beam penetrations, the elevation of top of beam, (where sloped) the elevation of the work point of both ends, camber, and such projecting elements as may be of concern to Architect.

   Additionally:
   a. Show each field connection complete with data and details necessary for assembling the structure. Direct special attention to the possible need for special guying, bracing or shoring to prevent deformation of existing or new structure due to stresses caused by erection procedures and equipment, by construction loadings and by forces imposed by natural phenomena.
   b. Prepare anchor bolt, base plate and embedded plate Erection Drawings containing complete location and placing details. Include details of erection templates. Provide Erection Drawings to the concrete trade in advance of applicable Work and in coordination with concrete construction sequence.
   c. Contractor's Professional Engineer licensed in the project’s jurisdiction shall review and accept Contractor's construction sequence. As evidence of conformance with this requirement, Contractor shall submit a letter bearing the seal and signature of Contractor's Professional Engineer, attesting to conformance with this requirement.



TYPICAL COPE DESIGNATION IN
ERECTION DRAWINGS

7. Drawing Index: Prepare, keep up-to-date, and submit a Drawing Index, cross-referencing assigned piece mark with the drawing number upon which the piece is detailed. Erection Drawings may be used for this purpose. Shop Drawings submitted without an up-to-date Index and the applicable Erection Drawing(s) showing the location of each piece, will be deemed an incomplete submission and will not be accepted as subject to any agreed Shop Drawing schedule.
8. Piece Drawings will not be reviewed for the information identified below that is to be contained within the Job Standards and Erection Drawings. Piece Drawings with given pieces having potential impact on building systems not associated with the Work of this Section will be reviewed.

    a. The Job Standard and Erection Drawings as specified herein are to contain the information required for the review of typical steel members, without the need to submit the corresponding Piece Drawings. Accordingly, except as specified herein, or as requested, the submission of Piece Drawings for typical beams, girders, columns and bracing is not required.

9. Submit Job Standards, Erection Drawings, Drawing Index and Piece Drawings in coordinated packages so that checking personnel will have all needed information in hand at the time of checking.
10. Field Work Drawings: Prepare Field Work Drawings depicting all field Work required to accommodate field conditions.
11. Shop Drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale, all Work to be provided. Shop Drawings shall be accurately dimensioned and shall be notated clearly.
12. Size and Grade of Steel for each component part of the structure shall be indicated clearly in Shop Drawings. Rolled shapes, tubes, plates and other components shall be identified by using the standard designations used in AISC's *Detailing for Steel Construction*.
13. Symbols: Welds and nondestructive tests shall be indicated by using the symbols conforming to AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*. Indicate joint designation, welding process, and other data in the tail of the welding symbol.
14. Detail in accord with and to accommodate Contractor's field measurements of supporting and adjoining construction. Do not fabricate before accepted Shop Drawings have been returned to Contractor.
15. Work of Other Sections: Show in Shop Drawings holes and other Work required for securing Work of other Sections to structural steelwork, as well as holes and other Work required for the passage of Work of other Sections through structural steelwork. Pay particular attention to the requirements of the Work specified under Section 03 30 00. Provide Field Work drawings for all such holes not shown in Shop Drawings.
16. Structural Steel Connections: Identify explicitly the type of connection used at each location. Distinguish between shop and field connections. Determine and establish the arrangement and layout of each connection to the extent that detailing options are allowed in the Drawings or in this Specification. Connections shall be proportioned by LRFD, or by ASD where allowed specifically in the Drawings and shall conform to controlling requirements given in the Drawings, specified herein, or required by the *Building Code*.

a. Proportion connections not completely detailed in the Drawings to resist loads and load combinations given, noted, specified or required by the Contract Documents or by *Building Code*. Include reinforcing plates stiffeners and all else required to provide adequately for the given loads and load combinations.
b. As a part of the preparation of Shop Drawings, Contractor's Professional Engineer licensed in the project's jurisdiction shall design and be responsible for the design adequacy of all connections required by the Work, unless detailed completely in the Drawings. Contractor shall submit a letter bearing the seal and signature of Contractor's Professional Engineer, attesting to conformance with this requirement. Provide supporting calculations on request.
c. Contractor shall ascertain that all connections have sufficient strength, stiffness and ductility to resist safely loads imposed by handling, shipping, erection, temporary conditions and the like.
d. Except where smaller connections are given explicitly in the Contract Documents, and except where larger connections are required to resist loads from handling, shipping erection and the like, Contractor shall provide connections for members in trusses and bracing capable of resisting not less than 50% of the tensile strength of the members.
e. Fillet welds, partial penetration welds, weld returns, plug welds and the like shall equal or exceed the sizes given in the tables and notes included in the Drawings and in all cases shall equal or exceed the minimums permitted by *AISC Specification*.
f. Single-angle, one-sided and other types of eccentric connections shall not be used except where more concentric connections are not practical. Use of such eccentric connections is subject to prior acceptance.
g. Prior to start of Shop Drawings, Contractor shall select and shall submit for acceptance the range of bolt sizes to be used for each grade of bolt. There shall be no overlap in bolt size between grades.

17. Indicate clearly the grade, size and number of bolts, the type, number, position, designation and orientation of each washer, the bolt tension indicating system and the size of each hole, whether slotted or round. Proportion connection details to ensure adequate wrench clearance for correct bolt tensioning sequences.
18. ASTM A490 bolts may be used in slip critical-type connections only, not relying on the bearing capacity of the connection and not to carry direct tensile loads.
19. Design and detailing of structural steel connections to plates or anchors embedded in concrete shall be based on tolerances in excess of the most severe combination of structural steel, concrete structure, and embedded item location tolerances. Refer to Specification Section 03 30 00 for tolerances for concrete structure and embedded item location, and detail structural steel to accept those tolerances.
20. Camber and Sweep: Show all camber dimensions in Shop Drawings. Where specific camber is not given in the Drawings, note in affected Shop Drawing that such members shall be fabricated with natural camber up. Detail, fabricate and erect beams and girders so that natural sweep is away from the immediately adjacent edge of slab.
21. Stud Shear Connectors and Concrete Anchors: Show in Shop Drawings welded stud shear connectors and concrete anchors which will be shop applied.
22. Deck Supports: Indicate specifically in Shop Drawings all structural steel shelves required to support steel deck ends and edges at supporting beams, columns, and other structural steel elements. Detail steel deck shelves to provide suitable dimension and configuration to develop steel deck end and edge welding and reactions.

23. Cleaning, Surface Preparation (SSPC), and Painting data and requirements, including specific identification of "no-paint" areas, shall be detailed and scheduled in Shop Drawings.
24. Contractor shall coordinate and cross-check for accuracy, completeness and correct relationship to the Work of other Sections, each Shop Drawing prepared for the Work of this Section, including each Shop Drawing prepared by accepted subcontractors. Contractor's check shall include a verification of compliance with the Contract Documents and shall be performed prior to submission and resubmission of each Shop Drawing. The personally inscribed initials of the person(s) preparing each Shop Drawing as well as the detailing agency's supervisor and chief checker shall be included in the title block or similarly prominent location.
25. Substitutions: Should Contractor desire a Substitution or Deviation from Drawings or Specifications, or both, Contractor shall submit the specific request in writing prior to the submittal of Shop Drawings showing the Substitutions or Deviations. Requests for Substitutions or Deviations shall be submitted on Contractor's letterhead. Substitutions and Deviations not identified, or identified only in letters of transmittal or in Shop Drawings, or both, without the required written description on Contractor's letterhead, may not be accepted and shall be sufficient cause for the rejection and the return of such Shop Drawings without further action.

    a. Acceptance of Shop Drawings including Substitutions and Deviations not detected during Shop Drawing review, shall not relieve Contractor from responsibility to conform strictly to the Contract Documents. Substitutions and deviations will be allowed only where permitted in writing.
    b. Substitute structural shapes will be accepted provided both structural stiffness and structure strength are not impaired in both the composite and the non-composite conditions and provided the substitute shape does not interfere with or otherwise compromise the Work of other trades.
    c. Architect is the sole judge of the suitability of Contractor-proposed substitutions. Review of Contractor-proposed substitutions and deviations is subject to the compensation provisions of Article 1.12.

26. Shop Drawing Review: Only Shop Drawings marked "No Exceptions Taken" or "Make Corrections Noted - Resubmission Not Required" may be used by Contractor in the Work. Shop Drawings marked "Make Corrections Noted - Resubmit" shall be corrected or completed (or both) as required and shall be resubmitted. This process shall be repeated the number of times required to achieve the mark "No Exceptions Taken" or "Make Corrections Noted" - "Resubmission Not Required". An example of Structural Engineer’s Shop Drawing review stamp is shown here for reference.

STRUCTURAL ENGINEER REVIEW

NO EXCEPTIONS TAKEN ☐ RESUBMISSION NOT REQUIRED ☐
MAKE CORRECTIONS NOTED ☐ RESUBMIT ☐
NOT REVIEWED ☐

LERA CONSULTING STRUCTURAL ENGINEERS, RLLP

BY: _____

DATE: _____

a. Review of Shop Drawings will include the following:

1) Member size, grade, spacing and elevation.
2) Structural integrity of connections, including conformance to job standard.
3) Penetrations, including size, location and conformance to job standards.

b. Temporary, shipping, handling or erection loadings will not be considered in this review.

c. Nonconformities and errors detected during review will be noted in Shop Drawings returned to Contractor upon completion of review. Acceptance of Shop Drawings, including Substitutions and Deviations not detected during review, will not relieve Contractor from sole responsibility to provide Work conforming strictly to the Contract Documents.

d. Shop Drawing review includes engineering calculations only to the extent deemed necessary to ascertain that Contractor's Professional Engineer's calculations and or Shop Drawings have been prepared by competent personnel. Contractor alone is responsible for the accuracy and the completeness of Contractor's engineering calculations.

e. Should Architect's or Structural Engineer's marks or corrections be made in any Shop Drawing that would or could result in incorrect fit of any part or result in insufficient strength or stability of the Work, Contractor shall so notify in writing so as to expedite the required correction or modification.

f. Review of Contractor's Shop Drawings does not include a review of bills of material and the like. Accordingly, information required for the review of Shop Drawings shall be contained outside of bills of materials and the like.

27. Resubmission of Shop Drawings: Prior to resubmission of Shop Drawings with additions, deletions, or corrections, Contractor shall cloud and identify all changes from the prior issue. Drawings submitted without each change both clouded and identified clearly will be returned and shall be resubmitted as though the original submittal had been rejected. Each submittal, whether or not accepted or rejected, shall contain a unique revision number, clearly identified.

28. Temporary Work: Depict and identify temporary members and connections which may be required for temporary construction, erection and the like.
29. Shop Drawing Log: Contractor shall number Shop Drawings, and revisions to Shop Drawings, in a format acceptable both to Contractor and to Architect/Structural Engineer. Structural Engineer will provide to Contractor in its letters of transmittal both the log-in and the log-out date of each Shop Drawing. Further, on request of Contractor, Structural Engineer will provide to Contractor aged listings of each Shop Drawing remaining in the office of Structural Engineer.

D. Product Data: Submit printed manufacturer's literature for each manufactured item specified under Part 2 - Products - along with test data as may be requested. Include detailed instructions for application and installation.

E. Mill Test Reports:

1. Submit certified copies of mill test reports for all steel furnished. Submit also to governing agencies having jurisdiction. Comply with all applicable parts of ASTM Specifications. Beyond ordering information normally provided by Contractor, the mill shall be instructed to color-code in accordance with ASTM A6, and to mark with heat number, size, and type and grade of steel.
2. Submit manufacturer's certification of bolts, nuts, washers, DTI's and the like for each production lot of each grade of each type and each size of fastener component and filler material for welding.
3. Mill test reports shall state clearly the governing ASTM specification and shall be certified and notarized by Contractor as conforming in all respects to that specification.
4. Material provided in accord with the above requirements may be used in the Work without further local tests. In the case of controversy, Contractor shall perform tension, bend and such other tests as are required to demonstrate compliance with the requirements of the Contract Documents.
5. All steel that is not properly identified or whose source is subject to question shall be rejected.

F. Material Identification: On completion of the Work, Contractor shall submit an affidavit, countersigned by the appropriate subcontractor(s), attesting that all materials and products provided for the Work conform to the applicable specifications, standards, yield points, grades and the like required by the Contract Documents.

G. Certification of Shielding Gas: Submit certification that shielding gas is a weldable grade having a dew point of -40°F (-40°C) or lower.

H. Names of Manufacturers/Suppliers: Submit for acceptance the names of the following products and/or producers along with certification that the products conform in all respects to the requirements of the Contract Documents:

1. plates and shapes
2. welding materials
3. shielding gas
4. stud shear connectors
5. deformed bar anchors
6. bolts, nuts and washers

7. bolt tension indicating devices
8. post-installed anchors
9. anchor bolts
10. shop and field paint and galvanizing

I. Post-Installed Anchor Certificates: Submit approved independent testing report per ACI 355 (ICC-ES report), Manufacturer's Printed Installation Instructions, letter describing installation procedures, and installer qualifications including certification for horizontal and overhead adhesive installation where applicable.

J. As-Built Shop Drawings: In a format acceptable to each, and at the completion of the Work, provide to Owner, to Architect and to Structural Engineer, one complete digital set of all Shop Drawings (including Job Standards, Erection Drawings, Index Sheets, Piece Drawings, Field Work Drawings and the like), so as to provide as-built drawings of finished and completed Work under this Section.

K. Governing Agencies: Provide all Shop Drawings, tests, inspections, reports, affidavits, manufacturer's certifications, certification of compliance with VOC limits, and other requirements and data to governing agencies having jurisdiction.

1.6 MEASUREMENTS, TEMPLATES AND TOLERANCES

A. Measurements:

1. Field Measurements: Obtain all field measurements required for proper fabrication and installation of Work covered by this Section. Submit, prior to installation, all measurements indicating discrepancies from the Drawings. Describe in writing and, where applicable, by sketches proposed methods of correcting discrepancies. Measurements are the responsibility of Contractor.
2. Lay out each part of the Work in strict accordance with the Architectural, Structural, Mechanical, Electrical, Plumbing and all other Drawings and be responsible for correct location of same. Lay out from at least two pre-established benchmarks and axis lines, individually correct for length and bearing.
3. Templates: Furnish templates and layout drawings for exact locations of items to be embedded in concrete, with setting instructions required for installation of embedded items.

B. Tolerances: Structural steel shall be fabricated and erected within the tolerances specified in the *AISC Specification*, *AISC Code*, and AWS, except that more or less restrictive tolerances, specifically shown or noted in the Drawings or provided under this Specification, shall take precedence and shall apply to the Work.

1. The plumbness tolerance of columns, sometimes given as 1:500, shall be taken as the square root of the sum of the squares of the slope for the two orthogonal axis.
2. The vertical dimension, measured from the column splice immediately above to the top of as-erected members framing to (or framing immediately adjacent to) the column, shall not vary by more than 1/4 inch (6 mm).
3. Individual beams and girders shall be considered level where the difference in elevation between ends of the members does not exceed 1:750.

4. Camber tolerances for beams and girders, as measured in the shop, shall not exceed the following:
   For lengths to 45 feet (14 m), plus 0.5 inches, minus 0 inches (12 mm/0 mm).
   For lengths greater than 45 feet (14 m), an additional 1/8 inch (3 mm) for each 10 feet (3 m) of length or fraction thereof.
5. Level column splices with shims to a tolerance of ±1/16 inch (1600 µm).

1.7 TESTING AND INSPECTION

A. Owner's Testing Agency: All work is subject to Special Inspection as required by *Building Code*. Subject to acceptance by Architect, Owner will engage and pay for the services of an independent testing agency (Testing Agency) as outlined in Section 01 40 00, Inspection and Testing. The selected Testing Agency will meet the requirements of ASTM E329. Contractor alone is responsible for the achieving of the required level of quality, both in the shop and in the field. Testing Agency will rely heavily on reviewed Shop Drawings, as described earlier in this Specification, in its examination of as-constructed Work. Contractor shall not retain Owner's Testing Agency for its own work but may, subject to acceptance by Owner, contract through Owner for such Work.

B. Responsibilities and Duties of Testing Agency: Testing Agency will perform the following functions, inspections and tests:

1. On instructions and at locations selected by Architect, Testing Agency may sample materials taken from the as-erected Work.

   a. High-tensile bolts, nuts and washers, of each size and grade, may be sampled and tested in accord with ASTM procedures.
   b. Coupons may be taken from structural steel shapes and plates and welds and tested in accord with ASTM procedures

2. Inspectors provided by Testing Agency will be qualified to examine the materials and the systems employed in the Work. In case of dispute between Contractor and Testing Agency as to the competence of any inspector, Structural Engineer shall be the final arbiter.
3. Both tests and inspections will comply with the requirements of the *Building Code*, as amended by the requirements and regulations of the Building Department and as Specified herein.
4. Testing Agency will inspect all shop and field welding and high-strength bolting in accord with the provisions of this Specification. Testing Agency, upon the completion of the Work, will be required to certify in writing that the welding and the high-strength bolting has been performed in accordance with the provisions of the Drawings and with this Specification, and with the applicable requirements of regulatory agencies having jurisdiction.
5. Testing and reporting by Testing Agency will be performed in accord with the following requirements:

   a. Testing will be performed in accord with the provisions of ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*.
   b. Liquid penetrant testing will conform to the provisions of ASTM E165 and AWS D1.1.

c. Magnetic particle inspection will conform to the provisions of ASTM E109 and AWS D1.1.
d. Ultrasonic, X-ray and gamma ray testing will conform to the provisions of AWS D1.1, Chapter 6.

6. Test specimens shall be taken by Contractor under the direction of Testing Agency and shall be machined by Contractor to dimensions required by the related ASTM specification and/or AWS standard.
7. Continuous inspection of high-tensile bolting will be performed by Testing Agency. Where the tension in any bolt is deemed to fall below the proper value, all bolts in that connection shall be examined.

   a. All bolts will be visually examined for proper tension.
   b. Ten percent of the bolts, but no fewer than two bolts, selected at random from each connection in question, shall be tested for bolt tension in accord with the provisions of the Specification for Structural Joints Using ASTM A325 or A490 Bolts.

8. Inspection of all shop and field welding will be provided by Testing Agency.

   a. All welds are to be visually inspected.
   b. Ten percent of the bolts, but no fewer than two bolts, selected at random from each connection in question, shall be tested for bolt tension in accord with the provisions of the Specification for Structural Joints Using A325 or A490 Bolts.
9. Continuous inspection of complete penetration welds will be provided by Testing Agency using ultrasonic or other non-destructive tests.

   a. Ultrasonic tests will be performed by specifically trained, qualified technicians, who will operate the equipment, visually examine the welds and will maintain records of welds examined, defects found and disposition of each defect. Technician will sign each weld that he or she inspects.
   b. Inspection instrumentation will be calibrated by the Testing Agency in accord with AWS D1.1.
   c. Welds requiring ultrasonic testing will be tested at an initial rate of 100% in order to authenticate the qualifications of each welder and each welding operator. Where the rejection rate is found to be less than 5% of the welds tested, the frequency of testing may be reduced to 25%. Where the rate of rejection increases to 5% or above, the inspection rate will again be increased to 100% until the defect rate is reduced to less than 5%. Percentages will be calculated for each welder separately.

10. Where ultrasonic indications arising from the weld root can be interpreted as either a weld defect or a back-up bar, the bar shall be removed by Contractor and back-welded, where required. The weld will then be retested. Questionable root indications, where no defect is found, will not be counted against the welder's rejection rate.
11. All material stressed transverse to the grain by welds, located within 6 inches (150 mm) to either side of the weld, will be tested ultrasonically for laminations. Testing will be in accord with ASTM A578.
12. Approximately 25% of groove welds accomplished in the shop will be retested in the field. Retesting will not take place until the welds are not less than 4 days old. Similarly, approximately 25% of material stressed transverse to the grain will be retested for laminar tearing.

13. All columns splices and other compression joints that depend upon contact bearing after alignment will be tested for conformance with this Section.
14. Perform Special Inspection of post-installed anchors in accordance with the Building Code, Manufacturer's Printed Installation Instructions, approved independent testing report per ACI 355, Contract Documents and approved shop drawings. As a minimum, provide continuous inspection of adhesive anchors installed in horizontal, or upwardly inclined orientations, supporting tension loads; and periodic inspection of all other conditions of post-installed anchors. Special Inspectors shall be qualified (via experience, training, ACI/CRSI certification, etc.) with the installation and inspection of post-installed anchors. Special Inspections shall include but are not limited to the following:

    a. Verify installer qualifications as required per the Contract Documents;
    b. Verify anchor type, material, size, length, and condition;
    c. Verify minimum concrete age, temperature, strength, and dry condition;
    d. Verify drilling method, hole cleaning, preparation per Manufacturer's Printed Installation Instructions; and
    e. Verify anchor position, setting, and installation method

C. Authorizations: Owner's Testing Agency will not be authorized to:

1. Authorize or accept deviations or substitutions from the Contract Documents.
2. Assume any of the responsibilities of Contractor; for example, Testing Agency may not advise formally or informally on any aspect of construction means, methods, techniques, sequences or procedures, or safety precautions and programs in connection with the Work.
3. Accept Shop Drawings or samples.
4. Approve or issue a Certificate of Payment, a Change Order, or issue verbal instructions which modify the Contract between Owner and Contractor.

D. Responsibilities and Duties of Contractor:

1. Performance or waiving of inspection, testing or surveillance by Testing Agency for a given portion of the Work will not relieve Contractor from responsibility to conform strictly to the requirements of the Contract Documents.
2. Access to Documents, Facilities and Materials: Furnish one copy of each accepted Shop Drawing and of each mill test certificate to Testing Agency. Provide reasonable office, desk and file space at each fabrication plant and at the site to allow Testing Agency to conveniently work with and to maintain project records and drawings. Provide authorized personnel convenient and free access to all parts, locations and areas of Work, including storage areas. Provide representative samples, coupons and the like as requested by Testing Agency. Provide hoisting, turning and moving of materials and reasonable quantities of scaffolding, power, casual labor, and other provisions and assistance necessary to allow quality and effective inspection and testing of Work.
3. Notice: Provide reasonable notice of the initiation of Work, including fabrication or erection requiring plant or jobsite testing or inspection.
4. Cost of Owner's Tests by Testing Agency will be borne by Owner. However, where additional tests are deemed necessary on account of failure to pass tests, the cost of additional testing will be deducted from payments to Contractor so as to reduce the Contract price.

E. One Shop Location is Assumed for purposes of this Contract. Where fabrication takes place in more than one shop, additional inspection costs resulting therefrom will be accomplished at Contractor's expense.

1.8 QUALITY ASSURANCE

A. Source Quality Control: Contractor's material control procedures shall be effective and shall assure that all Work fulfills the requirements of the project as well as the applicable provisions of the Contract Documents. All structural steel shall be identified and all material shall be tested in accord with the requirements of *Building Code*, of Building Department, of governmental authorities having jurisdiction and of this Specification.

B. Shop and Construction Site Quality Control: Contractor shall maintain, on staff, sufficient office, field engineering, and field supervision staff to assure that all data and layout drawings for Work of other Sections is transmitted to detailers to allow proper detailing of holes, penetrations, chases, and the like and to assure proper execution of the Work in the field.

1. Contractor's inspectors shall mark each weld or bolt inspected with an identifying mark. Such inspectors who provide inspections of poor quality shall be assigned to other projects or shall be retrained prior to reassignment to the Work.

C. Steel Fabricator: Fabricator shall have experience in the fabrication of structural steel for at least five (5) buildings of the type of this Work, and shall, within the last five (5) consecutive years, have successfully completed in a timely fashion at least two (2) projects similar in scope and type to the required work of this Section, and shall possess all capabilities and qualifications required for AISC Cbd (Complex Steel Buildings) Certification.

D. Steel Erector: The Erector performing the Work of this Section must, within the last five (5) consecutive years, have successfully completed in a timely fashion at least three (3) projects similar in scope and type to the required work for this Section.

E. Structural Steel Detailer: Should Contractor or the structural steel subcontractor elect to subcontract any portion of the steel detailing Work, the structural steel detailing firm shall be subject to acceptance. As a minimum requirement for acceptance, the structural detailing firm shall demonstrate experience in detailing of not less than five (5) buildings of the type of this work and shall demonstrate in-house quality control procedures to the satisfaction of Construction Manager and of Architect.

1. Acceptance of subcontract detailing firm is provisional and may be withdrawn where detailing is not of sufficient quality to meet project requirements.

F. Bolt Installation shall be in accord with the provisions of this Specification and in no case less than the best industry practice.

1. A qualified representative of the manufacturer shall be present for the start-up installation of each bolt type (DTI and/or TCF) used in the Work. For DTI's, a representative of the bolt manufacturer and a representative of the DTI manufacturer shall be present.

2. Contractor shall provide and shall maintain in good condition a Skidmore Wilhelm bolt tension calibrator (or other device accepted by Structural Engineer) at each location where high-strength bolts are being tensioned. Contractor shall test regularly:

    a. each lot of structural fasteners (bolt, nut, DTI, washer and lubricant assemblies) before installation in the Work for the achievement of proper tension; and
    b. the competence and understanding of bolting crews for each method of tensioning bolts for each size and grade employed in the work.

3. All members of bolting crews shall be fully instructed and experienced in the bolt tensioning system(s) employed in the Work.

    a. Each bolter, both shop and field, shall sign his own name immediately adjacent to each bolt group tensioned by that bolter. Such bolters who fail to follow proper procedures for snugging steel plies or fail to provide proper tension in bolts shall be retrained prior to reassignment to the Work or shall be removed from the Work.

G. Welding Procedure Qualification: Each welding procedure shall be described fully in a welding procedure specification and shall be designated prequalified under AWS D1.1 or shall be qualified in accord with provisions of AWS D1.1 and of *Building Code* prior to use in the Work.

H. Welder Qualification: Welders and welding operators performing work under this Section shall be qualified in accordance with *Building Code* and with applicable AWS requirements for each specific welding procedure and process which the welder will use in the Work.

1. Contractor shall, when requested, require any welder to be retested; retesting, when requested, shall be performed with no additional compensation to Contractor.
2. Welder, both shop and field, shall sign his own name immediately adjacent to each weld accomplished by that welder. Such welders who provide welds of poor quality shall be removed from the Work and shall be assigned to other projects or shall be retrained prior to reassignment to the Work.

    a. In addition to normal quality assurance testing by Contractor, all welds not signed shall be tested by Contractor by UT, MT or other appropriate method accepted by Structural Engineer.

I. Qualifications: Contractor shall determine, shall warrant and shall certify that producer, detailer, fabricator, erector, materials suppliers and all others involved in the Work, along with their personnel, are experienced, qualified and adequately staffed to undertake the specific Work required under this Section.

J. Post-Installed Anchors shall be installed by workers with experience and training with installing the specified anchors. Installation of adhesive anchors in horizontal or upwardly inclined orientations supporting tension load shall be performed by installers certified through the ACI/CRSI adhesive anchor installer certification program, or approved equivalent.

K. Documentation of Contract Conformance: Perform quality control functions required to achieve and to document that Work conforms to the Contract Documents. Provide access to Contractor's quality control documents and reports upon request. Provide reasonable numbers of copies of specific quality control reports on request.

1. Contractor shall monitor initial fabrication and from time-to-time during the fabrication period, and shall inspect each delivery prior to loading for shipment. Contractor's monitoring and inspection shall assess the quality of fabricated material by visual inspections, checking of all material test reports, checking of all welding, bolting and other fabrication test reports and the evaluation of quality control procedures through which the fabricated material has passed.

L. Purchase Orders: Each purchase order shall identify the end use of the purchased material. Contractor shall ensure that manufacturer or vendor understands fully the intended use of the material in the Work. Provide manufacturers and vendors with a copy of this Section of the Project Specifications.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials to be Installed Under Other Sections:

1. Anchor bolts, embedded plates, anchorage devices, and other items required to be embedded in cast-in-place concrete shall be delivered to the project site at times coordinated by Contractor to allow convenient installation and orderly cast-in-place concrete operations.
2. Include setting drawings, templates, and directions for installation with all anchor bolts and with all other items or devices furnished and delivered to the project site for installation under other Sections of this Specification.

B. Storage of Materials:

1. Structural steel members and materials, whether or not fabricated, which are stored on or off the project site shall be supported above ground on platforms, skids or other supports. Where applicable, stacked members shall be separated by effective softeners. Storage methods shall protect steel members from overstress, permanent deformation and other damage.
2. Structural steel members and parts shall be protected from corrosion. Storage methods shall provide for free and rapid drainage of rainwater and shall prevent collection of water on or within stored members.
3. Materials shall be delivered to the site, ready for use, in the manufacturer's original and unopened containers and packaging, bearing labels as to type of material, brand name, and manufacturer's name.
4. Packaged materials shall be stored under cover in dry, weathertight, adequately ventilated and clean locations off the ground. Delivered materials which are damaged or otherwise

not suitable for installation, shall be removed from the jobsite and replaced with accepted materials.

5. All fastener components shall be protected from dirt and moisture in closed containers at the site of installation. Only as many fastener components as are anticipated to be installed during the work shift shall be taken from protected storage. Fasteners components that are not incorporated into the Work shall be returned to protected storage. Fastener components shall not be cleaned or modified from the as-delivered condition. Post-installed anchors shall be stored in accordance with manufacturer's requirements.

C. Identification: Provide and maintain identification of all steels furnished to a specified minimum yield strength greater than 36 ksi (Grade 235) in accordance with ASTM A6.

D. Painted Steel:

1. Handling, Shipping and Erecting of shop painted steel pieces shall not be performed until the paint has dried thoroughly. Special care shall be taken to avoid abrasion or other damage to painted surfaces. Stacking and storing of painted members in the shop, in transit, and at the jobsite shall be done using appropriate softeners and timbers suitable to protect the paint from damage and to keep individual members free from contact with the ground and with each other.
2. Contractor shall furnish members in-place, fully painted, including all touch-up painting required as specified herein, at all locations where painting is required in the Drawings, by the provisions of this Specification, and by *Building Code*.

E. Cleaning: Subsequent to shipment and prior to erecting into the Work, Contractor shall clean steel to the extent required to allow full bond of paint or of fireproofing materials, as appropriate.

F. Delivered Materials shall be identical to accepted samples.

G. Removal: Delivered materials which are damaged or otherwise not suitable for installation, shall be removed from the jobsite and replaced with acceptable materials.

1.10 JOB CONDITIONS

A. Contractor's Responsibility: Contractor shall be solely responsible for the correctness of dimensions and quantities and for the fitting to other Work; for Work to be confirmed and correlated at the site; for information pertaining to the fabrication procedure or to the means, methods, techniques, sequences and procedures of construction; and for the coordination of the Work of this Section with the Work of all other trades. The verification of the physical interrelationships of elements of the Work from Contract Documents and in the field is solely Contractor's responsibility. Review of Contractor's submissions does not relieve Contractor from these responsibilities.

B. Contractor's Coordination: Contractor shall coordinate and schedule the Work of this Section with the Work of other Sections of this Specification in order to optimize quality and to avoid delay in overall job progress.

C. Rejection of Work: Testing Agency may inspect and test materials at the source before shipment as well as at the site before, during or after installation in the Work. Construction Manager and Architect reserve the right, at any time before final acceptance of the completed Work, to reject material not conforming with specified requirements, regardless of previous tests, inspections, acceptances, or inclusion in certificates of payment.

D. Provisions for Other Work: The Work under this Section shall include required cutting, punching, drilling, welding and all else required for the attachment and the passing-through of other Work.

E. Construction Sequence: Descriptions of limitations on construction sequence are intended to assist Contractor in coordinating the Work of the Project. Descriptions do not describe fully the limitations given, do not describe all limitations, nor do they preclude construction sequences not contemplated herein. Whether or not Contractor follows the limitations on construction sequence described herein, and until such time as the structural work is completed, Contractor remains fully responsible for both the stability and the safety of the Work; adherence to the limitations described herein does not relieve Contractor from that responsibility.

1. Generally, the structure is to be constructed from the bottom to the top, floor-by-floor, with Contractor supplying such temporary bracing and shoring as may be required to compensate for the lack of completion of portions of the construction. See the Structural Drawings for additional sequence and pre-loading requirements associated with the columns and wall transfers.
2. Plan and accomplish construction sequence in accord with Structural, Architectural, Mechanical, Electrical and all other Drawings forming a part of the Work.
3. Sealing of Erection Drawings by Contractor's Professional Engineer shall include and imply a full review of construction sequence and of related operations. Alternatively, Contractor shall submit a letter bearing the seal and signature of Contractor's Professional Engineer attesting to conformance with this requirement.

F. Construction Loads: The structure is designed to resist safely the loading prescribed by *Building Code* for the finished building. No provision is included for loads or stresses imposed or induced by Contractor's means and methods of construction. Design loads are provided in *Building Code* but are sometimes modified upward as provided in Structural Engineer's Design Criteria.

1. Where Contractor elects to place loads on the structure or elects to otherwise load or deform the structure in excess of the design loads, Contractor shall submit drawings and supporting calculations prepared under the supervision of and sealed by Contractor's Professional Engineer.

    a. Review of Contractor's submittal shall not relieve Contractor from full responsibility for Contractor's means and methods of construction.
    b. Review of Contractor's submittal will be treated as a Substitution or Deviation, as provided under Article 1.12.

2. Alternatively, Contractor may seek professional services from Structural Engineer. Such services may be obtained through Owner or, with the permission of Owner, may be obtained directly from Structural Engineer. Architect will not be involved contractually in any such services.

G. Accidents and Hazardous Conditions: Contractor shall prepare a detailed written report of all accidents and other occurrences involving death, significant personal injury and/or significant losses in tangible property and shall submit the report promptly.

H. Installing and Rigging Equipment: Contractor shall shore all construction susceptible to impact loading from the installation of equipment installed by other trades.

1. Such equipment shall include but shall not be limited to boilers, chillers, refrigeration equipment, pumps, transformers, elevator machines and the like.
2. Remove shoring when equipment installation is complete.

1.11 DEFICIENT WORK

A. Repairing, Patching, Cleaning: Contractor shall correct all deficiencies in the Work of this Specification, including areas where Testing Agency reports, or Construction Manager's or Architect's rejections have indicated that Work is not in full compliance with the Contract Documents. Perform, at no expense to Owner, all additional tests that Construction Manager or Architect deem necessary to reconfirm noncompliance of the original Work and perform, at no expense to Owner, all tests and inspections which may be necessary to show compliance of corrected Work.

B. Defective and Nonconforming Work: Defective Work, unsuitable Work or Work otherwise failing to conform to the Contract Documents shall be made good by Contractor at no change in the amount of the Contract. Contractor shall prepare appropriate details and procedures for bringing such Work into conformance with the Contract Documents and shall submit such details and procedures for acceptance. Corrective Work, including materials, shall conform strictly to accepted details and procedures. Nonconforming Work may be rejected at any time, regardless of prior acceptance in Shop Drawings, prior inspection, inclusion in inspection or test reports, or inclusion in certificates of payment.

C. Deficiencies: Where Work exhibits any one or more of the following Deficiencies, or where Work otherwise fails to conform to the requirements of the Contract Documents or to the requirements of *Building Code*, for any reason or combination of reasons, such Work shall be considered Deficient and not in conformance with the requirements of the Contract:

1. Bent, twisted, buckled or warped pieces.
2. Unauthorized cutting, reaming and so forth.
3. Materials or workmanship not in accord with the Drawings, with the Specifications, with accepted samples, or with referenced codes or standards.
4. Cracking, interior or surface defects and the like.
5. Exceedance of tolerances.
6. Painted, unpainted or galvanized surfaces not sufficiently clean to provide full bonding of spray fireproofing, paint or other coatings.
7. Tops of flanges not sufficiently clean to receive field-applied stud shear connectors or deck welding.
8. Post-installed anchors not set in accordance with Manufacturer’s Printed Installation Instructions, adhesive anchors not set with insufficient adhesive (no overfill visible).

D. Replacement or Repair: Where Construction Manager or Architect, at its sole discretion, finds any deficiencies or other Work not in accord with the requirements of the Contract Documents, Construction Manager or Architect may order that the affected Work be replaced or repaired at Contractor's expense.

1. Contractor shall reimburse Owner for the actual amount of the fees of Testing Agency for the reinspection and the retesting of Work deemed defective by Construction Manager or by Architect.

E. Cost: The cost of all other activities and procedures associated with defective Work shall be paid by Contractor.

1.12 PROFESSIONAL FEES AND COSTS

A. Scope: Contractor shall compensate Architect, Structural Engineer and Architect's other consultants for services incurred because of Contractor-proposed deviations (including substitutions), extra submittals of Shop Drawings, deficient and defective Work and the like. Compensation will be at the rates given in the standard time-and-expense billing policy of the firm. Architect will notify both Owner, Construction Manager and Contractor prior to the commencement of services associated with each item under this Article.

B. Substitutions and Deviations: Contractor-proposed Substitutions and Deviations will be evaluated and reviewed where requested by Contractor.

C. Shop Drawings: The review of the first and the second submittals of each Shop Drawing are normal services, but the review of the third and all subsequent submittals of each Shop Drawing will be considered an extra service and subject to the compensation provisions of this Article.

D. Deficient Work: The evaluation, review and design and all other activities associated with Deficient Work are subject to the compensation provisions of this Article.

E. Expediting: Where Contractor requests special handling of submittals, such costs are subject to the compensation provisions of this Article.

1.13 PRE-BID CONFERENCE

A. Function: Prior to submission of bids, Owner or Construction Manager will call a Pre-Bid Conference, with all bidders invited to attend. The principal function of the Pre-Bid Conference is to clarify matters involving the bidding of the project. Such technical matters as may be of concern to Contractor are proper topics for this Conference.

1. While minutes will be prepared and will be distributed, discussions that take place during the course of the Conference, including the minutes of those discussions, do not modify bidding or construction requirements or the content of the Contract Documents. Such modifications are accomplished only through the issuing of a formal addendum.
2. Be prepared to pose such questions regarding the Construction Documents as will affect either cost, schedule, or any other subject deemed significant to the bidding or construction process. Submit questions in writing, prior to Conference, where practical.

1.14 PRE-CONSTRUCTION CONFERENCE

A. Function: Within 30 days following Notice to Proceed, Contractor shall schedule a meeting at a mutually agreed time, the meeting to include Contractor, Fabricator, Erector, Construction Manager, Architect and Structural Engineer. The principal function of the Pre-Construction Conference is to clarify matters involving the construction of the project, including the requirements of coordination and scheduling. Such technical matters as may be of concern to Contractor are proper topics for this Conference.

1. While minutes shall be prepared and distributed by Contractor, discussions that take place during the course of the Conference, including the minutes of those discussions, do not modify construction requirements or the content of the Contract Documents. Such modifications are accomplished only through the issuing of formal, written instructions.
2. Be prepared to discuss all aspects of construction coordination, construction sequence, quality control, welding and bolting procedures and the like. Submit an agenda, in writing and in advance of Conference.

PART 2 - PRODUCTS

2.1 GENERAL

A. Structural Steel furnished for each location shall provide the minimum yield point given in the Drawings, shall conform to the applicable ASTM Steel Specification, shall meet the requirements of *Building Code*, shall be suitable for use in welded structures and shall meet the requirements both of the Drawings and of this Specification. All material shall be new and of best commercial quality. Steels produced to modified ASTM Specifications shall not be used without written acceptance. Except where specific products are given in the Drawings or in this Specification, structural steel used in the Work may be chosen by Contractor from the applicable specifications listed in *AISC Specification* and accepted by both *Building Code* and by governing agencies having jurisdiction.

1. Contractor, in ordering materials from manufacturers and vendors, shall ensure that the manufacturer or vendor understands fully the intended use of the as-fabricated and as-erected Work. Provide manufacturers and vendors with a full copy of this Section. Purchase orders shall identify the end use of purchased materials.
   Particular care shall be taken to identify materials:

   a. stressed in tension transverse to the grain (rigid frames, trusses, etc.)
   b. heavy sections used in tension (particularly sections with a flange thickness in excess of 1.60 inches (41 mm))
      It is the intent of these provisions to assist producer in the selection of materials best suited for the intended purpose.

2. Unless noted specifically as not carrying tensile loads or detailed as bolted, all steels and products selected for use in the Work shall be suitable for use as tension members, connected by welding.

3. Where spliced by welding, wide flange members with flange thickness exceeding 1.60 inches (41 mm) and plates with thickness exceeding 2.00 inches (50 mm) shall meet the following toughness criteria:

   a. Unless otherwise noted, provide material with Charpy V-notch impact values of not less than 20 ft-lb at 70°F (27 N-m at 21°C).
   b. Where exposed to weather or to ambient temperature changes or where designated in the Drawings, provide material with Charpy V-notch impact values of not less than 20 ft-lb at 40°F (27 N-m at 4°C).
   c. Test members in accordance with ASTM A673, with the following exceptions required by *AISC Specification*:

      1) For wide flange sections, the center longitudinal axis of the specimens shall be located as near as practical to midway between the inner flange surface and the center of the flange thickness at the intersection with the web mid-thickness.
      2) For pieces produced from ingot, tests shall be conducted by the producer on material selected from a location representing the top of each ingot or part of an ingot used to produce the product represented by these tests.

   d. Report test results in accordance with ASTM A370.

2.2 MATERIALS

A. Welding Materials shall be as required by *Building Code* and by AWS for the conditions of intended use and for the metal being welded. Provide welding materials with as-welded Charpy V-Notch impact values of not less than 20 ft-lb at 0°F (27 N-m @ -18°C). Welding materials shall conform to the base metal/filler metal combinations listed in the AWS Specifications and Table 2.2-1 and to the filler metal classifications listed in Table 2.2-2, except where other welding material or material combinations and related welding processes are accepted.

TABLE 2.2-1

	Filler Metal Classifications			
Base Metal Yield	SMAW	SAW	GMAW	FCAW
Up to & Incl. 50 ksi	E70 (E480)	F7 (F48)	ER70 (ER480)	E7 (E48)
60 ksi & 65 ksi	E80 (E550)	F8 (F55)	ER80 (ER550)	E8 (E55)
70 ksi & greater	E90 (E620)	F9 (F62)	ER90 (ER620)	E9 (E62)

TABLE 2.2-2				
Base Metal	Welding Process	AWS Spec.	Filler Metal Classification	
Carbon Steel and Low Alloy Steel	SMAW	A5.1	E7018	
		A5.5	E8018-C3, E9018-D3	
	SAW	A5.17	F7A2-EXXX	
		A5.23	F8A2-EXXX, F9A4-EXXX	
	GMAW	A5.18	ER70S-6, ER70S-2	
		A5.28	ER80S-D2, ER90S-D2	
	FCAW	A5.20	E71T-8, E71T-1, E70T-1, E70T-6	
		A5.29	E71T-8Ni1, E81T1-Ni1, E91T1-Ni2	
Stainless Steel			(Type 304)	(Type 316)
	SMAW	A5.4	E308L	E316L
	SAW	A5.9	ER308L	ER316L
	GMAW	A5.9	ER308LSi	ER316LSi
	FCAW	A5.22	E308LT	E316LT
Stainless Steel to Carbon Steel	SMAW	A5.4	E309L	
	SAW	A5.9	ER309L	
	GMAW	A5.9	ER309LSi	
	FCAW	A5.22	E309LT	

Welding electrodes which have been dampened or which have been contaminated by grease or other substances deleterious to welding shall not be used in the Work.

B. Shielding Gas shall be of a welding grade having a dew point of -40°F (-40°C) or lower.

C. Stud Shear Connectors: Material and equipment for welded studs and stud shear connectors shall conform to *Building Code*, to AWS D1.1 and to applicable portions of Section 05 30 00 "Metal Deck and Stud Shear Connectors". Material shall conform to AWS D1.1, Chapter 7, Type B and to ASTM A108, Grade 1015 or 1020, cold finished carbon steel, with dimensions conforming to AISC Specification. Accepted manufacturers are the Nelson Stud Welding Division of TRW, Midwest Fasteners, or other accepted manufacturer.

D. Deformed Bar Anchors shall be ASTM A496 deformed bars prepared for stud welding in accordance with AWS D1.1. Material shall conform to AWS D1.1, Chapter 7, Type C. Accepted manufacturer is the Nelson Stud Welding Division of TRW or other accepted manufacturer. Provide 1/2 inch (12 mm) diameter, 36 inch (1000 mm) long bars, unless otherwise given in drawings.

E. High Tensile Bolts, Tension Control Fasteners, Nuts, DTI's and Washers shall conform to the applicable ASTM specification shown in Table 2.2-3.

TABLE 2.2-3			
Bolts	Nuts	DTI's	Washers
ASTM A325 (Type 1), ASTM F1852 (TCF), and ASTM A490 (Type 1)	ASTM A563 (DH)	ASTM F959	ASTM F436

NOTE: Neither A490 Type 2, A490 Type 3, nor A325 Type 3 shall be used in the work.

All fastener components shall bear the manufacturer's mark; nuts shall bear the DH symbol. Sleeve nuts, clevises and the like shall develop the full strength of the threaded rod or bolt. All bolts, nuts and washers shall be cold forged; bolts shall have rolled threads. Neither hot forged bolts or nuts nor cut threads may be used in the Work.

1. In addition to the mandatory testing provided in the ASTM specification, proof load testing (ASTM F606), chemical analysis (ASTM A751) and certification shall be required of manufacturer; for galvanized bolts, nuts and washers, manufacturer's certification shall include the results of the rotational-capacity tests as well as the results of the zinc thickness measurements. Except for the rotational-capacity tests of galvanized bolt, nut and washer assemblies, which shall be performed in accord with the Shipping Lot Method, all testing and analysis shall be conducted in accord with the Production Lot Method. Testing shall be completed for each grade of each type of each size of fastener. Fastener components not in full conformance to the appropriate ASTM specification shall not be shipped to the Work.

    a. Proof load testing shall be conducted on full-size bolts and components not on machined test specimens.
    b. Proof load testing shall be accomplished using Method 1 (Length Measurement) of Method F606.
    c. Testing shall include both hardness and tensile strength.

2. Bolts, nuts and washers shall be manufactured by a member of the Industrial Fasteners Institute.
3. Accepted manufacturers are:

    a. LeJeune Bolt Company
    b. Infasco
    c. Nucor Fastener
    d. Unytite
    e. Lohr Structural Fastener
    f. Other where accepted.

4. Mechanical galvanized bolts, nuts, washers, DTI's and inserts, as applicable, conforming to ASTM B695, Class 50 shall be used at all surfaces containing galvanized materials and at all surfaces exposed to ambient temperature. Galvanizing shall be undertaken only on A325, Type 1 bolts, ASTM A563 DH nuts, ASTM F959 DTI's, and F436 heat treated washers. ASTM F1852 tension control fasteners shall not be galvanized by any process.

5. Beveled washers shall be square, smooth, and shall be sloped to provide contact surfaces in full bearing. Provide for all slopes of 1:20 and larger.
6. The diameter of holes in special, beveled and square washers shall not exceed 1/16" (1600 μm) more than the nominal bolt diameter.
7. Thread Lubrication shall conform to bolt manufacturer's written recommendation. All galvanized A563 nuts shall be provided with an additional lubricant that shall be clean and dry to the touch and have a color that contrasts with the zinc coating so its presence is visually obvious. Galvanized structural bolts shall be Rotational Capacity Tested in accordance with the provisions of ASTM A325, and a record of such tests for each lot shall be submitted to the Structural Engineer

F. *Bolt Tension Indicating Devices shall be direct-tension indicating washers (DTI) or tension control* fasteners (TCF).

1. Direct-tension indicating washers shall be of domestic manufacture, containing only domestically produced raw materials, conforming to the latest revision of ASTM F959. No 'squirt-type' DTI's are to be used, nor DTI's with slots cut in the back. Accepted manufacturers are TurnaSure LLC, Bethfast Inc., or other where accepted. Provide mechanically galvanized (ASTM B695, Class 50) washers for all surfaces and assemblies containing galvanized materials.
2. Tension control fasteners shall conform to the latest revision of ASTM F1852 for the A325 strength level, and to the applicable provisions of ASTM A490 Type I as well as the provisions of Section 2.8 of the RCSC Specification pertaining to Alternative-Design Fasteners. Accepted manufacturers are LeJeune Bolt Company, Infasco, Vermont Fasteners Manufacturing, or other where accepted.

    a. Neither A490 Type 2, A490 Type 3 nor A325 Type 3 shall be used in the Work.

G. *Unfinished Bolts shall be ASTM A307, Grade A, regular low carbon steel hexagonal heads and* nuts.

1. Nuts for ASTM A307 bolts shall be ASTM A563, Grade A (heavy hex for bolts larger than 1 1/2 inch diameter) nuts installed with thread locking compound, ESNA elastic stop nuts by McLean-Fogg or SPS Technologies, or other accepted nut.
2. Washers for A307 bolts shall conform to American Standard B18.22.1, Type B or to ASTM F436.

H. *Stainless Steel shapes, plates, fasteners, washers and the like shall be Type 18-8 conforming to* AISI Grade 304 or 316.

1. Stainless steel bolts shall conform to ASTM F593, Group 1 or 2, Condition SH or CW. Accepted manufacturers are Robbins Manufacturing or other where accepted.
2. Stainless steel nuts shall conform to ASTM F594, Group 1 or 2, Condition SH or CW. Accepted manufacturers are Robbins Manufacturing or other where accepted.

I. *Anchor Bolts: May be of uncoated steel unless otherwise required by the Drawings, by Building Code* or by governmental authorities having jurisdiction. Unless otherwise provided in the Drawings provide 1 inch (25 mm) diameter or larger.

1. Unless otherwise given, provide as follows:

a. Bolt material conforming to ASTM A36 FY 36 (245 MPa).
b. Two heavy hex nuts as specified for ASTM A325.
c. 3 x 3 x 3/8 (75x75x10 mm), FY 36 (245 MPa) plate washer.

2. Where designated A449, provide as follows:

a. Bolt material conforming to ASTM A449.
b. Two heavy hex nuts as specified for *A*STM A325.
c. 3 x 3 x 1/2 (75x75x12 mm), FY 50 (345 MPa) plate washer.

3. Where designated Dywidag, provide as follows:

a. Threadbars conforming to ASTM A615 except for marking.
b. Hex nut (developing not less than 100% of the yield strength of the bar) plus lock nut.
c. 3 x 3 x 1/2 (75x75x12 mm), FY 50 (345 MPa) plate washer.

J. Post-Installed Mechanical Anchors shall be either expansion or undercut type. Where substitutions are requested, the alternate anchor shall be similar in type to that specified in the Contract Documents and be designed in accordance with substitution requirements.

1. Standard Wedge-Type Expansion Anchors:

a. Kwik Bolt 3 and TZ, by Hilti Corp.
b. Power-Stud+ SD1 and SD2, by Power Fasteners Inc.
c. Strong-Bolt 2, by Simpson Stront-Tie
d. Other where accepted

2. Heavy-Duty Wedge-Type Expansion Anchors:

a. HSL 3 Heavy Duty Sleeve Anchor, by Hilti Corp.
b. Power-Bolt, by Powers Fasteners Inc.
c. Other where accepted

3. Undercut Expansion Anchors:

a. HDA Undercut Anchor, by Hilti Corp.
b. Atomic+, by Powers Fasteners Inc.
c. Torq-Cut, by Simpson Strong-Tie
d. Other where accepted

4. Galvanizing shall conform to ASTM B 695, Class 50 or to ASTM B 633, SC1.
5. Stainless steel for studs and washers shall conform to AISI Grade 304 or Grade 316 and to ASTM F 593, Group 1 or Group 2, Condition SH. Nuts shall be of stainless steel conforming to ASTM F 594, Group 1 or Group 2, Condition SH.

K. Post-Installed Adhesive Anchors shall be either acrylic or epoxy, injectable type. Where substitutions are requested, the alternate adhesive shall be similar in type to that specified in the Contract Documents and be designed in accordance with substitution requirements.

1. Acryllic or Vinylester Adhesive:

    a. HY200, by Hilti Corp.
    b. AC100+ Gold, by Powers Fasteners Inc.
    c. Other where accepted

2. Epoxy Adhesive:

    a. Hilti RE 500 V3, by Hilti Corp
    b. PE1000+, by Powers Fasteners Inc.
    c. SET-XP, by Simpson Strong-Tie
    d. Other where accepted.

3. Galvanizing shall conform to ASTM B 695, Class 50 or to ASTM B 633, SC1.
4. Stainless steel for studs and washers shall conform to AISI Grade 304 or Grade 316 and to ASTM F 593, Group 1 or Group 2, Condition SH. Nuts shall be of stainless steel conforming to ASTM F 594, Group 1 or Group 2, Condition SH.

L. Thread Locking Compound shall be Loc-Tite 242 or 243, as appropriate, by Loctite Corporation, or other accepted compound.

M. Steel Deck Support Shelves: Provide angles of 5/16 inch (8 mm) minimum thickness and 3 inch (75 mm) minimum width except where different shapes or dimensions are accepted.

N. Shop and Field-Applied Paint shall be provided where designated in the Drawings, specified herein, and where required by *Building Code*. Paint materials shall be fully compatible with fireproofing and other materials in contact with the paint and shall be selected from the following:

1. Alkyd Modified Shop Primer and Field Touch-Up:

    a. Carbocoat 150 Primer, by Carboline Inc.
    b. Dulux Alkyd Primer 681-FD, by DuPont Co.
    c. Tnemec Primer 10-99, by Tnemec Company Inc.
    d. Other where accepted

2. Zinc-Rich Shop Primer:

    a. Carbozinc 11 HS or Carbozinc 859, by Carboline Inc.
    b. Ganicin 347-Y-931, by DuPont Co.
    c. Tneme-Zinc 90-96 or Tneme-Zinc 90-97, by Tnemec Company Inc.
    d. Other where accepted

3. Zinc-Rich Field Touch-Up:

    a. Carbozinc 859, by Carboline Inc.
    b. Ganicin 347-Y-937, by DuPont Co.
    c. Tneme-Zinc 90-97 by Tnemec Company Inc.
    d. Other where accepted

4. Where aluminum alloy is in contact with or fastened to steel members, the aluminum shall be kept from direct contact with the steel by painting the steel with a dielectric separator such as Bitumastic 50 by Carboline Inc., or other where accepted.
5. Fusion Bonded Epoxy Coating shall conform to ASTM A775. Acceptable manufacturer is Scotch Kote 413 by 3M, or other where accepted.

O. Galvanized Steel: Where required to be galvanized, members shall be hot-dipped after fabrication in accordance with ASTM A123 or with ASTM A153, as applicable. Galvanizing shall equal or exceed 2 oz. per square foot (600 g/m^2) of surface.

P. Galvanizing Repair Paint: Provide organic, zinc-rich paint that contains at least 90% zinc particles in the dried film. Galvanizing paint shall comply with either ASTM A-780, Federal Specification DOD-P-21035 or Military Specification MIL-P-26915.

1. Brite Zinc, by Brite Products
2. ZIRP, by Duncan Galvanizing Corp.
3. ZRC Cold Galvanizing Compound, by ZRC Products Company
4. Other where accepted

Q. Weldable Primer shall be used for the protection of beveled surfaces to be complete penetration or partial penetration welded in the field. Weldable primer is also acceptable for the protection of milled surfaces used in bearing connections. Acceptable primers are CarboWeld 11 HS by Carboline, Deoxalumite by AACO, or other accepted weldable primer.

R. Milled Surfaces: Coat with Multi-Bond 120 (Carbo-Crylic), by Carboline Inc., or other accepted rust-inhibitive coating.

PART 3 - EXECUTION

3.1 CONTRACTOR'S INSPECTION

A. Examination of Field Conditions: Examine all surfaces, features and facilities to which Work must be attached or applied, abut or clear. Notify Construction Manager and Architect in writing of all conditions which are or will be detrimental to proper and expeditious installation of Work. Starting of Work shall represent acceptance by Contractor of surfaces and of conditions as suitable and correct for performing Work as specified.

B. Field Measurements: Contractor shall verify, by measurements at the jobsite, all dimensions affecting the Work of this Section. Field dimensions at variance with those in accepted Shop Drawings shall be reported in writing by Contractor. Decisions regarding corrective measures shall be subject to acceptance and acceptance shall be obtained before starting fabrication of items affected. The starting of Work shall represent acceptance by Contractor of all dimensions affecting the Work of this Section as suitable and correct for the performing of all Work under this Section.

3.2 FABRICATION

A. Structural Steel shall be shop fabricated in strict accord with Shop Drawings, certificates, and other accepted data. All Work shall conform to the applicable Standard as given herein and as need apply to the Work. Workmanship shall be of the best practice of relevant trades and shall be performed by skilled mechanics making use of modern tools and equipment in good condition. To the extent practical, Work shall be accomplished in the shop and not in the field.

B. Material Delivery Tolerances: While ASTM A6 and A20 are acceptable delivery tolerances for mill material, Contractor shall straighten, square, flatten and torsionally align plates and shapes as necessary to provide fabricated elements within allowable tolerances as well as to provide correct alignment, good fit and uniform erection clearance, as applicable.

C. Cleaning and Straightening: Prior to fabrication or Work, all steel shall be examined for confirmation to the delivery tolerances. All out-of-tolerance conditions shall be corrected prior to fabrication by making use of techniques accepted under this Specification. Steel shall then be cleaned by blasting and/or wire brushed so as to remove all loose mill, scale and rust.

D. Camber and Sweep: Except where specific camber or sweep is designated in the Drawings, beams shall be fabricated with natural camber up. Provide spandrels and beams adjacent to openings with the natural sweep inward (toward the building and away from immediately adjacent openings). Designated camber shall provide actual camber in the erected steelwork within camber tolerances set forth in AISC Manual (for rolled shapes) and in AWS D1.1, Chapter 5.23 (for built-up shapes).

E. Finishing shall mean milled to ASA 250 or smoother, unless another finishing method is both designated in Shop Drawings and accepted. Finished surfaces shall be protected by a corrosion inhibiting substance. Finish contact surfaces of grillages, base plates, column splices, where indicated "fit to bear", and at other locations where indicated in Drawings.

F. Gas Cutting: Gas cutting, including miscellaneous cuts, copes, cuts for weld access and the like, shall provide smooth, uniform, workmanlike surfaces and shall achieve a 1000 micron surface roughness or better as defined by ANSI/ASME B46.1. Except where accepted, gas cutting shall be machine guided; cutting by hand-guided tools will require grinding. Provide 1/2 inch (13 mm) minimum radius cut at all reentrant corners except where a smaller or larger radius for specific details is shown or noted in the Drawings or specifically proposed by Contractor and accepted in Shop Drawings. Gas cut surfaces shall be made uniform and notch-free by chipping, planing, welding and grinding as required, and shall be verified by Contractor by full visual inspection; where hand-held cutting tools are used, and where required by *AISC Specification*, Contractor shall provide 100% inspection by liquid-penetrant or by magnetic particle.

1. Galvanized Members: Gas-cut surfaces at reentrant corners shall be ground to bright metal and tested by dye-penetrant or magnetic particle testing prior to galvanizing, and shall be verified by Contractor by full visual inspection after galvanizing.

G. Straightening: Fabricated materials containing sharp kinks or bends shall be rejected. Material straightened prior to fabrication shall be examined carefully for signs of distress and for other defects before being placed in fabrication. Distressed or otherwise defective material shall not be used in the Work. Straightening by the use of properly controlled heat will be permissible if done by personnel skilled in heat straightening, using equipment and techniques in accord with written procedure documents and applicable detail sketches prepared by the Fabricator and accepted.

1. Follow procedures provided under AWS D1.1.
2. Fuel shall be propane and oxygen.
3. Temperature may not exceed 1200°F (650°C) - a dull red color - or limits specified for quench and tempered steels, as applicable.

    a. Control with Tempilstick or Thermomelt Stick for 1000°F (550°C) to 1200°F (650°C) range.
    b. Single burner torches shall be used.

4. Air cool at ambient temperature.

    a. Water cooling shall be used only with written permission.

5. All welds in straightened material shall be reinspected by Contractor, by UT or MT as appropriate.

H. Grinding: Sharp corners, projections, and similar rough or sharp surfaces or edges shall be eased and smoothed by grinding so as to provide notch-free surfaces.

I. Preheat: Welding shall be performed on material preheated to a temperature above the dewpoint, regardless of other preheating requirements. Preheat for welding shall be soaked preheat and shall be verified by heat sensitive crayons (Tempilstik, by Tempil, Inc.) or other accepted means.

J. Welding Materials and processes shall be selected from those specified herein and shall conform to accepted welding procedure specifications. Welding materials shall be fresh and new. Welding electrodes or flux contaminated by deleterious substances or moisture shall not be used and shall be removed promptly from the Work. Low hydrogen electrodes which cannot be used promptly after opening of hermetically sealed containers shall be stored in electric holding ovens at 250°F (120°C) minimum. Electrodes or flux which have been dampened or contaminated shall be removed promptly from the Work.

K. Tack Welds: Exercise the same degree of control in making tack welds as required for structural welds, including provision of preheat and postheat appropriate to the basemetals joined. Tack welds which crack shall be cut or ground and damaged base metal repaired. Remove and grind smooth tack welds not incorporated into permanent structural welds.

L. Arc Strikes: Stray arcing between electrodes or other portions of the welding system and base metal locations outside structural welds shall be avoided to the maximum extent practicable. In those locations where arc strikes do occur, the affected base metal shall be ground smooth, or otherwise repaired, to remove the effects of the arc strike and ensure continuing soundness of the base metal.

M. Shop Bolting with ASTM A325 or ASTM A490 bolts shall conform to applicable provisions of the *AISC Specification* and *Specification for Structural Joints Using ASTM A325 or* A490 *Bolts* except that all bolting provisions set forth in ERECTION of this Section shall apply to high-strength shop bolting.

N. Drainage Holes: Provide hollow tubular, box and other members with effective drainage holes except where members are sealed tight at Contractor's option or in accord with notes and details included in the Drawings. Structural Steel Sub-Contractor is fully responsible to provide steelwork free of entrapped water at the completion of the project.

O. Beam Openings: Provide openings as shown, noted or scheduled in the Drawings. Provide holes, slots and openings required for passage of Work of other trades together with necessary reinforcing. Use suitable templates for accurate location of openings. Where openings are shown in the Drawings or in Shop Drawings, changes in location will not be permitted except where accepted specifically. Beam openings not shown or scheduled shall be provided only where accepted specifically.

P. Steel Deck Support Material shall be shop welded to structural steel except where field welding is necessary to provide required erection sequences.

Q. Bolt Holes: Drill or punch holes at right angles to the surface of the metal. Provide holes not more than 1/16 inch (1500 μm) larger than the connector diameter unless oversize or slotted holes are shown or noted in the Drawings or specifically accepted. Do not make or enlarge holes by burning. Drill or sub-punch and ream material where thickness exceeds the connector diameter and in all material thicker than 7/8 inch (22 mm). Holes shall be true and fair without torn or ragged edges. Elongated punch and die sets shall be used to punch elongated holes. Burrs shall be removed.

R. Quality of Welds and Base Metal: Quality of all welds shall conform to AWS D1.1, Chapter 6 - Part C. When examined by UT, partial and complete penetration welds shall conform to AWS D1.1, Chapter 6 statically loaded acceptance criteria. Unless otherwise noted, welds shall be assumed to be subjected to tension stress normal to the weld axis. Cracking or incomplete penetration shall be cause for rejection of each weld possessing such defects, regardless of other acceptance or rejection criteria. Base metal containing gross discontinuities before or after welding or lamellar tearing after welding shall be repaired in accord with procedures accepted by Structural Engineer or shall be discarded and replaced.

1. Provide material thickness and width transitions in accord with details in the Drawings where shown, and in accord with the provisions of AWS D1.1, Article 2.29.
2. Provide weld access holes or cuts in accord with details shown in the Drawings, the provisions of AWS D1.1, the provisions of the *AISC Specification* and the gas cutting provisions of this Specification. Plug access holes with defect-free base metal and weld metal where sealed members are required.

S. Built-Up Members shall be constructed true to line. Plate edges shall be cut or milled true to line. Included plate edges shall be parallel straight or curved lines with edge surfaces normal to the plate surface. Provide uniform cross section, minimum practicable twist, and minimum practicable deviation from true lines. Provide true and uniform camber where noted in the Drawings. Provide bent plates true to line and uniformly true to angle.

1. Weld built-up members using weld procedures, weld patterns and weld joint designs which will produce true lines and avoid distortion of base metal.
2. Splice web plates prior to cutting longitudinal edges to line and prior to bending or to curving. Splice flange plates prior to fitting up assembled web plates.
3. Camber for built-up members shall be achieved by the cutting of web plates to the required parabolic curvature.
4. Weld sequence shall be planned and executed so as to minimize locked-in stresses and to minimize distortion.
5. Completed members shall be straight or uniformly curved, as applicable, and shall align with adjacent construction where required to assist in achieving the designed architectural effect.
6. At the finished ends of built-up members, prior to finishing (if required), carbon arc gouge grooves along lines of plate intersections in sufficient depth to provide positive, crack-free seal weld. Increase depth of gouge and weld size to the extent required to compensate for end finishing.

T. Stud Shear Connectors and Deformed Bar Anchors: Prepare structural steel surfaces as recommended by the stud manufacturer. Use automatic stud welding systems and use such systems in strict accord with the manufacturer's printed instructions. All welding ferrules shall be broken and shall be removed from the Work. Fillet welding shall be used for repair welding only. Arc weld repairs to stud welds shall be made to the extent required by AWS D1.1, Chapter 7. Conform to applicable provisions of Section 05 30 00.

1. Where indicated in the Drawings, bend deformed bar anchors in accordance with the Drawings and with this Specification:

    a. Before automatic stud welding, cold bend deformed bar anchors as required in accordance with the bend requirements given in the Contract Documents for concrete reinforcing bars of the same diameter. The use of heat to either bend or straighten deformed bar anchors is not permitted.
    b. Once bent, the shop straightening of either deformed bar anchors is not permitted. The field straightening of bars that have been embedded in concrete is not permitted except where accepted specifically.

U. Wide Flange Members of trusses, at intersecting panel points, may have their webs trimmed back to provide clearance for flange welds, unless specific details require webs to be flush with member ends or extended and developed by bolting or welding.

V. Brittle Fracture Contractor shall take all measures necessary to minimize the occurrence of brittle fracture. Measures shall include proper materials selection, fabrication techniques and the like.

1. Both base metal and welding materials shall provide adequate notch toughness.
2. Stress concentrations shall be minimized by carefully controlling notches and by controlling weld defects such as lack of fusion and cold cracking. Stress relief holes shall be provided at all welded web-to-flange interfaces for shapes with flange thickness in excess of 1.0 inches (25 mm).
3. Welds, including multiple-pass welds shall be completed in a single operation, without interruption.
4. Cooling rates and non-uniformity of cooling of welds shall be reduced by proper insulating blankets and, where necessary, by post-heating.

5. Excessive elevation of welding temperatures shall be avoided. Practices such as the simultaneous welding of both sides of a stiffener within the bosom of a wide flange shape shall not be allowed.
6. Provide and then remove run-on and run-off tabs at all locations where start-up or termination portion of weld may create a stress raiser.
7. Particular care shall be taken to eliminate cold cracking.

    a. Pre-heat and post-heat conditions shall be provided not less than as required per AWS D1.1.
    b. Welding electrodes are assumed to be of the low hydrogen type, thoroughly baked, and that rust and oil in welding grooves is not present. Note that sufficient pre-heating, with lower heating rate and wider pre-heated zone is required in order to keep interpass temperatures above minimum values, particularly where heavier sections are being welded.
    c. Weld cooling rate shall be controlled so as to reduce residual stresses caused by welding and to enhance hydrogen evolution.
    d. Welding at ambient temperatures below 32°F (0°C) shall not be accomplished without prior acceptance.

8. Take special care to grind copes, access holes and other cuts so as to improve the surface and to reduce the potential for notch formation.

W. Weld Inspection: Contractor shall inspect 100% of shop and field welds to assure that all welding conforms to the requirements of Contract Documents. Governing documents include, but are not limited to this Specification, Contract Drawings, *Building Code* and ANSI/AWS D1.1, D1.3, and D1.4. All inspections shall assume that welds are in tension, with direction of stress in most critical direction (for example, transverse to undercut).

X. Runon and Runoff Tabs shall be removed and the surface made smooth prior to visual and non-destructive testing and prior to shipping Work to the site. Tabs for field welds shall be removed at all locations where required or directed.

Y. Clean, Paint and Galvanize steel as provided herein. Do not paint steel except where provided specifically herein or in the Drawings.

Z. Holes for Division 03 30 00: Provide holes through structural steel for reinforcing steel and for form ties and the like in accord with shop drawings provided under Section 03 30 00.

AA. Weep Holes: Where open members (such as wide flange shapes or channels) are positioned on their sides with flanges up, capable of holding water, provide weep holes as shown in the drawings or as specified. Unless otherwise noted, provide 1/2 inch (12 mm) diameter weep holes at 10 feet (3 meters) o.c., but not less than three 1/2 inch (12 mm) diameter weep holes per piece: one weep hole at each end, and one at midspan.

3.3 ERECTION

A. Erection of steelwork shall be performed by skilled workers in accord with the accepted Shop Drawings and certificates and shall conform strictly to the Contract Documents.

B. Surveys: Contractor shall employ a Professional Engineer or Professional Surveyor licensed in the project's jurisdiction and experienced in surveying steel building frameworks to oversee all survey work. Contractor shall organize structural steel surveying procedures and records to demonstrate the degree of conformance of the steelwork to tolerances applicable to plumb, level, horizontal alignment and allowable displacement from theoretical elevation. Contractor shall report all discrepancies. Contractor shall not proceed with each erection step until appropriate acceptable corrections have been made, or until compensating adjustments to the structural steelwork have been accepted. Contractor's surveys for steelwork shall:

1. Establish permanent bench marks as shown and as necessary for the accurate erection of structural steel;
2. Assure that elevations of bearing surfaces, and locations of anchor devices are checked by accurate surveying before erection work proceeds.
3. Provide survey data during the course of the Work and a final survey showing the E-W, N-S and elevation position of the work points of each steel frame, truss, column and other major member as compared to theoretical location.
4. Take surveys and measure tolerances and plumbness at 68°F (20°C) or show corrections to surveys where temperature is either higher or lower.

C. Anchor Bolts and Other Connectors: Furnish anchor bolts, embedded plates and other connection materials which must be embedded into concrete Work, for placement under Section 03 30 00. Deliver to the site on-time and complete with templates and placing drawings. Tighten nuts in a manner consistent with the intent and the metallurgy of the bolt material.

1. Unless otherwise provided, for bolts designated as A325 or Dywidag thread bars, tighten 1/4 turn past snug tight.

D. Base Plates, Bearing Plates and Grillages: Furnish and place base plates and bearing plates accurately. Securely shim, level and align. Be responsible for maintaining steel in proper position through completion of grouting and until grout has achieved full strength. Non-shrink grout will be furnished and placed under Section 03 30 00. Do not allow grouting until beams, girders, trusses and so forth are permanently attached to column.

E. Guying and Bracing: The structural system may require temporary bracing in addition to members shown in the Drawings in order to resist safely all imposed loads during construction and to maintain correct alignment. Provide temporary guying, bracing and connecting members where needed to resist safely all possible combinations of construction and erection loads including dead loads, erection loads, wind and other lateral loads and superimposed construction loads, both horizontal and vertical. Remove temporary members and connections after permanent members are in place, final connections are made and concrete has achieved design strength. Design of temporary shoring, bracing and guying is Contractor's sole and complete responsibility, including all details of installation and removal, methods, sequence and timing. Contractor's Professional Engineer shall design and supervise the adequacy, installation and removal of temporary bracing.

F. Bolt Tensioning: ASTM A325 and A490 bolts shall be installed using one of the following systems:

1. Tension controlled fasteners with splined twist-off nubs (TCF) shall be installed in accord with *AISC Specification* requirements and with applicable printed instructions and

recommendations provided by the fastener manufacturer and tensioning system supplier. To provide uniform and full tensioning in multi-bolt joints, bolts shall be tightened in stages to assure uniform contact between faying surfaces and snug-tight condition at all points within each joint prior to final tensioning and shearing of the spline.

a. Tension controlled fasteners (TCF) shall be included in the base bid for ASTM A325 bolt sizes equal to and less than 1-1/8 inch (29 mm) in diameter.
b. Contractor shall check each TCF bolt after tensioning to verify that the sheared surface does not display any abnormality. Bolts displaying an abnormality shall be removed and replaced.
c. As an alternative, Contractor may include in his bid an add or deduct price for use of direct-tension indicating washers (DTI) on ASTM A325 bolt sizes equal to and less than 1-1/8 inch (29 mm) diameter.

2. Bolts 1 inch (25 mm) in diameter and larger and all ASTM A490 bolts shall be tensioned utilizing direct-tension indicating washers (DTI) in strict accord with ASTM F959. Under no circumstance may a DTI be reused. DTI washers shall not be used directly over slotted or oversized holes but shall be used in addition to all special washers required at slotted or oversize holes. Tensioning methods, number, thickness and type of washers, procedure and measurements shall be in strict accord with the manufacturer's latest printed instructions and recommendations and the latest requirements of the RCSC Specification.

a. Contractor shall verify correct tension by measuring the average residual gap between the bolt head or nut and the DTI in strict accord with ASTM F959. Torque wrenches or calibrated wrenches shall not be used to inspect or to verify the tension.
b. For bolts exposed to the weather, gaps in Type 325 DTI shall be reduced to less than 0.005 inches (130 μm) for not less than half of the perimeter of the DTI.

3. Filler beams may, at Contractor's option, be connected without making use of a tension control device but, if so, shall be tensioned by the “match marked” turn-of-the-nut technique. Filler beams do not frame to, or frame immediately adjacent to columns, do not frame to girders carrying columns, posts or hangers (except stair landing hangers), and do not frame to trusses.
4. Except where specifically waived in the Structural Drawings, all ASTM A325 and A490 bolts, whether or not used in bearing-type connections, shall be fully tensioned. This requirement shall be maintained whether or not required by *AISC Specification*.

G. Bolting Requirements: Contractor shall pay strict attention to the applicable codes and standards, to the requirements of this Specification and to the following general requirements:

1. Impact Wrenches used for tightening ASTM A325 and ASTM A490 bolts shall be in sufficiently good repair to dependably deliver the manufacturer's full rated torque. Air compressor(s) used to power impact wrenches shall be in good repair and shall be capable of delivering adequate air pressure and volume so that full rated performance is achieved from each wrench at the point of bolting. Air hoses and couplings shall be non-leaking. The impact wrench(es) selected shall tighten the bolts to not less than the minimum specified tension in thirty seconds or less.

    a. For bolt sizes equal to or larger than 1 inch (25 mm) ASTM A325 and 7/8 inch (22 mm) A490, provide impact wrenches equivalent to or larger in capacity than a Chicago Pneumatic CP6120, with air pressure at the wrench not less than 100 psi (700 kPa).

2. Washers: A hardened washer shall be installed adjacent to the bearing face of the turned element (nut or bolt head) of each ASTM A325 or ASTM A490 bolt assembly. A 5/16 inch (8 mm) thick washer or thicker, otherwise conforming to ASTM F436, shall be used at both ends of 1-1/8 inch (28 mm) and 1-1/4 inch (32 mm) diameter A490 bolts connecting material with standard size holes where material is 5/8 inch (16 mm) or less in thickness.
3. Long Slotted Holes, where accepted, and where on an outside ply, shall be covered completely by 5/16 inch (8 mm) ASTM F436 hardened washers; alternatively, either plate washers or continuous bars of at least 3/8 inch (10 mm) thickness and minimum yield point of Fy = 50 ksi (345 MPa) may be used. Holes in plate washers or bars shall be standard size. Regular hardened washers are required in addition to plate washers or bars.
4. Short Slotted and Oversized Holes, where accepted, and where on an outside ply, shall be covered by ASTM F436 hardened washers, plate washers or continuous bars as provided for long slotted holes.
5. Bolts and Nuts, at time of tightening, shall be clean, rust-free, free from thread damage, and shall retain not less than the light residual coating of oil as received from the factory. Thread lubricants shall be applied to all ASTM A490 bolts or nuts, to all 1 inch (25 mm) and larger ASTM A325 bolts and to all bolts and nuts that display any sign of loss of residual oil, rust or other contaminant. Where galvanized nuts are not wax-dipped by manufacturer, apply thread lubricant.

    a. Lubrication shall be completed prior to assembly and prior to being sent up into the Work, except that under no circumstance shall twist-off type tension-control fasteners be field lubricated.
    b. In the event of a dispute regarding tightness of bolts installed in the field, cleanliness and lubrication of bolts and nuts used for verification tests shall be specifically representative of field materials and conditions.

6. Tightening Procedures: During tightening, to the full extent practical, the unturned bolt element shall be held without rotation. All plies shall first be brought into full contact by partially tensioning all of the bolts. Tensioning shall commence from the most rigid part of the connection, moving to the free edges.
7. Retightening: ASTM A490 bolts and galvanized ASTM A325 bolts, once completely or partially tensioned, shall not be reused. ASTM A325 bolts may be reused only with specific written acceptance.
8. Length: Bolts shall not project beyond the face of the nut by more than three full threads. However, bolts shall at least be flush with the other face of the nut.

H. ASTM A307 Grade A Bolts may be used only where permitted by the Structural Drawings. Threads shall be precluded from the faying surfaces. Tighten using full manual effort on a suitable wrench so as to bring all surfaces into full bearing. Bolt head shall be tapped throughout the tightening process.

I. Unfair Holes shall not be enlarged by burning or drifting alone. Enlarge holes where necessary and permitted by flame piercing and reaming or by reaming alone or by other accepted means. Holes after enlargement shall be true round holes normal to the surfaces joined. Increase bolt size to fill enlarged and reamed holes, which shall then meet the requirements for "normal-sized" holes relative to the bolt size selected.

J. Faying Surfaces: Paint materials not specified as satisfying the mean slip coefficient for Class A surfaces as defined in the S*pecification for Structural Joints Using* ASTM A325 or A490 *Bolts* shall not be applied to faying surfaces.

K. Field Welding shall be performed only by properly licensed and certified welders. Welders shall wear on their helmets labels showing their AWS Qualification Number and shall carry at all times AWS identification/ certification cards. Pay strict attention to the need for welder to sign his/her name near welds which they have made. All welding provisions set forth in FABRICATION of this Section shall apply to field welding. Field welding shall be performed in accord with accepted procedure specifications. Field welds shall be subject to the same acceptance criteria as shop welds. Do not weld over a shop weld in the field unless the field weld is made with the same electrode and the same weld procedure as used in the shop.

L. Splices: Column splices and other compression joints that depend upon contact bearing after alignment shall conform with the following:

1. Bearing surfaces shall be cleaned before the parts are assembled.
2. Fastening of compression splices and joints shall be performed after the abutting surfaces have been brought uniformly into contact.

M. Permanent Connections: Structural members shall be permanently attached and made rigid only after all elements to be attached have been brought within the specified tolerances.

N. Field Fabrication, gas cutting and welding work shall conform to the applicable provisions of FABRICATION of this Section. Bent, kinked or deformed members may be rejected by Architect at its sole discretion. Such members may be straightened and corrected only in accord with accepted procedures. Gas cutting shall occur only where the metal being cut is not carrying stress, and provided stresses will not later be carried through a flame-cut surface.

O. Finger Tight: Bolts designated as "finger tight" shall be tensioned to 60 inch-pounds (6 N-m) with the goals of bringing the parts firmly together while allowing for a sliding connection. Provide thread locking compound at all such locations. Provide not less than two full cycles of torquing and untorquing to ensure that all bolts are properly tensioned.

P. Tolerances: Do not exceed tolerances provided under this Specification, *AISC Code*, *AISC Specification*, and AWS D1.1.

Q. Shims, where required to correct fit-up of Work, shall be free of corrosion and shall be of stainless steel.

R. Runoff and Runon Tabs shall be provided at the ends of all sensitive butt welds and both tabs and erection aids shall be removed at all locations where they interfere with the Work of other trades, and at all locations designated. Runoff tabs shall be not less than 1-1/4 inches (30 mm) in length.

S. Post-Installed Anchors shown in the Drawings, or accepted in writing, shall be installed in strict accord with Manufacturer's Printed Installation Instructions. Set perpendicular to concrete surface. Anchors may be placed in block or brick work only where voids within 9 inches (230 mm) of the anchor have been filled solidly, with grout. Drilled holes shall be cleaned thoroughly by compressed air or water jet. Holes in structural steel, intended to fit over post-installed anchors, shall be 1/16th inch (1500 µm) larger than the nominal diameter of the bolt except where larger or smaller holes are stipulated in the Drawings. Provide standard plate washer underneath Anchor Manufacturer’s provided washer.

T. Lock Nuts or Thread Locking Compound shall be used on all nuts not tensioned in accord with the specifications for ASTM A325 or ASTM A490 bolts and on all ASTM A307 bolts. Provide thread locking compound on A325 and A490 bolts only where allowed specifically in the Drawings; at other locations, use locking nuts as specified herein.

3.4 CLEANING, PAINTING AND GALVANIZING

A. General: Steel Work shall be cleaned, painted or galvanized as provided herein. Basic Work shall be done in the shop, with field touch-up, only, done in the field.

B. Corrosion Protection: This Specification contemplates 6 levels of corrosion protection:

1. Concrete-Encased/Unpainted: Steel Work shall be cleaned to meet the requirements of SSPC-SP2, by wire brush or other means at the option of Contractor. Reclean following erection to the extent required to achieve original condition.
2. Fireproofed/Unpainted: Steel Work shall be shop cleaned to meet the requirements of SSPC-SP3. Additional cleaning shall be accomplished in the field to ensure proper adherence of spray fireproofing.
3. Fireproofed/Shop Primed: Provide as for Fireproofed/Unpainted, but paint with shop primer with field touch-up, not less than 2.0 mils nor more than 4.0 mils dry film thickness (50 µm/100 µm). Provide only where shown specifically in the Drawings.
4. Shop Primed: Provide as for Fireproofed/Shop Primed.
5. Exposed to Ambient Temperature: Steel which is enclosed, concrete-encased or fireproofed, but which is not protected from changes in ambient temperature, shall be cleaned to meet the requirements of SSPC-SP6 before painting with a zinc-rich primer with field touch-up, not less than 2.0 mils nor more than 4.0 mils dry film thickness (50 µm/100 µm).
6. Exposed to Weather: Steel which is exposed to the weather including exterior lintels (except where stainless is required) shall be hot-dipped galvanized. Touch-up at welds and at damaged surfaces after first cleaning to SSPC-SP3, with slag and weld spatter removed first from all areas. Paint galvanized steel where shown in Drawings.

    a. Provide galvanized bolts, nuts, washers, DTI's, and inserts, as applicable, for the bolting of galvanized members.

C. Paint shall be applied only to dry surfaces, only at times when steel surface temperatures are above the dew point, and shall be applied thoroughly and evenly without sags or holidays. Paint shall be applied by suitable spray equipment in strict accord with the paint manufacturer's printed instructions. Provide a dry film thickness within the range specified herein, including around outside corners or other abrupt changes in surface profile.

D. Field Touch-Up shall be provided to field bolts of painted and of galvanized components and to all points of damage, including areas receiving weld after coating.

1. Unpainted surfaces shall be recleaned to the extent necessary to achieve sound tight bond of other Work.
2. Painted surfaces shall be cleaned and painted to the standards of the shop coating and touch-up so as to provide for workmanlike surfaces and for tight bond of other Work.
3. Galvanized surfaces shall be cleaned of slag and burned metal, by vigorous wire brushing and other tools, to base metal free from loose particles. Finish clean by solvents in accord with SSPC-SP1. Field-apply galvanizing touch-up to achieve quality of the original and undamaged shop coating.
4. Coat no-paint areas after completion of erection.

E. Contact with Aluminum: Surfaces which will be in contact with aluminum shall receive two coats of a dielectric separator over a shop-primed surface.

F. Handling, Shipping, Storing and Erection of Painted Steel: Contractor shall exercise handling means as well as shipping, storage and erection techniques to reasonably protect painted surfaces from damage, abrasion and soiling in order to minimize the need for touch-up painting after erection. Shop paint shall be adequately dry to withstand handling without damage prior to moving or loading steel elements for storage or delivery.

END OF SECTION 05 10 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
   2. Cold-formed metal framing includes studs, tracks, accessories, and reinforcement required to support partitions, operable walls, toilet partitions, soffits, bulkheads, displays, and similar mounted or suspended elements.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
   2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies, with height limitations.
   3. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.

6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment, indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. MarinoWARE

B. SCAFCO Steel Stud Company

C. The Steel Network, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height.
b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
c. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height.
d. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft. (239 Pa).
e. Floor Joist Framing: Vertical deflection of 1/360 for live loads and l/240 for total loads of the span.

f. Roof Rafter Framing: Vertical deflection of 1/120 of the horizontally projected span for live loads.
g. Ceiling Joist Framing: Vertical deflection of 1/120 of the span for live loads and 1/240 for total loads of the span.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
   a. Upward and downward movement of 1/2 inch (12.7 mm).
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
   1. Floor and Roof Systems: AISI S210.
   2. Wall Studs: AISI S211.
   3. Headers: AISI S212.
   4. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
   1. Grade: ST33H (ST230H).
   2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZM150), or GF30 (ZGF90).

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 33 (230).
   2. Coating: G60 (Z180).

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-3/8 inches (35 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-1/4 inches (32 mm).

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-3/8 inches (35 mm).

D. Steel Single- or Double-L Headers: Manufacturer's standard L-shapes used to form header beams, of web depths indicated, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Top Flange Width: 1-1/2 inches (38 mm).

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-3/8 inches (35 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Manufacturers: Basis of Design : Clark Dietrick or approved equal by one of following:
      a. AllSteel & Gypsum Products, Inc.
      b. MarinoWARE
      c. Simpson Strong-Tie Co., Inc.
      d. Steeler, Inc.
      e. The Steel Network, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
   2. Flange Width: 1 inch (25.4 mm) plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications..

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
      b. Flange Width: 1 inch (25.4 mm) plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).

b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25.4 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-3/8 inches (35 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-1/4 inches (32 mm).

C. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
2. Flange Width: 1 inch (25.4 mm) plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

D. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
a. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
b. Flange Width: 1 inch (25.4 mm) plus the design gap for one-story structures.
2. Inner Track: Of web depth indicated, and as follows:
a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
b. Flange Width: Dimension equal to sum of outer deflection track flange width plus 1 inch (25.4 mm).

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.7 FLOOR JOIST FRAMING

A. Steel Joists: Manufacturer's standard C-shaped steel joists, of web depths indicated, unpunched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

B. Steel Joist Track: Manufacturer's standard U-shaped steel joist track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).

2. Flange Width: 1-1/4 inches (32 mm), minimum.

2.8 ROOF-RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.9 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm).
   2. Flange Width: 1-5/8 inches (41 mm), minimum.

2.10 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.
   7. Gusset plates.
   8. Stud kickers and knee braces.
   9. Hole-reinforcing plates.
   10. Backer plates.

2.11 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M , Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
   1. Uses: Securing cold-formed steel framing to structure.
   2. Type: Torque-controlled expansion anchor.
   3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
   4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593 (ASTM F 738M), and nuts, ASTM F594 (ASTM F 836M).

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.12 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.35 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.13 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch (3.18 mm) in 10 feet (304.8 cm) and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3.18 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch (3.18 mm).

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6.35 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.59 mm).

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
   1. Anchor Spacing: 24 inches (609.6 mm).

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch (3.18 mm) between the end of wall-framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
   1. Stud Spacing: 12 inches (304.8 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
   1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
   2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
   1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches (1219.2 mm). Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches (152.4 mm) deep.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
1. Stud Spacing: 12 inches (304.8 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1219.2 mm) apart. Fasten at each stud intersection.
1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (304.8 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
1. Install solid blocking at 96-inch (2440-mm) centers.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: 12 inches (304.8 mm).

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single deep-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to studs and anchor to building structure.
   4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches (1219.2 mm) apart. Fasten at each stud intersection.
   1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (304.8 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at 96-inch (2440-mm) centers.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.7 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch (3.18 mm) in 10 feet (304.8 cm) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3.18 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.8 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.9 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

3.10 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Section 05 52 13 - Pipe and Tube Railings.

B. Section 07 71 23 - Manufactured Gutters and Downspouts: Downspout boots.

C. Section 09 91 13 - Exterior Painting: Paint finish.

D. Section 09 91 23 - Interior Painting: Paint finish.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.

E. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.

F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 MATERIALS - ALUMINUM

2.3 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.4 FABRICATED ITEMS

A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.

B. Lintels: Loose lintel angles and bolted lintel assemblies, as indicated on Structural and Architectural Drawings. Provide the following:

1. Finish:

a. Hot-dip galvanize after fabrication in accordance with ASTM A123/A123M.

b. Field-paint exposed portions of lintels in accordance with Section 099113 “Exterior Painting,” suitable for galvanized steel.

c. Do not paint or prime surfaces in contact with masonry or concrete.

2. Fasteners:
   a. Exterior lintel bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A153/A153M.
   b. Drill bolt holes prior to galvanizing whenever possible.
   c. Field modifications (cut edges, drilled holes) shall receive zinc-rich coating per ASTM A780.
3. Installation:
   a. Install lintels in accordance with Structural Drawings.
   b. Provide bearing lengths and shims as noted.
   c. Ensure galvanized coating remains intact; contractor shall touch up any damaged areas per ASTM A780.
4. Performance Requirements:
   a. Provide corrosion protection suitable for exterior exposure, embedded conditions, and wet masonry interfaces.
   b. Provide continuous corrosion protection to all faces of lintel, including those built into masonry pockets.

C. Exterior Stair Nosings
1. Metal stair nosing inserts for cast-in-place concrete stairs.
2. Material: Stainless Steel.
3. Profile: Cast-in nosing with slip-resistant abrasive or serrated surface.
4. Abrasive Insert: Factory-installed, non-slip, color as selected by architect from manufacturer's standard range.
5. Performance: Provide nosings with slip resistance suitable for exterior stair applications and compliant with applicable accessibility requirements.
6. Basis of Design: [Manufacturer and product, or “subject to compliance with requirements”].

D. Door Frames for Overhead Door Openings and Wall Openings: Channel sections; prime paint finish.

2.5 DOWNSPOUT BOOTS

A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
1. Configuration: Angular.
2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
3. Manufacturers:
   a. Downspoutboots.com, a division of J. R. Hoe & Sons; ____: www.downspoutboots.com/#sle.

2.6 HIDDEN ACCESS PANELS

A. Infill tray with perimeter drainage grate.
1. Material: Stainless steel.
2. Size: 12 by 12 inches (300 x 300 mm).
3. Loading: Pedestrian according to AASHTO HB.
4. Manufacturers:
   a. WunderCovers: www.wundercovers.com/#sle.

2.7 FINISHES - STEEL

A. Prime Painting: One coat.

B. Galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating. (Provide minimum 530 g/sq m galvanized coating.)

C. Galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.8 FINISHES - ALUMINUM

A. Exterior Aluminum Surfaces: Class I color anodized.

B. Interior Aluminum Surfaces: Class I natural anodized.

C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

D. Pigmented Organic Coating System: AAMA 2603 polyester or acrylic baked enamel finish; color as indicated.
   1. Manufacturers:
      a. PPG; Duracron: www.ppgmetalcoatings.com/#sle.

E. High Performance Organic Coating System: AAMA 2604 multiple coat, thermally cured fluoropolymer system; color as indicated.
   1. Manufacturers:
      a. Sherwin-Williams Company; POLANE Solar Reflective 2K Urethane Enamel: oem.sherwin-williams.com/#sle.

F. High Performance Organic Coating System: Multi-coat, high-durable polyester system; color as indicated on drawings.
   1. Systems:
      a. Two-coat in accordance with AAMA 2604.
   2. Manufacturers:
      a. Beckers Group; Beckry Tech: www.beckers-group.com/#sle.

G. Fluoroethylene Vinyl Ether (FEVE) Coating: Superior performing resin based organic powder coatings system complying with AAMA 2605; single coat applications when applied to aluminum with dry film thickness (DFT) of 2 to 3 mil, 0.002 to 0.003 inch (0.051 to 0.076 mm); color and gloss as scheduled.
   1. Apply coating to exposed metal surfaces with proper preparation and pretreatment in accordance with resin manufacturer's instructions.
   2. Products:
      a. PPG; Coraflon Platinum: www.ppgindustrialcoatings.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

D. Hidden Access Panels:
   1. Mount panel frame on mortar bed at indicated elevation, plumb and level.
   2. Infill panel cover with paver units following layout pattern without disruptions.
   3. Place panel cover in panel frame securely.

E. Metal stair nosing inserts shall be furnished under this Section and installed in coordination with concrete stair construction. Installation shall be performed by the concrete contractor unless otherwise indicated.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall mounted handrails.

B. Stair railings and guardrails.

C. Exterior railings at steps and ramps.

D. Exterior StartFragment non-penetrating, passive fall protection barrier system on roofs.EndFragment

1.2 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

B. Section 09 91 13 - Exterior Painting: Paint finish.

C. Section 09 91 23 - Interior Painting: Paint finish.

1.3 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

B. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.

C. Fabricator Qualifications:
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 207.
   2. A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.
   3. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Handrails and Railings:
   1. Garlock Safety Systems; _____: www.garlocksafety.com/#sle.
   2. Kee Safety, Inc; Kee Klamp (steel): www.keesafety.com/#sle.
   3. The Wagner Companies; ____: www.wagnercompanies.com/#sle.

B. Non-Weld Pipe Fittings:
   1. Kee Safety, Inc; Kee Klamp (steel): www.keesafety.com/#sle.

C. Accessibility-Compliant Handrail Brackets:
   1. Rakks/Rangine Corporation; ADA Compliant HR-202: www.rakks.com/#sle.

D. StartFragment Exterior non-penetrating, passive fall protection barrier system:
   1. Safety Rail Company; wsafetyrailcompany.comEndFragment

2.2 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Allow for expansion and contraction of members and building movement without damage to connections or members.

C. Dimensions: See drawings for configurations and heights.

D. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

E. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.3 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Anchor railings securely to structure as required by manufacturer.

END OF SECTION 05 52 13

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Framing with dimension lumber.
   2. Rooftop equipment bases and support curbs.
   3. Wood blocking, cants, and nailers.
   4. Wood furring and grounds.
   5. Wood sleepers.
   6. Utility shelving.
   7. Plywood backing panels.
   8. Pressure-treated nailers associated with masonry restoration and exterior flashing.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches (50.8 mm) nominal (1.5 inch (38 mm) actual) size in least dimension.

B. Dimension Lumber: Lumber of 2 inches (50.8 mm) nominal (1.5 inch (38 mm) actual) or greater size but less than 5 inches (127 mm) nominal (4.49 inch (114 mm) actual) size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
   3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
   4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
   5. Provide documentation of kiln-dried-after-treatment (KDAT) for UC3b material exposed to weather.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
   1. Preservative-treated wood.
   2. Fire-retardant-treated wood.

3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
   2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (457.2 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

E. Fasteners and connectors in contact with preservative-treated wood shall be hot-dip galvanized or stainless steel.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated or required by code, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (320.04 cm) beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high-temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Proj

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application:
1. Provide fire-retardant-treated wood only where indicated on Drawings, required by fire-resistance-rated assemblies, or required by code.
2. All other miscellaneous rough carpentry shall be untreated or preservative-treated as specified in Article 2.2.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade of any species.
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine or southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Northern species; NLGA.
   7. Eastern softwoods; NeLMA.
   8. Western woods; WCLIB or WWPA.

B. Other Framing: No. 2 grade of any of the following species:
   1. Hem-fir (north); NLGA.
   2. Southern pine; SPIB.
   3. Douglas fir-larch; WCLIB or WWPA.
   4. Southern pine or mixed southern pine; SPIB.
   5. Spruce-pine-fir; NLGA.
   6. Douglas fir-south; WWPA.
   7. Hem-fir; WCLIB or WWPA.
   8. Douglas fir-larch (north); NLGA.
   9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Rooftop equipment bases and support curbs.
   4. Cants.
   5. Furring.
   6. Grounds.
   7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine or southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Western woods; WCLIB or WWPA.
   7. Northern species; NLGA.
   8. Eastern softwoods; NeLMA.

C. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:
   1. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Premium or No. 2 Common (Sterling) grade; NeLMA, NLGA, WCLIB, or WWPA.

2. Mixed southern pine or southern pine No. 1 grade; SPIB.
3. Hem-fir or hem-fir (north), Select Merchantable or No. 1 Common grade; NLGA, WCLIB, or WWPA.
4. Spruce-pine-fir (south) or spruce-pine-fir, Select Merchantable or No. 1 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

D. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods, No. 2 Common grade; NELMA.
5. Northern species, No. 2 Common grade; NLGA.
6. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.7 METAL FRAMING ANCHORS

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 (Z180) coating designation.
1. Use for interior locations unless otherwise indicated.

B. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.91 mm) thick.
1. Use for wood-preservative-treated lumber and where indicated.

C. Stainless-Steel Sheet: ASTM A666/A666M, Type 304.
1. Use for exterior locations and where indicated.

D. Fasteners shall match or exceed the corrosion resistance of the connector.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.64 mm).

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406.4 mm) o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438.4 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438.4 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal (38-mm actual) thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (609.6 cm) o.c.

H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking. Provide separators between treated lumber and aluminum components.

K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
   2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
   3. ICC-ES evaluation report for fastener.

L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal- (19-by-63-mm actual-) size furring horizontally at 24 inches (609.6 mm) o.c.

C. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406.4 mm) o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 53

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SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Plastic-laminate-faced architectural cabinets.
   2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets that are not concealed within other construction.

B. Related Requirements:
   1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For plastic-laminate-faced architectural cabinets.
   1. Include plans, elevations, sections, and attachment details.
   2. Show large-scale details.
   3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
   5. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or fabricator's standard size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:
   1. Plastic Laminates: 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish required.
      a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermoset Decorative Panels: 8 by 10 inches (200 by 250 mm), for each color, pattern, and surface finish.
    a. Provide edge banding on one edge.
3. Corner Pieces:
    a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches (457.2 mm) high by 18 inches (457.2 mm) wide by 6 inches (152.4 mm) deep.
    b. Miter joints for standing trim.
4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of product.
1. Composite wood and agrifiber products.
2. Thermoset decorative panels.
3. High-pressure decorative laminate.
4. Glass.
5. Adhesives.

C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
1. Build mockups of typical architectural cabinets as shown on Drawings
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60

and 90 deg F (16 and 32 deg C) and relative humidity between 25 and 55 ???Insert numbers??? percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Fabricators: Subject to compliance with requirements

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.
   1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
   2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. Type of Construction: Frameless.

C. Door and Drawer-Front Style: Flush overlay.

D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

E. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade HGS.
   4. Edges: Grade HGS.
   5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

F. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3 , Grade VGS.
      a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
      b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.

c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Solid-hardwood lumber.

3. Drawer Bottoms: Hardwood plywood.

G. Dust Panels: 1/4-inch (6.4-mm) plywood or tempered hardboard above compartments and drawers unless located directly under tops.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2. Match Architect's sample.

3. As selected by Architect from laminate manufacturer's full range.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches (101.6 mm) long, 5/16 inch (7.94 mm) in diameter.

E. Catches: Magnetic catches, BHMA A156.9 , B03141.

F. Adjustable Shelf Standards and Supports: BHMA A156.9 , B04071; with shelf rests, B04081.

G. Shelf Rests: BHMA A156.9, B04013; metal.

H. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer.

a. Type: Full extension.

b. Material: Zinc-plated steel with polymer rollers.

2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

3. For drawers not more than 3 inches (76.2 mm) high and not more than 24 inches (609.6 mm) wide, provide Grade 2.

4. For drawers more than 3 inches (76.2 mm) high, but not more than 6 inches (152.4 mm) high and not more than 24 inches (609.6 mm) wide, provide Grade 1.
5. For drawers more than 6 inches (152.4 mm) high or more than 24 inches (609.6 mm) wide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches (508 mm) high and 16 inches (406.4 mm) wide, provide Grade 1HD-100.

I. Slides for Sliding Glass Doors: BHMA A156.9, B07063; plastic.

J. Door Locks: BHMA A156.11, E07121.

K. Drawer Locks: BHMA A156.11, E07041.

L. Door and Drawer Silencers: BHMA A156.16, L03011.

M. Float Glass for Cabinet Doors: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.
1. Thickness: 0.12 inch (3 mm).
2. Tint Color: Blue-green ???Insert color???.

N. Tempered Float Glass for Cabinet Doors: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3, 0.24 inch (6 mm) thick unless otherwise indicated.
1. Tint Color: Blue-green ???Insert color???.
2. Unframed Glass Doors: Seam exposed edges seamed before tempering.

O. Mirror Glass for Cabinet Doors: ASTM C1503, Mirror Select, Quality-Q3.
1. Thickness: 0.12 inch (3 mm).

P. Decorative Glass for Cabinet Doors: Provide decorative glass complying with Section 088113 "Decorative Glass Glazing."

Q. Tempered Float Glass for Cabinet Shelves: ASTM C1048, Kind FT, Condition A, Type I, Class 1 (clear), Quality-Q3; with exposed edges seamed before tempering, 0.24 inch (6 mm) thick.
1. Tint Color: Blue-green .

R. Grommets for Cable Passage: 1-1/4-inch (32-mm) OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Color: Brown.

S. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
1. Dark, Oxidized, Satin Bronze, Oil Rubbed: BHMA 613 for bronze base; BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: BHMA 605 for brass base; BHMA 632 for steel base.
3. Bright Brass, Vacuum Coated: BHMA 723 for brass base; BHMA 729 for zinc-coated-steel base.
4. Satin Brass, Blackened, Bright Relieved, Clear Coated: BHMA 610 for brass base; BHMA 636 for steel base.
5. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
6. Bright Chromium Plated: BHMA 625 for brass or bronze base; BHMA 651 for steel base.
7. Satin Stainless Steel: BHMA 630.

T. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Double click to insert sustainable design text for adhesives.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.6 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."
   1. For glass in frames, secure glass with removable stops.
   2. For exposed glass edges, polish and grind smooth.

PART 3 EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch (3.18 mm) in 96 inches (2438.4 mm) using concealed shims.
   1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (406.4 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 41 16

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SECTION 07 01 50.19 - PREPARATION FOR REROOFING

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

B. ASTM C1153 - Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging; 2010 (Reapproved 2015).

C. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2024.

D. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2023).

E. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2016a (Reapproved 2023).

F. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2026b.

G. ASTM D2178/D2178M - Standard Specification for Asphalt Glass Felt Used in Roofing and Waterproofing; 2015a (Reapproved 2021).

H. ASTM D4601/D4601M - Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing; 2004 (Reapproved 2020).

I. PS 1 - Structural Plywood; 2023.

J. PS 2 - Performance Standard for Wood Structural Panels; 2018.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:
   1. Full tear-off of roof system at areas indicated on Drawings.
   2. Re-cover preparation of roof areas indicated on Drawings.
   3. Removal of flashings and counterflashings.
   4. Temporary roofing.

B. Related Requirements:
   1. Section 011000 "Summary" for use of premises and for phasing requirements.
   2. Section 015000 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for reroofing preparation.

1.4 DEFINITIONS

A. EPS: Molded (expanded) polystyrene.

B. Full Roof Tear-off: Removal of existing roofing system down to existing roof deck.

C. OSB: Oriented strand board.

D. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

E. Roof Re-Cover Preparation: Existing roofing system is to remain and be prepared for new roof installed over it.

1.5 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting removal Work, conduct conference at Project site.
   1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing tear-off, including, but not limited to, the following:
      a. Reroofing preparation, including roofing system manufacturer's written instructions.
      b. Temporary protection requirements for existing roofing system components that are to remain.
      c. Existing roof drains and roof drainage during each stage of reroofing, and roof-drain plugging and plug removal.
      d. Construction schedule and availability of materials, Installer's personnel, equipment, and facilities needed to avoid delays.
      e. Existing roof deck conditions requiring Architect notification.
      f. Existing roof deck removal procedures and Owner notifications.
      g. Condition and acceptance of existing roof deck and base flashing substrate for reuse.
      h. Structural loading limitations of roof deck during reroofing.
      i. Base flashings, special roofing details, drainage, penetrations, equipment curbs, and condition of other construction that affect reroofing.
      j. HVAC shutdown and sealing of air intakes.
      k. Shutdown of fire-suppression, -protection, and -alarm and -detection systems.
      l. Asbestos removal and discovery of asbestos-containing materials.
      m. Governing regulations and requirements for insurance and certificates if applicable.
      n. Existing conditions that may require Architect notification before proceeding.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Temporary Roofing Submittal: Product data and description of temporary roofing system.
   1. If temporary roof remains in place, include surface preparation requirements needed to receive permanent roof, and submit a letter from roofing manufacturer stating acceptance of the temporary roof and that its inclusion does not adversely affect the new roofing system's resistance to fire and wind or specified special warranty.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.
   1. Include certificate that Installer is approved by warrantor of existing roofing system.
   2. Include certificate that Installer is licensed to perform asbestos abatement.

B. Field Test Reports:
   1. Fastener pull-out test report.

C. Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including exterior and interior finish surfaces, that might be misconstrued as having been damaged by reroofing operations.
   1. Submit before Work begins.

D. Landfill Records: Indicate receipt and acceptance of demolished roofing materials and hazardous wastes, such as asbestos-containing materials, by a landfill facility licensed to accept them.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Approved by warrantor of existing roofing system to work on existing roofing.

B. Regulatory Requirements:
   1. Comply with governing EPA notification regulations before beginning roofing removal.
   2. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.9 FIELD CONDITIONS

A. Existing Roofing System: Built-up asphalt roofing.

B. Owner will not occupy portions of building immediately below reroofing area.

C. Protect building to be reroofed, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from reroofing operations.

D. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

E. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.
   1. A roof moisture survey of existing roofing system is available for Contractor's reference.
   2. The results of an analysis of test cores from existing roofing system are available for Contractor's reference.
   3. Construction Drawings and Project Manual for existing roofing system are provided for Contractor's convenience and information, but they are not a warranty of existing conditions. They are intended to supplement rather than serve in lieu of Contractor's own investigations. Contractor is responsible for conclusions derived from existing documents.

F. Weather Limitations: Proceed with reroofing preparation only when existing and forecasted weather conditions permit Work to proceed without water entering existing roofing system or building.
   1. Remove only as much roofing in one day as can be made watertight in the same day.

G. Hazardous Materials: It is not expected that hazardous materials, such as asbestos-containing materials, will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. Existing roof will be left no less watertight than before removal.
   3. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner.
      a. Hazardous materials will be removed by Owner under a separate contract.

H. Hazardous Materials: A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
   1. Hazardous material remediation is specified elsewhere in the Contract Documents.
   2. Do not disturb hazardous materials or items suspected of containing hazardous materials except according to procedures specified elsewhere in the Contract Documents.
   3. Coordinate reroofing preparation with hazardous material remediation to prevent water from entering existing roofing system or building.

PART 2 PRODUCTS

2.1 TEMPORARY PROTECTION MATERIALS

A. EPS Insulation: ASTM C578.

B. Plywood: DOC PS 1, Grade CD, Exposure 1.

C. OSB: DOC PS 2, Exposure 1.

2.2 TEMPORARY ROOFING MATERIALS

A. Design and selection of materials for temporary roofing are Contractor's responsibilities.

B. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

C. Base Sheet: ASTM D4601/D4601M, Type II, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet.

D. Glass-Fiber Felts: ASTM D2178/D2178M, Type IV, asphalt-impregnated, glass-fiber felt.

E. Asphalt Primer: ASTM D41/D41M.

F. Roofing Asphalt: ASTM D312/D312M, Type III or IV.

G. Base Sheet Fasteners: Capped head, factory-coated steel fasteners, listed in FM Approvals' RoofNav.

2.3 INFILL AND REPLACEMENT MATERIALS

A. Use infill materials matching existing roofing system materials unless otherwise indicated.
   1. Infill materials are specified in Section 075113 "Built-up Asphalt Roofing" unless otherwise indicated.

B. Wood blocking, curbs, and nailers are specified in Section 061000 "Rough Carpentry."

C. Plywood roof sheathing is specified in Section 061600 "Sheathing."

D. Parapet Sheathing:
   1. ASTM C 1177/C 177M or ASTM C1278/C1278M water-resistant gypsum substrate; 1/4 inch (6.35 mm) thick.
   2. Pressure-preservative-treated plywood wall sheathing, 19/32 inch (15.08 mm) thick, complying with Section 061600 "Sheathing."

E. Fasteners: Factory-coated steel fasteners with metal or plastic plates listed in FM Approvals' RoofNav, and acceptable to new roofing system manufacturer.

2.4 AUXILIARY REROOFING MATERIALS

A. General: Use auxiliary reroofing preparation materials recommended by roofing system manufacturer for intended use and compatible with components of existing and new roofing system.

PART 3 EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:
   1. Loosely lay 1-inch- (25-mm-) minimum thick, EPS insulation over existing roofing in areas not to be reroofed.
      a. Loosely lay 15/32-inch (12-mm) plywood or OSB panels over EPS. Extend EPS past edges of plywood or OSB panels a minimum of 1 inch (25.4 mm).

2. Limit traffic and material storage to areas of existing roofing that have been protected.
3. Maintain temporary protection and leave in place until replacement roofing has been completed. Remove temporary protection on completion of reroofing.
4. Comply with requirements of existing roof system manufacturer's warranty requirements.

B. Seal or isolate windows that may be exposed to airborne substances created in removal of existing materials.

C. Shut off rooftop utilities and service piping before beginning the Work.

D. Test existing roof drains to verify that they are not blocked or restricted.
1. Immediately notify Architect of any blockages or restrictions.

E. Coordinate with Owner to shut down air-intake equipment in the vicinity of the Work.
1. Cover air-intake louvers before proceeding with reroofing work that could affect indoor air quality or activate smoke detectors in the ductwork.

F. During removal operations, have sufficient and suitable materials on-site to facilitate rapid installation of temporary protection in the event of unexpected rain.

G. Maintain roof drains in functioning condition to ensure roof drainage at end of each workday.
1. Prevent debris from entering or blocking roof drains and conductors.
a. Use roof-drain plugs specifically designed for this purpose.
b. Remove roof-drain plugs at end of each workday, when no work is taking place, or when rain is forecast.
2. If roof drains are temporarily blocked or unserviceable due to roofing system removal or partial installation of new roofing system, provide alternative drainage method to remove water and eliminate ponding.
a. Do not permit water to enter into or under existing roofing system components that are to remain.

3.2 ROOF TEAR-OFF

A. Notify Owner each day of extent of roof tear-off proposed for that day and obtain authorization to proceed.

B. Lower removed roofing materials to ground and onto lower roof levels, using dust-tight chutes or other acceptable means of removing materials from roof areas.

C. Remove aggregate ballast from roofing. Store aggregate ballast for reuse in manner not to exceed structural loading limitations of roof deck.

D. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing using a power broom.

E. Remove pavers and accessories from roofing.
1. Store and protect pavers and accessories for reuse in manner not to exceed structural loading limitations of roof deck.
2. Discard cracked pavers.

F. Full Roof Tear-off: Where indicated on Drawings, remove existing roofing and other roofing system components down to the existing roof deck.
1. Remove substrate board.
2. Remove base flashings and counter flashings.

3. Remove perimeter edge flashing and gravel stops.
4. Remove copings.
5. Remove expansion-joint covers.
6. Remove flashings at pipes, curbs, mechanical equipment, and other penetrations.
7. Remove roof drains indicated on Drawings to be removed.
8. Remove wood blocking, curbs, and nailers.
9. Bitumen and felts that are firmly bonded to concrete decks are permitted to remain if felts are dry.
    a. Remove unadhered bitumen, unadhered felts, and wet felts.
10. Remove fasteners from deck or cut fasteners off slightly above deck surface.

3.3 DECK PREPARATION

A. Inspect deck after tear-off of roofing system.

B. If broken or loose fasteners that secure deck panels to one another or to structure are observed, or if deck appears or feels inadequately attached, immediately notify Architect.
    1. Do not proceed with installation until directed by Architect.

C. If deck surface is unsuitable for receiving new roofing or if structural integrity of deck is suspect, immediately notify Architect.
    1. Do not proceed with installation until directed by Architect.

D. Provide additional deck securement as indicated on Drawings.

E. Replace steel deck as indicated on Drawings.

F. Replace steel deck as directed by Architect.
    1. Deck replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

G. Prepare and paint steel deck surface.

H. Replace plywood roof sheathing as indicated on Drawings.

I. Replace plywood roof sheathing as directed by Architect.
    1. Roof sheathing replacement will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

3.4 INFILL MATERIALS INSTALLATION

A. Immediately after roof tear-off, and inspection and repair, if needed, of deck, fill in tear-off areas to match existing roofing system construction.
    1. Installation of infill materials is specified in Section 075113 "Built-up Asphalt Roofing."
    2. Installation of wood blocking, curbs, and nailers is specified in Section 061000 "Rough Carpentry."

B. Install new roofing patch over roof infill area.
    1. If new roofing is installed the same day tear-off is made, roofing patch is not required.

3.5 TEMPORARY ROOFING

A. Install approved temporary roofing over area to be reroofed.

B. Install temporary roofing over area to be reroofed.
    1. Install two glass-fiber felts, lapping each sheet 19 inches (482.6 mm) over preceding sheet.

2. Embed glass-fiber felt in a solid mopping of hot roofing asphalt applied within equiviscous temperature range.
3. Glaze-coat completed surface with hot roofing asphalt.

C. Remove temporary roofing before installing new roofing.

D. Prepare temporary roof to receive new roofing according to approved temporary roofing proposal.
1. Restore temporary roofing to watertight condition.
2. Obtain approval for temporary roof substrate from roofing manufacturer and Architect before installing new roof.

3.6 ROOF RE-COVER PREPARATION

A. Remove blisters, ridges, buckles, mechanically attached roofing fastener buttons projecting above roofing, and other substrate irregularities from existing roofing that inhibit new recover boards from conforming to substrate.
1. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.
2. Scarify surface of sprayed polyurethane foam as necessary to achieve a sufficiently uniform plane to receive new recover boards.
3. Broom clean existing substrate.
4. Coordinate with Owner's inspector to schedule times for tests and inspections.
5. Verify that existing substrate is dry.
a. Spot check substrates with an electrical capacitance moisture-detection meter.
6. Remove materials that are wet or damp.
a. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

B. Remove blisters, ridges, buckles, mechanically attached roofing fastener buttons projecting above roofing, and other substrate irregularities from existing roofing that inhibit new recover boards from conforming to substrate.
1. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.
2. Shave surface of sprayed polyurethane foam as necessary to achieve a sufficiently uniform plane to receive new recover boards.
3. Broom clean existing substrate.
4. Coordinate with Owner's inspector to schedule times for tests and inspections.
5. Verify that existing substrate is dry before proceeding with installation.
a. Spot check substrates with an electrical capacitance moisture-detection meter.
6. Remove materials that are wet and damp.
a. Removal will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

C. Remove blisters and areas of roofing not fully adhered.

D. Remove mechanically attached roofing fastener buttons projecting above roofing and other substrate irregularities that inhibit new recover boards from conforming to substrate.
1. Remove loose aggregate from aggregate-surfaced, built-up bituminous roofing with a power broom.

2. Clean substrate of contaminants, such as dirt, debris, oil, and grease, that can affect adhesion of coated foamed roofing.
3. Power vacuum the existing roof surface.
    a. If recommended by foam manufacturer, prime dried surface at recommended rate with recommended primer.
4. Scarify surface of coated polyurethane roofing as necessary to achieve a suitable substrate for new roofing.
5. Provide additional uplift securement for existing roofing system with new screws and plates applied to each roof zone at the following densities:
6. Verify that surface is dry by pressing litmus paper to surface areas most likely to retain moisture, such as shaded areas and low spots.
    a. If paper changes color, surface is too wet to apply foam.
7. Build up isolated low spots on existing roofing with sprayed foam specified in Section 075700 "Coated Foamed Roofing" to prevent ponding.

3.7 BASE FLASHING REMOVAL

A. Remove existing base flashings.
    1. Clean substrates of contaminants, such as asphalt, sheet materials, dirt, and debris.

B. Do not damage metal counterflashings that are to remain.
    1. Replace metal counterflashings damaged during removal with counterflashings of same metal, weight or thickness, and finish as existing.

C. Inspect parapet sheathing, wood blocking, curbs, and nailers for deterioration and damage.
    1. If parapet sheathing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

D. Remove existing parapet sheathing and replace with new parapet sheathing to comply with Section 061600 "Sheathing."
    1. If parapet framing, wood blocking, curbs, or nailers have deteriorated, immediately notify Architect.

E. When directed by Architect, replace parapet framing, wood blocking, curbs, and nailers to comply with Section 054000 "Cold-Formed Metal Framing."

3.8 FASTENER PULL-OUT TESTING

A. Perform fastener pull-out tests according to SPRI FX-1, and submit test report to Architect before installing new roofing system.
    1. Obtain Architect's approval to proceed with specified fastening pattern.
        a. Architect may furnish revised fastening pattern commensurate with pull-out test results.

3.9 DISPOSAL

A. Collect demolished materials and place in containers.
    1. Promptly dispose of demolished materials.
    2. Do not allow demolished materials to accumulate on-site.
    3. Storage or sale of demolished items or materials on-site is not permitted.

B. Transport and legally dispose of demolished materials off Owner's property.

END OF SECTION 07 01 50.19

SECTION 07 21 00 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Board insulation and integral vapor retarder at perimeter foundation wall, underside of floor slabs, over roof deck, and exterior wall behind GWB wall finish.

B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

B. Section 07 26 00 - Vapor Retarders: Separate vapor retarder materials.

C. Section 07 51 00 - Built-Up Bituminous Roofing: Installation requirements for board insulation over low slope roof deck.

D. Section 072119 - Foamed-In-Place Insulation

1.3 DEFINITIONS

A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.

1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.4 REFERENCE STANDARDS

A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).

D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

E. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.

F. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Samples for Verification: Submit two samples 12 by 12 inches (304 by 304 mm) in size illustrating insulation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.

B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.

C. Insulation in Metal Framed Interior Walls: Acoustic Batt insulation with no vapor retarder.

D. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
   1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.

B. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, comply with ASTM C1289.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of core foam.
         2) Compressive Strength: Classes 1-2-3, Grade 3 - 25 psi (172 kPa), minimum.
         3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inch (38.1 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48), minimum, at 75 degrees F (24 degrees C).
         4) See Drawings for assembly R-value
   2. Board Size: 48 inch by 96 inch (1220 mm by 2440 mm).
   3. Board Thickness: 1.5 inch (37.5 mm).
   4. Tapered Board: Slope as indicated; minimum thickness ____ inch (____ mm); fabricate of fewest layers possible.
   5. Board Edges: Square.

2.3 MINERAL FIBER BLANKET INSULATION MATERIALS

A. Mineral Fiber Enclosure for Recessed Ceiling Fixtures: Insulated box enclosure with foil facing on exterior side for placement over recessed ceiling light fixture; flame spread index of 25 or less, and smoke development index of 450 or less when tested in accordance with ASTM E84.
   1. Light Fixture Size: As indicated on drawings.

2.4 ACCESSORIES

A. Sheet Vapor Retarder: See Section 07 26 00.

B. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
   1. Application: Sealing of interior circular penetrations, such as pipes or cables.
   2. Width: Are required for application.

C. Self-Adhered Transition Flashing: Multipurpose, self-adhered flashing with modified butyl adhesive, polyester fiber top sheet, and polypropylene interlayer.
   1. Application: Primerless adhesion for use as through-wall flashings and wall transitions to roof and below-grade systems.
   2. Thickness: 45 mil, 0.045 inch (1.14 mm), nominal.
   3. Size: 6 inches (152 mm) wide, in rolls 75 feet (23 m) long.

D. Flashing Tape: Special reinforced film with high performance adhesive.
   1. Application: Window and door opening flashing tape.
   2. Width: As required for application.

E. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
   1. Width: 3-1/2 inches (89 mm).
   2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.

F. Air and Moisture Sealing Insulation Fasteners: Preassembled fastener units consisting of sealing washer, screw, and gasketing tube.

G. Infill Strips:
   1. High-performance insulation, PIR or XPS.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Adhere a 6 inches (152 mm) wide strip of polyethylene sheet over construction, control, and expansion joints with double beads of adhesive each side of joint.
   1. Tape seal joints.
   2. Extend sheet full height of joint.

B. Apply adhesive to back of boards:
   1. Three continuous beads per board length.

C. Install boards horizontally on foundation perimeter.
   1. Place boards to maximize adhesive contact.

D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Board Installation Over Roof Deck, General:
   1. See applicable roofing specification section for specific board installation requirements.
   2. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.
   3. Do not apply more insulation than can be covered with roofing on the same day.

3.6 BATT INSTALLATION

A. Install insulation and vapor retarder in accordance with manufacturer's instructions.

B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

END OF SECTION 07 21 00

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Foamed-in-place insulation.
   1. On interior face of existing mass masonry walls.
   2. At wall-to-roof insulation continuity transitions as indicated on drawings.

B. Foamed-in-place intumescent insulation, two-layer hybrid system.

C. Protective intumescent coating.

1.2 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2019.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

D. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

E. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

F. FM 4880 - Examination Standard for Class 1 Fire Rating of Building Panels or Interior Finish Materials; 2022.

G. NFPA 275 - Standard Method of Fire Tests for the Evaluation of Thermal Barriers; 2022.

H. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

I. UL 1040 - Standard for Safety Fire Test of Insulated Wall Construction; Current Edition, Including All Revisions.

J. UL 1715 - Standard for Safety Fire Test of Interior Finish Material; Current Edition, Including All Revisions.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.

C. Certificates: Certify that products of this section meet or exceed specified requirements.

D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection as required by ABAA QAP.

E. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.

F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified, with minimum three years documented experience, and approved by manufacturer.

B. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:
   1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.
   2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.6 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Construct 1 mock-up, 8 feet long by 8 feet wide; include insulation overcoat, wall construction, window and frame, and door frame in mock-up.

C. Locate where directed.

1.7 FIELD CONDITIONS

A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.

B. Do not apply foam when temperature is within 5 degrees F (2.78 degrees C) of dew point.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Foamed-In-Place Insulation:
   1. Basis of Design: Carlisle Spray Foam Insulation: www.carlislesfi.com/#sle.
   2. Huntsman Building Solutions; Heatlok HFO Pro: www.huntsmanbuildingsolutions.com/#sle.
   3. Johns Manville; JM Corbond High Yield Open-Cell: www.jm.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MATERIALS

A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.
   1. Regulatory Requirements: Comply with applicable code for flame and smoke, concealment, and fire protection requirements.
      a. Fire Protection: Provide 15-minute thermal barrier of 1/2 inch (12.7 mm) gypsum board or equivalent material complying with NFPA 275 test method, or foamed-in-place insulation either exposed or with covering that complies with FM 4880, NFPA 286, UL 1040, or UL 1715.

2. Thermal Resistance: R-value (RSI-value) of 7.1 (1.25), minimum, per 1-inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature when tested in accordance with ASTM C518.
3. Water Vapor Permeance: Vapor semi permeable; 10 perms or less and greater then 1 perm, when tested at intended thickness in accordance with ASTM E96/E96M, desiccant method.
4. Water Absorption: Less than 2 percent by volume, maximum, when tested in accordance with ASTM D2842.
5. Air Permeance: 0.04 cfm per square foot (0.2 L/(s/sq m)), maximum, when tested at intended thickness in accordance with ASTM E2178 at 1.57 psf (75 Pa).
6. Closed Cell Content: At least 90 percent.
7. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.3 ACCESSORIES

A. Primer: As required by insulation manufacturer.

B. Protective Coating: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.
1. Closed-cell spray polyurethane foam shall be separated from the interior by a 15-minute thermal barrier of gypsum board unless tested and approved for exposure per NFPA 286.
2. Coating Type: Single component, water-based.
3. Protected Insulation Type: Spray polyurethane foam (SPF).
4. Application: Apply using brush, roller, or airless sprayer.
5. Surface Burning Characteristics: Flame spread/smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
6. Color: Black.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify work within construction spaces or crevices is complete before insulation application.

B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation adhesion.

3.2 PREPARATION

A. Mask and protect adjacent surfaces from over spray or dusting.

B. Apply primer in accordance with manufacturer's instructions.

3.3 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Field inspections and tests will be performed by an independent testing agency.

C. Coordination of ABAA Tests and Inspections:
1. Provide testing and inspection required by ABAA QAP.
2. Notify in ABAA writing of schedule for air barrier work. Allow adequate time for testing and inspection.
3. Cooperate with ABAA testing agency.

4. Allow access to air barrier work areas and staging.
5. Do not cover air barrier work until tested, inspected, and accepted.

3.5 PROTECTION

A. Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION 07 21 19

SECTION 07 51 13 - BUILT-UP ASPHALT ROOFING

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.

B. ASTM C728 - Standard Specification for Perlite Thermal Insulation Board; 2017a (Reapproved 2022).

C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.

D. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2024.

E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.

F. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2023).

G. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2026b.

H. ASTM D4263 - Standard Practice for Indicating Moisture in Concrete by the Plastic Sheet Method; 2024.

I. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016 (Reapproved 2023).

J. ASTM D4897/D4897M - Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing; 2016 (Reapproved 2023).

K. ASTM D6222/D6222M - Standard Specification for Atactic Polypropylene (APP) Modified Bituminous Sheet Materials Using Polyester Reinforcements; 2016 (Reapproved 2023).

L. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2020a.

M. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2023.

N. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.

O. CRRC-1 - CRRC-1 Roof Product Rating Program Manual; 2026.

P. PS 2 - Performance Standard for Wood Structural Panels; 2018.

Q. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:
   1. Built-up asphalt roofing.
   2. Vapor retarder.
   3. Roof insulation.

B. Related Requirements:
   1. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
   2. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
   3. Section 077129 "Manufactured Roof Expansion Joints" for proprietary manufactured roof expansion-joint assemblies.
   4. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
   5. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.4 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to Work of this Section.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
   3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.
   6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing.
   7. Review governing regulations and requirements for insurance and certificates if applicable.
   8. Review temporary protection requirements for roofing during and after installation.
   9. Review roof observation and repair procedures after roofing installation.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For built-up roofing. Include plans, elevations, sections, details, and attachments to other work, including:
   1. Base flashings and built-up terminations.
   2. Tapered insulation, including slopes.
   3. Crickets, saddles, and tapered edge strips, including slopes.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:
   1. Cap sheet, of color required.
   2. Flashing sheet, of color required.
   3. Aggregate surfacing material in gradation and color required.
   4. Roof paver, full sized, in each color and texture required.

5. Walkway pads or rolls, of color required.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that built-up roofing complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: For components of built-up roofing, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Research/Evaluation Reports: For components of built-up roofing, from ICC-ES.

E. Field quality-control reports.

F. Sample Warranties: For manufacturer's special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For built-up roofing to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for built-up roofing identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by built-up roofing manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.11 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be installed according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of built-up roofing that fail in materials or workmanship within specified warranty period.

1. Special warranty includes built-up roofing membrane, base flashings, roofing accessories, and other components of built-up roofing.
2. Warranty Period: 30 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of built-up roofing such as built-up roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Johns Manville, Carlisle, GAF, Soprema

B. Source Limitations: Obtain components including roof insulation for built-up roofing from same manufacturer as built-up roofing.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed built-up roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Built-up roofing and base flashings shall remain watertight.
1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by built-up roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:
1. Corner Uplift Pressure: ???Insert lbf/sq. ft. (kPa/sq. m)???.
2. Perimeter Uplift Pressure: ???Insert lbf/sq. ft. (kPa/sq. m)???.
3. Field-of-Roof Uplift Pressure: ???Insert lbf/sq. ft. (kPa/sq. m)???.

D. FM Global Listing: Built-up roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
1. Fire/Windstorm Classification: Class 1A-60.
2. Hail-Resistance Rating: MH.

E. Energy Star Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75when tested according to CRRC-1.

G. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

H. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 ROOFING MEMBRANE SHEET MATERIALS

A. Sheathing Paper: Red-rosin type, minimum 3 lb/100 sq. ft. (0.16 kg/sq. m).

B. Base Sheet: ASTM D 4601, Type II, SBS-modified asphalt-impregnated and -coated sheet, with glass-fiber-reinforcing mat, dusted with fine mineral surfacing on both sides.
   1. Weight: 25 lb/100 sq. ft. (1.2 kg/sq. m), minimum.

C. Base Sheet: ASTM D 4601, Type I, nonperforated, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

D. Base Sheet: ASTM D4897/D4897M, Type II, venting, nonperforated, heavyweight, asphalt-impregnated and -coated, glass-fiber base sheet with coarse granule surfacing or embossed venting channels on bottom surface.

E. Base Sheet: ASTM D 2626, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

F. Ply Sheet: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.

G. Cap Sheet: ASTM D 3909, asphalt-impregnated and -coated, glass-fiber cap sheet, with white coarse mineral-granule top surfacing and fine mineral surfacing on bottom surface.

2.4 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: ASTM D 2178, Type IV, asphalt-impregnated, glass-fiber felt.

B. Backer Sheet: ASTM D 4601, Type I, asphalt-impregnated and -coated, glass-fiber sheet, dusted with fine mineral surfacing on both sides.

C. Backer Sheet: ASTM D 2626, asphalt-saturated and -coated organic felt, dusted with fine mineral surfacing on both sides.

D. Granule-Surfaced Flashing Sheet: ASTM D 6164/D 6164, Grade G, Type I or II, polyester-reinforced, SBS-modified asphalt sheet; granule-surfaced base flashing; suitable for application method specified, and as follows:
   1. Granule Color: White.

E. Metal-Foil-Surfaced Flashing Sheet: ASTM D 6298, glass-fiber-reinforced, SBS-modified asphalt sheet; metal-foil surfaced; suitable for application method specified, and as follows:
   1. Foil Surfacing: Aluminum.

F. Smooth-Surfaced Flashing Sheet: ASTM D6222/D6222M , Grade S, Type I or II, polyester-reinforced, APP-modified asphalt sheet; smooth surfaced; suitable for application method specified.

G. Granule-Surfaced Flashing Sheet: ASTM D6222/D6222M , Grade G, Type I or II, polyester-reinforced, APP-modified asphalt sheet; granule surfaced; suitable for application method specified, and as follows:
   1. Granule Color: White.

H. Glass-Fiber Fabric: Woven glass-fiber cloth, treated with asphalt, complying with ASTM D 1668, Type I.

2.5 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D41/D41M.

B. Roofing Asphalt: ASTM D 312, Type IV.

C. Roofing Asphalt: ASTM D 6152, SEBS modified.

2.6 AUXILIARY BUILT-UP ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing manufacturer for intended use and compatible with built-up roofing.
   1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Cold-Applied Adhesive: Roofing manufacturer's standard asphalt-based, one- or two-part, asbestos-free, cold-applied adhesive specially formulated for compatibility and use with built-up base flashings.

C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing manufacturer for application.

D. Mastic Sealant: Polyisobutylene, plain or modified bitumen; nonhardening, nonmigrating, nonskinning, and nondrying.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening built-up roofing components to substrate; tested by manufacturer for required pullout strength, and acceptable to roofing manufacturer.

F. Aggregate Surfacing: ASTM D 1863, No. 6 or No. 67, clean, dry, opaque, water-worn gravel or crushed stone, free of sharp edges.

G. Miscellaneous Accessories: Provide those recommended by roofing system manufacturer.

2.7 SUBSTRATE BOARDS

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch (12.7 mm) thick, factory primed.

B. Substrate Board: ASTM C1278/C1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/2 inch (12.7 mm) thick.

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.8 VAPOR RETARDER

A. Polyethylene Film: ASTM D4397, 6 mils (0.01 inch (0.15 mm)) thick, minimum, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq. m).
   1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
   2. Adhesive: Manufacturer's standard lap adhesive, FM Global approved for vapor-retarder application.

B. Laminated Sheet: Polyethylene laminate, two layers, reinforced with cord grid, with maximum permeance rating of 0.06 perm (3.5 ng/Pa x s x sq. m).

1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

C. Self-Adhering Sheet Vapor Retarder: ASTM D 1970, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil- (1.0-mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

D. Self-Adhering Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil- (0.76- mm-) total thickness; maximum permeance rating of 0.1 perm (6 ng/Pa x s x sq. m); cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

E. Glass-Fiber Felts: ASTM D 2178, Type IV, asphalt impregnated.

2.9 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 12 inches (304.8 mm) per 1/4 inch (6.35 mm) unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.10 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatible with built-up roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation to substrate and acceptable to roofing manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
3. Full-spread spray-applied, low-rise, two-component urethane adhesive.

D. Insulation Cant Strips: ASTM C728, perlite insulation board.

E. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

F. Wood Nailer Strips: Comply with requirements in Section 061000 "Rough Carpentry."

G. Tapered Edge Strips: ASTM C728, perlite insulation board.

H. Tapered Edge Strips: ASTM C208, Type II, Grade 1, cellulosic-fiber insulation board.

I. Cover Board: ASTM C208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (12.7 mm) thick.

J. Cover Board: DOC PS 2, Exposure 1, oriented strand board, 7/16 inch (11.11 mm) thick.

K. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch (6.35 mm) thick, factory primed.

L. Cover Board: ASTM C1278/C1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, 1/4 inch (6.35 mm) thick.

M. Substrate Joint Tape: 6- or 8-inch- (150- or 200-mm-) wide, coated, glass fiber.

2.11 COATING MATERIALS

A. Roof Coating: ASTM D 1227, Type II, Class 1, mineral-colloid-emulsified, fibered asphalt emulsion, asbestos free.

B. Roof Coating: ASTM D 1227, Type III, Class 1, mineral-colloid-emulsified asphalt emulsion, nonfibered.

C. Roof Coating: ASTM D 2824, Type I, nonfibered aluminum-pigmented asphaltic coating.

D. Roof Coating: Acrylic elastomer emulsion coating, formulated for use on bituminous roof surfaces and complying with ASTM D 6083.
   1. Color: White.

2.12 WALKWAYS

A. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition, slip-resisting pads, manufactured as a traffic pad for foot traffic and acceptable to roofing manufacturer, 3/8 inch (9.52 mm) thick, minimum.
   1. Pad Size: 30" x 30".

B. Walkway Cap-Sheet Strips: ASTM D 6164/D 6164, Grade G, Type I or II, polyester-reinforced, SBS-modified asphalt sheet; granule surfaced; suitable for application method specified, and as follows:
   1. Granule Color: White.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:
   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."
   4. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.59 mm) out of plane relative to adjoining deck.
   5. Verify that minimum concrete drying period recommended by roofing manufacturer has passed.
   6. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
      a. Test for moisture by pouring 1 pint (0.5 L) of hot roofing asphalt on deck at start of each day's work and at start of each roof area or plane. Do not proceed with Work

of this Section if test sample foams or can be easily and cleanly stripped after cooling.

7. Verify that concrete curing compounds that impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.

D. Install insulation strips in ribs of acoustical roof decks according to acoustical roof deck manufacturer's written instructions.

3.3 INSTALLATION, GENERAL

A. Comply with built-up roofing manufacturer's written instructions.

B. Asphalt Heating: Heat asphalt to its equiviscous temperature, measured at the mop cart or mechanical spreader immediately before application. Circulate asphalt during heating. Do not raise asphalt temperature above equiviscous temperature range more than one hour before time of application. Do not exceed asphalt manufacturer's recommended temperature limits during asphalt heating. Do not heat asphalt within 25 deg F (14 deg C) of flash point. Discard asphalt maintained at a temperature exceeding finished blowing temperature for more than 4 hours.

1. Apply hot roofing asphalt within plus or minus 25 deg F (14 deg C) of equiviscous temperature.

C. Asphalt Heating: Heat and apply SEBS-modified roofing asphalt according to roofing manufacturer's written instructions.

D. Substrate-Joint Penetrations: Prevent roofing asphalt and adhesives from penetrating substrate joints, entering building, or damaging built-up roofing components or adjacent building construction.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to built-up roofing manufacturer's written instructions.

3.5 VAPOR-RETARDER INSTALLATION

A. Polyethylene Film: Loosely lay polyethylene-film vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50.8 mm) and 6 inches (152.4 mm), respectively. Continuously seal side and end laps with tape.

B. Laminate Sheet: Loosely lay laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50.8 mm) and 6 inches (152.4 mm), respectively. Continuously seal side and end laps with tape.

C. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches (89 mm) and 6 inches (152.4 mm), respectively. Seal laps by rolling.

D. Built-up Vapor Retarder: Install two glass-fiber felt plies lapping each felt 19 inches (482.6 mm) over preceding felt. Embed each felt in a solid mopping of hot roofing asphalt. Glaze coat completed surface with hot roofing asphalt.

E. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into built-up roofing.

3.6 INSULATION INSTALLATION

A. Install one lapped base-sheet course and mechanically fasten to substrate according to built-up roofing manufacturer's written instructions.

B. Nailer Strips: Mechanically fasten 4-inch nominal- (89-mm actual-) width wood nailer strips of same thickness as insulation perpendicular to sloped roof deck at the following spacing:
   1. 16 feet (487.68 cm) apart for roof slopes greater than 1 inch (25.4 mm) per 12 inches (304.8 mm) but less than 3 inches (76.2 mm) per 12 inches (304.8 mm).
   2. 48 inches (1219.2 mm) apart for roof slopes greater than 3 inches (76.2 mm) per 12 inches (304.8 mm).

C. Insulation Cant Strips: Install and secure preformed 45-degree insulation cant strips at junctures of built-up roofing with vertical surfaces or angle changes greater than 45 degrees.

D. Install tapered insulation under area of roofing to conform to slopes indicated.

E. Install insulation with long joints of insulation in a continuous straight line, with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6.35 mm) with insulation.
   1. Cut and fit insulation within 1/4 inch (6.35 mm) of nailers, projections, and penetrations.

F. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68.58 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (152.4 mm) in each direction.
   1. Where installing composite and noncomposite board insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

G. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

H. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

I. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
   1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m), and allow primer to dry.
   2. Set each layer of insulation in a solid mopping of hot roofing asphalt.
   3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
   4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   1. Fasten insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
   2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

K. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
   1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
   2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
   3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt.
   4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
   5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

L. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (152.4 mm) in each direction. Loosely butt cover boards together and fasten to roof deck. Tape joints if required by roofing manufacturer.
   1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
   2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.
   3. Apply hot roofing asphalt to underside and immediately bond cover board to substrate.

3.7 BUILT-UP ROOFING INSTALLATION, GENERAL

A. Install roofing according to roofing manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
   1. Install roofing system BU-3-N-A-A, according to roof assembly identification matrix and roof assembly layout illustrations in NRCA's "The NRCA Roofing and Waterproofing Manual" as well as Section requirements.

B. Install roofing according to roofing manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing" and as follows:
   1. Deck Type: C (concrete or nonnailable).
   2. Base Sheet: One.
   3. Number of Ply Sheets: Two.
   4. Surfacing Type: A (aggregate).
   5. Mineral-granule-surfaced cap sheet is in addition to number of ply sheets specified.

C. Start installation of built-up roofing in presence of manufacturer's technical personnel.

D. Where roof slope exceeds 12 inches (304.8 mm) per 1/2 inch (12.7 mm) , install built-up roofing sheets parallel with slope.
   1. Backnail built-up roofing sheets to substrate according to roofing manufacturer's written instructions.

E. Coordinate installation of roofing so insulation and other components of built-up roofing not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.
   1. Provide tie-offs at end of each day's work to cover exposed built-up roofing sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.
   2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing.
   3. Remove and discard temporary seals before beginning work on adjoining roofing.

3.8 ROOFING MEMBRANE INSTALLATION

A. Loosely lay one course of sheathing paper, lapping edges and ends a minimum of 2 inches (50.8 mm) and 6 inches (152.4 mm), respectively.

B. Install lapped base-sheet course, extending sheet over and terminating beyond cants. Attach base sheet as follows:
   1. Mechanically fasten to substrate.
   2. Spot or strip mop to substrate with hot roofing asphalt.
   3. Adhere to substrate.

C. Install two ply sheets starting at low point of roofing. Align ply sheets without stretching. Shingle side laps of ply sheets uniformly to achieve required number of plies throughout thickness of roofing membrane. Shingle in direction to shed water. Extend ply sheets over and terminate beyond cants.
   1. Embed each ply sheet in a solid mopping of hot roofing asphalt applied at rate required by roofing manufacturer, to form a uniform membrane without ply sheets touching.

D. Cap Sheet: Install lapped granulated cap sheet starting at low point of roofing. Offset laps from laps of preceding ply sheets, and align cap sheet without stretching. Lap in direction to shed water. Extend cap sheet over and terminate beyond cants.
   1. Embed cap sheet in a solid mopping of hot roofing asphalt applied at rate required by built-up roofing manufacturer.

E. Aggregate Surfacing: After installing and testing roofing, base flashing, and stripping, promptly apply flood coat to roof surface with 60 lb/100 sq. ft. (3.0 kg/sq. m) of hot roofing asphalt.

While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 400 lb/100 sq. ft. (20 kg/sq. m).
2. If aggregate surfacing is delayed, promptly apply glaze coat of hot roofing asphalt at a rate of 10 lb/100 sq. ft. (0.5 kg/sq. m).

F. Glaze coat roofing surface with hot roofing asphalt applied at a rate of 10 to 15 lb/100 sq. ft. (0.5 to 0.75 kg/sq. m).

3.9 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof; secure to substrates according to built-up roofing manufacturer's written instructions and as follows:
   1. Prime substrates with asphalt primer if required by built-up roofing manufacturer.
   2. Backer-Sheet Application: Mechanically fasten backer sheet to walls or parapets. Adhere backer sheet over built-up roofing at cants in cold-applied adhesive.
   3. Backer-Sheet Application: Adhere backer sheet to substrate in cold-applied adhesive.
   4. Flashing-Sheet Application: Adhere flashing sheet to substrate in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C). Apply hot roofing asphalt to back of flashing sheet if recommended by roofing manufacturer.
   5. Flashing-Sheet Application: Adhere flashing sheet to substrate in cold-applied adhesive at rate required by roofing manufacturer.
   6. Flashing-Sheet Application: Adhere flashing sheet to substrate in asphalt roofing cement at rate required by roofing manufacturer.
   7. Flashing-Sheet Application: Torch apply flashing sheet to substrate.

B. Extend base flashing up walls or parapets a minimum of 8 inches (203.2 mm) above built-up roofing and 4 inches (101.6 mm) onto field of built-up roofing.

C. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.
   1. Seal top termination of base flashing with a strip of glass-fiber fabric set in asphalt roofing cement.

D. Install stripping according to roofing manufacturer's written instructions, where metal flanges and edgings are set on built-up roofing.
   1. Flashing-Sheet Stripping: Install flashing-sheet stripping in a continuous coating of asphalt roofing cement or in a solid mopping of hot roofing asphalt applied at not less than 425 deg F (218 deg C), and extend onto roofing membrane.
   2. Flashing-Sheet Stripping: Install flashing-sheet stripping by heat welding and extend onto roofing membrane.
   3. Built-up Stripping: Install stripping of not fewer than two roofing ply sheets, setting each ply in a continuous coating of asphalt roofing cement or in a solid mopping of hot roofing asphalt, and extend onto roofing membrane 4 inches (101.6 mm) and 6 inches (152.4 mm), respectively.

E. Roof Drains: Set 30-by-30-inch (760-by-760-mm) metal flashing in bed of asphalt roofing cement on completed built-up roofing. Cover metal flashing with built-up roofing cap-sheet stripping, and extend a minimum of 6 inches (152.4 mm) beyond edge of metal flashing onto field of built-up roofing. Clamp built-up roofing, metal flashing, and stripping into roof-drain clamping ring.

1. Install stripping according to roofing manufacturer's written instructions.

3.10 COATING INSTALLATION

A. Apply coating to built-up roofing according to manufacturer's written instructions, by spray, roller, or other suitable application methodto provide a dry film thickness of not less than 20 mils (0.02 inch (0.5 mm)).

3.11 WALKWAY INSTALLATION

A. Walkway Pads: Install walkway pads, using units of size indicated or, if not indicated, of manufacturer's standard size, according to walkway pad manufacturer's written instructions.
   1. Set walkway pads in additional pour coat of hot roofing asphalt after sweeping away loose aggregate surfacing.

B. Walkway Cap-Sheet Strips: Install walkway cap-sheet strips, approximately 36 inches (914.4 mm) wide and in lengths not exceeding 10 feet (304.8 cm), leaving a space of 6 inches (152.4 mm) between strips, over built-up roofing. Adhere in hot roofing asphalt.

C. Roof-Paver Walkways: Install walkway roof pavers according to roofing manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches (76.2 mm) of space between adjacent roof pavers.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish reports to Architect.
   1. Electric Field Vector Mapping (EFVM): Testing agency shall survey entire roof area for potential leaks using electric field vector mapping (EFVM).

B. Test Cuts: Remove test specimens to evaluate problems observed during quality-assurance inspections of built-up roofing as follows:
   1. Determine approximate quantities of components within built-up roofing according to ASTM D 3617.
   2. Examine test specimens for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA's "Quality Control Guidelines for the Application of Built-up Roofing."
   3. Repair areas where test cuts were made according to roofing manufacturer's written instructions.

C. Repair or remove and replace components of built-up roofing where test results or inspections indicate that they do not comply with specified requirements.
   1. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.13 PROTECTING AND CLEANING

A. Protect built-up roofing from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove built-up roofing that does not comply with requirements, repair substrates, and repair or reinstall roofing to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.14 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:
   1. Owner: Westchester County Airport
   2. Address: 240 Airport Rd, West Harrison, NY 10604
   3. Building Name/Type: Building 1
   4. Address: 240 Airport Rd, West Harrison, NY 10604.
   5. Area of Work: Building 1
   6. Acceptance Date: _____.
   7. Warranty Period: 30 years.
   8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:
   1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
      a. lightning;
      b. peak gust wind speed exceeding 150 mph ;
      c. fire;
      d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
      e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
      f. vapor condensation on bottom of roofing; and
      g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
   2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
   3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
   4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent

said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 51 13

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, exterior penetrations, and other items indicated in Schedule.

B. Sealants for joints within sheet metal fabrications.

C. Precast concrete splash pads.

1.2 RELATED REQUIREMENTS

A. Section 07 71 23 - Manufactured Gutters and Downspouts.

1.3 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2026.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

E. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

G. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).

H. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).

I. CDA A4050 - Copper in Architecture - Handbook; Current Edition.

J. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Warranty: all roofing components herein shall be warrantied per roofing section

1.6 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Sheet Metal Flashing and Trim:
   1. Stainless Steel:
      a. York Manufacturing
      b. Hohmann & Barnard
      c. Cheney Flashing Company
   2. Aluminum:
      a. Hickman Edge Systems
      b. Petersen Aluminum Corp.
      c. Fairview Architectural LLC
   3. Substitutions: See Division 1

B. Exterior Penetration Flashing Panel:
   1. Quickflash Weatherproofing Products, Inc; _____: www.quickflashproducts.com/#sle.

2.2 SHEET MATERIALS

A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal.

B. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 0.032 inch (0.81 mm) thick; clear anodized finish.
   1. Clear Anodized Finish: AAMA 611, AA-M12C22A41, Class I, clear anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.

C. Stainless Steel: ASTM A666/A666M, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch (0.40 mm) thick; smooth No. 4 - Brushed finish.

2.3 PREFINISHED ALUMINUM SHEETS

A. Aluminum Sheet Substrates: ASTM B209/B209M, alloy and temper as recommended by manufacturer for application.

B. High-Performance Organic Coating System: Comply with AAMA 2604 for aluminum preparation, pretreatment, primer and finish coat system; provide thermally cured, 50-percent PVDF or silicone-modified polyester systems; tested for weathering for 5 years with 5 delta units color change maximum.

2.4 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.5 FLASHING

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.6 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Underlayment: ASTM D226/D226M, organic roofing felt, Type I, No. 15.

C. Primer Type: Zinc chromate.

D. Concealed Sealants: Non-curing butyl sealant.

E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.38 mm).

3.3 INSTALLATION

A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

B. Apply plastic cement compound between metal flashings and felt flashings.

C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

3.4 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.5 SCHEDULE

A. Through-Wall Flashing in Masonry:

B. Fascia and Cornices:

C. Counterflashings at Roofing Terminations (over roofing base flashings):

D. Counterflashings at Curb-Mounted Roof Items:

E. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports:

END OF SECTION 07 62 00

SECTION 07 71 00 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured roof specialties, including copings, fascias, and gravel stops.

B. Roof control and expansion joint covers.

1.2 RELATED REQUIREMENTS

A. Section 07 72 00 - Roof Accessories: Manufactured curbs, roof hatches, and snow guards.

1.3 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2026.

B. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2026.

C. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.

D. NRCA (RM) - The NRCA Roofing Manual; 2026.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.

C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Roof Edge Flashings and Copings:
   1. Architectural Products Co; _____: www.archprod.com/#sle.
   2. ATAS International, Inc; Rapid-Lok Fascia: www.atas.com/#sle.
   3. Drexel Metals Inc; _____: www.drexmet.com/#sle.
   4. Hickman Edge Systems; _____: www.hickmanedgesystems.com/#sle.
   5. Metal-Era Inc; _____: www.metalera.com/#sle.
   6. Metal Roofing Systems, Inc; Rapid Lock Coping: www.metalroofingsystems.biz/#sle.

B. Control and Expansion Joint Covers:
   1. Construction Specialties, Inc; Roof Covers: www.c-sgroup.com/#sle.
   2. EMSEAL Joint Systems, Ltd; Emseal RoofJoint: www.emseal.com/#sle.
   3. GAF; ____: www.gaf.com/#sle.
   4. Hickman Edge Systems; _____: www.hickmanedgesystems.com/#sle.
   5. Johns Manville; ____: www.jm.com/#sle.
   6. Metal-Era Inc; _____: www.metalera.com/#sle.

C. Pipe and Penetration Flashings:

1. Elmdor; _____: www.elmdor.com/#sle.

D. Counterflashings:
1. ATAS International, Inc; ____: www.atas.com/#sle.
2. Hickman Edge Systems; _____: www.hickmanedgesystems.com/#sle.
3. Metal-Era Inc; _____: www.metalera.com/#sle.

E. Pipe Penetration Wall Seal and Insulation Protection System:
1. Airex Manufacturing, Inc; Airex Pro-System Kit: www.airexmfg.com/#sle.

2.2 COMPONENTS

A. Roof Edge Flashings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
1. Configuration: Fascia, cant, and edge securement for roof membrane.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
3. Exposed Face Height: As indicated on drawings.
4. Material: Formed aluminum sheet, 0.050 inch (1.3 mm) thick, minimum.
5. Finish: 70 percent polyvinylidene fluoride (PVDF).
6. Color: As selected by Architect from manufacturer's standard range.
7. Products:
a. Hickman Edge Systems; Drip Edge Fascia: www.hickmanedgesystems.com/#sle.
b. Metal-Era Inc; Anchor-Tite Drip Edge: www.metalera.com/#sle.

B. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
3. Wall Width: As indicated on drawings.
4. Outside Face Height: As indicated on drawings.
5. Inside Face Height: As indicated on drawings.
6. Material: Formed aluminum sheet, 0.040 inch (1.01 mm) thick, minimum.
7. Finish: 70 percent polyvinylidene fluoride.
8. Color: As selected by Architect from manufacturer's standard range.

C. Control and Expansion Joint Covers: Composite construction of ____-inch (____ mm) wide flexible EPDM flashing of white color with closed cell urethane foam backing, each edge seamed to aluminum sheet metal flanges, designed for nominal joint width of 1 inch (25.4 mm). Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.

D. Expansion Joint Covers: Roof-to-roof joint cover comprised of continuous rails fastened to continuous cleat and covered with metal cap.
1. Material: Aluminum sheet, 0.04 inch (1.02 mm) thick.
2. Fasteners: Concealed. Factory-punched fastener holes.
3. Color: As selected by Architect from manufacturer's standard range.

E. Pipe and Penetration Flashing: Base of rounded aluminum, compatible with _____ roof systems, and capable of accomodating pipes sized between 3/8 inch (9.5 mm) and 12 inches (305 mm).
   1. Caps: EPDM.
   2. Color: White

F. Roof Penetration Sealing Systems: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

G. Engineered Roof Perimeter Blocking: Prefabricated 20-gauge, 0.036-inch (0.91 mm) galvanized steel retainer for lightweight concrete; with cleat to accept copings; attach to roof deck in lieu of wood blocking at roof edge; for low slope roof installations.

H. Counterflashings: Factory fabricated and finished sheet metal that overlaps top edges of base flashing by at least 4 inches (102 mm), and designed to snap into through-wall flashing or reglets with lapped joints.
   1. Material: Formed aluminum sheet, 0.025 inch (0.64 mm) thick, minimum.

I. Pipe Penetration Wall Seal: Seal for HVAC piping wall penetrations with wall-mounted rigid plastic outlet cover and elastomeric wall seal gasket.
   1. Outlet Cover Color: Gray.

J. Lightning Rod Bracket: For attaching lightning rod to roof system; fastened to underside of coping.
   1. Material: Stainless steel, 20 gauge, 0.0375 inch (0.95 mm).
   2. Fasteners: Concealed. Factory-punched fastener holes.

2.3 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

B. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.4 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.

B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

C. Insulation Board Adhesive: Two-component, low-rise polyurethane foam adhesive used for adhering insulation to low slope roof deck materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.
   1. See Section 07 72 00 for information on roofing related accessories.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.

B. Seal joints within components when required by component manufacturer.

C. Anchor components securely.

END OF SECTION 07 71 00

SECTION 07 71 23 - MANUFACTURED GUTTERS AND DOWNSPOUTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-finished aluminum gutters and downspouts.

1.2 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2026.

B. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.

C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.

D. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 10 years.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on prefabricated components.

C. Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.

D. Samples: Submit two samples, 8 inch (____ mm) long illustrating component design, finish, color, and configuration.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.

B. Prevent contact with materials that could cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Gutters and Downspouts:
   1. Hickman Edge Systems; Wind Resistant Gutter: www.hickmanedgesystems.com/#sle.
   2. Metal-Era Inc; Seal-Tite WR Gutter: www.metalera.com/#sle.
   3. SAF Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc; ____: www.saf.com/persys/#sle.

2.2 MATERIALS

A. Pre-Finished Aluminum Sheet: ASTM B209/B209M; 0.032 inch (0.8 mm) thick.
   1. Finish: Plain, shop pre-coated with polyvinylidene fluoride (PVDF) coating.
   2. Color: As selected from manufacturer's standard colors.

2.3 COMPONENTS

A. Gutters: CDA rectangular style profile.

B. Downspouts: CDA rectangular profile.

C. Anchors and Supports: Profiled to suit gutters and downspouts.

D. Fasteners: Galvanized steel, with soft neoprene washers.

2.4 FABRICATION

A. Form gutters and downspouts of profiles and size indicated.

B. Fabricate with required connection pieces.

C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.

D. Hem exposed edges of metal.

E. Fabricate gutter and downspout accessories; seal watertight.

2.5 FINISHES

A. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604, multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.6 ACCESSORIES

A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
   1. Configuration: Angular.
   2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
   3. Finish: Manufacturer's standard factory applied powder coat finish.
   4. Color: To be selected by Architect from manufacturer's standard range.
   5. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

3.2 PREPARATION

A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

3.3 INSTALLATION

A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.

B. Slope gutters 1/8" per foot

C. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

D. Connect downspouts to downspout boots at 12" above grade. Grout connection watertight.

E. Connect downspouts to storm sewer system. Grout connection watertight.

F. Set splash pans under downspouts.

END OF SECTION 07 71 23

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SECTION 07 84 00 - FIRESTOPPING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Section 09 21 16 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.2 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

C. FM (AG) - FM Approval Guide; Current Edition.

D. ITS (DIR) - Directory of Listed Products; Current Edition.

E. UL (FRD) - Fire Resistance Directory; Current Edition.

F. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

B. Fire Ratings: Refer to drawings for required systems and ratings.

2.2 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
   2. Fire Ratings: See drawings for required systems and ratings.

B. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Caulk or putty.

C. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Any material meeting requirements.

D. Firestopping at Cable Tray Penetrations: Any material meeting requirements.

E. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.

F. Firestopping at Control Joints (without Penetrations): Any material meeting requirements.

G. Firestopping Between Top of Partition Wall and Roof Slab: Fiber firestopping with smoke seal coating; UL (FRD) , F Rating equal to connecting wall partition, provide at locations as indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

3.3 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.4 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 84 00

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Silicone joint sealants.
   2. Mildew-resistant joint sealants.
   3. Latex joint sealants.

B. Related Requirements:
   1. Section 079219 "Acoustical Joint Sealants" for sealing joints in sound-rated construction.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Submittals:
   1. Product Data: For sealants, indicating VOC content.
   2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency .

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
6. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
    a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint- sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Verify sealants and sealant primers comply with the following:
   1. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
   2. Architectural sealants have a VOC content of 250 g/L or less.
   3. Sealants and sealant primers for porous substrates have a VOC content of 775 g/L or less.
   4. Sealants and sealant primers for nonporous substrates have a VOC content of 250 g/L or less.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, T, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Uses T and NT.
   1. Manufacturers: Subject to compliance with requirements, undefined:
      a. Soudal USA.
      b. The Dow Chemical Company.

2.3 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Adfast.
      b. Soudal USA.
      c. The Dow Chemical Company.

2.4 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Everkem Diversified Products, Inc.
      b. Franklin International.
      c. Tremco Incorporated.

2.5 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Adfast.
      b. Alcot Plastics Ltd.
      c. BASF Corporation.
      d. Construction Foam Products; a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
      a. Concrete.
      b. Masonry.
      c. Unglazed surfaces of ceramic tile.
   3. Remove laitance and form-release agents from concrete.
   4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
      a. Metal.
      b. Glass.
      c. Porcelain enamel.
      d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint- sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so

sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces (JS-1).
   1. Joint Locations:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Tile control and expansion joints.
      c. Joints between different materials listed above.
   2. Joint Sealant: Silicone, 50, T, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces (JS-2).
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints between metal panels.
      d. Joints between different materials listed above.
      e. Perimeter joints between materials listed above and frames of doors windows and louvers.
      f. Control and expansion joints in ceilings and other overhead surfaces.
   2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces (JS-3).
   1. Joint Locations:
      a. Control and expansion joints in tile flooring.
   2. Joint Sealant: Silicone, nonstaining, S, NS, T, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces (JS-4).
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Tile control and expansion joints.
      c. Vertical joints on exposed surfaces of unit masonry concrete walls and partitions.
   2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces (JS-5).
   1. Joint Locations:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Concealed mastics (JS-6).

1. Joint Locations:
    a. Aluminum thresholds.
    b. Sill plates.
2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:
    1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
        a. Extent of Testing: Test completed and cured sealant joints as follows:
            1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
            2) Perform two tests for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
        b. Test Method: Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
        c. Inspect tested joints and report on the following:
            1) Whether sealants filled joint cavities and are free of voids.
            2) Whether sealant dimensions and configurations comply with specified requirements.
            3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
        d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
        e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
    2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

END OF SECTION 07 92 00

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SECTION 07 95 13 - EXTERIOR EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior expansion joint covers.

B. Related Requirements:
   1. Section 077129 "Manufactured Roof Expansion Joints" for factory-fabricated roof expansion joint cover assemblies.
   2. Section 079100 "Preformed Joint Seals" for preformed foam and extruded-silicone joint seals.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.

B. Shop Drawings: For each expansion joint cover assembly.
   1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
   2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.

C. Samples: For each exposed expansion joint cover assembly and for each color and texture specified, full width by 6 inches (152.4 mm) long in size.

D. Samples for Initial Selection: For each type of exposed finish.
   1. Include manufacturer's color charts showing the full range of colors and finishes available for each exposed metal and elastomeric seal material.

E. Expansion Joint Cover Assembly Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
   1. Manufacturer and model number for each expansion joint cover assembly.
   2. Expansion joint cover assembly location cross-referenced to Drawings.
   3. Nominal, minimum, and maximum joint width.
   4. Movement direction.
   5. Materials, colors, and finishes.
   6. Product options.
   7. Fire-resistance ratings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each fire-resistance-rated expansion joint cover assembly, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Furnish units in longest practicable lengths to minimize field splicing.

B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross- connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Expansion joint cover assemblies shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Fire-Resistance Ratings: Provide expansion joint cover assemblies with fire barriers identical to those of systems tested for fire resistance according to UL 2079 or ASTM E1966 by a qualified testing agency.
   1. Hose Stream Test: Wall-to-wall and wall-to-soffit assemblies shall be subjected to hose stream testing.

C. Expansion Joint Design Criteria (All Expansion Joints) :
   1. Type of Movement: Thermal.
      a. Nominal Joint Width: As indicated on Drawings.
      b. Minimum Joint Width: As indicated on Drawings.
      c. Maximum Joint Width: As indicated on Drawings.

2.3 EXTERIOR EXPANSION JOINT COVERS

A. Exterior Metal-Plate Joint Cover : Assembly consisting of sliding metal cover plate in continuous contact with gaskets mounted on metal frames fixed to sides of joint gap.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc.; comparable product by one of the following:
      a. Balco; a CSW Industrials Company.
      b. Inpro Corporation.
      c. Nystrom.
   2. Basis-of-Design Models and Applications:
      a. ASM-X 400 w/ Fire Barrier – New soffit to wall. New wall to wall.
      b. ASMC-X 400 & 600 w/ Fire Barrier – Wall to wall
      c. PDS 1000x4 w/ Fire Barrier – Exterior Plaza / traffic joint.
      d. SRJ-1000 w/ Fire Barrier – Roof to roof.
      e. SRJW 400, 500, 600, 800, 900, 1100, 1200, all w/ Fire Barrier – New roof to GWB Wall.
         1) Manufacturer shall have discretion to evaluate the expansion joint connections between roofs and walls to optimize joint cover widths.
   3. Installation: Surface mounted.
   4. Vapor Barrier: Polyethylene vapor barrier integral to manufacturer’s expansion joints.
   5. Fire-Resistance Rating: Not less than two hours.
   6. Exposed Metal:
      a. Aluminum: Kynar 500 finish.
         1) Color: As selected by Architect from full range of industry colors and color densities.

B. Preformed Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes

in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

1. Basis-of-Design Product: Subject to compliance with requirements, provide CS Group PS-VF or comparable product by one of the following:
   a. EMSEAL ColorSeal, a Sika Company.
   b. MM Systems Corporation.
   c. Pecora Corporation.
2. Design Criteria:
   a. Nominal Joint Width: As indicated on Drawings.
   b. Movement Capability: -50 percent/+50 percent.
3. Joint Seal Color: As selected by Architect from full range of industry colors.
4. Fire Resistance Rating: Not less than that indicated on drawings.

2.4 MATERIALS

A. Aluminum: ASTM B221, Alloy 6063-T5 for extrusions; ASTM B209, Alloy 6061-T6 for sheet and plate.
   1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.

C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.

D. Moisture Barrier: Manufacturer's standard, flexible elastomeric material.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0 inch (0.02 mm) or thicker.

B. Color Anodic Finish: AAMA 611, or thicker.

2.6 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

2.7 ACCESSORIES

A. Moisture Barriers: Manufacturer's standard continuous, waterproof membrane within joint and attached to substrate on sides of joint.
   1. Provide where indicated on Drawings.

B. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.

B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.

B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.

B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
   1. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
   2. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
   3. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
   4. Install frames in continuous contact with adjacent surfaces.
      a. Shimming is not permitted.
   5. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (76.2 mm) from each end and not more than 24 inches (609.6 mm) o.c.

C. Preformed Foam Joint Seals: Install in compliance with manufacturer's written instructions. Install with minimum number of end joints.
   1. Install each length of seal immediately after removing protective wrapping.
   2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
   3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
   4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

D. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.

E. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

F. Fire-Resistance-Rated Assemblies: Coordinate installation of expansion joint cover assembly materials and associated work so complete assemblies comply with performance requirements.
   1. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.

3.4 CONNECTIONS

A. Transition to Roof Expansion Joint Covers: Coordinate installation of exterior wall and soffit expansion joint covers with roof expansion joint covers specified in Section 077129

"Manufactured Roof Expansion Joints." Install factory-fabricated units at transition between exterior walls and soffits and roof expansion joint cover assemblies.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections.

3.6 FIELD QUALITY CONTROL

A. Water-Spray Test: Provide water spray quality assurance test of installed expansion joint cover assemblies in accordance with AAMA 501.2 during construction process and before installation of interior finishes.

1. Perform a *minimum of one test in each designated area as indicated on drawings. Verify visual confirmation of failure mode.*
2. Conduct tests in each area *as indicated on the drawings at completion expansion joint and adjacent components.*

END OF SECTION 07 95 13

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SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Fire-rated hollow metal doors and frames.

D. Thermally insulated hollow metal doors with frames.

E. Commercial security hollow metal doors and frames.

F. Detention security hollow metal doors and frames.

G. Hollow metal borrowed lites glazing frames.

1.2 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

C. Section 09 91 13 - Exterior Painting: Field painting.

D. Section 09 91 23 - Interior Painting: Field painting.

1.3 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.

B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.

C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.

D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.

H. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.

J. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.

K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

L. ITS (DIR) - Directory of Listed Products; Current Edition.

M. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.

N. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2024.

O. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

Q. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.

R. UL (DIR) - Online Certifications Directory; Current Edition.

S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: https://steeldoor.org/sdi-certified/#sle.

B. Maintain at project site copies of reference standards relating to installation of products specified.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hollow Metal Doors and Frames:
1. Ceco Door, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
2. Curries, an Assa Abloy Group company; _____: www.assaabloydss.com/#sle.
3. Deansteel Manufacturing Company, Inc; Hollow Metal Doors - SP Series: www.deansteel.com/#sle.
4. De La Fontaine; HC - Honeycomb Core: www.delafontaine.com/#sle.
5. Mesker, dormakaba Group; FDJ Series Drywall Frames: www.meskeropeningsgroup.com/#sle.
6. Republic Doors, an Allegion brand; ____: www.republicdoor.com/#sle.
7. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.

2.2 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ICC A117.1 and ADA Standards.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Manufacturers standard for application indicated.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.

7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 3 - Extra Heavy-duty.
    b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
    e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

C. Type refer to door schedule on drawings , Interior Doors, Non-Fire-Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

D. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    a. Level 2 - Heavy-duty.
    b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
    c. Model 1 - Full Flush.
    d. Door Face Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
    a. Attach fire rating label to each fire rated unit.

4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.

2.4 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Exterior Door Frames: Full profile/continuously welded type.
   1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   3. Frame Finish: Factory primed and field finished.
   4. Weatherstripping: Integral, recessed into frame edge.

C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
   2. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   3. Frame Finish: Factory primed and field finished.

D. Door Frames, Fire-Rated: Slip-on type at gypsum board walls, and knock-down type at masonry walls.
   1. Fire Rating: Same as door, labeled.
   2. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
   3. Frame Metal Thickness: 18 gauge, 0.042 inch (1.0 mm), minimum.
   4. Frame Finish: Factory primed and field finished.

E. Commercial and/or Detention Security-Resistant Door Frames: With same security resistance as door; face welded or full profile/continuously welded construction, ground smooth, fully prepared and reinforced for hardware installation.
   1. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
   2. Frame Finish: Factory primed and field finished.

F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

I. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.

2.5 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.6 ACCESSORIES

A. Louvers: Roll formed steel with overlapping frame; finish same as door components ; factory-installed.
   1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.

B. Door Window Frames: Door window frames with glazing securely fastened within door opening.

C. Glazing: As specified in Section 08 80 00, factory installed.

D. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.

E. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches (102 mm) as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.

F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.

D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.

E. Install door hardware as specified in Section 08 71 00.

3.4 TOLERANCES

A. Maximum Diagonal Distortion: 1/16 inch (1.6 mm) measured with straight edge, corner to corner.

END OF SECTION 08 11 13

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SECTION 08 34 63 - SPECIALTY DOORS AND FRAMES

PART 1 GENERAL

1.1 DESCRIPTION

A. The barriers shown on the plans and herein specified are the products of Kane Innovations, Erie, Pennsylvania. This manufacturer's name and products have been used to establish the standards of construction and quality of workmanship required for this project.
Manufacturers bidding on this project must be actively engaged in the fabrication of specified items for a minimum of five (5) years prior to the bid date. Manufacturers requesting approval to bid their products as equal must submit to the Architect full-size drawings, including details of construction, and a complete operating barrier sample, ten (10) days prior to the bid date.

1.2 SUBMITTALS

A. Manufacturer shall submit shop drawings, showing details of attachment to surround materials and elevations showing scope of the project.

B. Samples of materials as may be requested without cost to owner: frame sections, woven rod panel, fasteners, mullion section, corner section, etc.

1.3 WARRANTY

A. The operation of the barrier supplied by Kane Innovations on the designated project is warranted for one (1) year against any proven defective material or parts, as called for in the specifications and approved shop drawings. This warranty does not cover abuse by others.

PART 2 PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. KANE INNOVATIONS, ERIE, PA(800) 773-2439 OR APPROVED EQUAL

2.2. MAIN FRAME

A. THE MAIN FRAME SHALL BE BUILT-UP TUBULAR TYPE, MEASURING 1-3/4" 44.45 X 2-1/2" 63.5, WITH FIXED CONCEALMENT PLATES. THE OPEN CHANNEL FRAME MEMBERS SHALL BE FORMED OF NOT LESS THAN 13-GAUGE TYPE 304 STAINLESS STEEL SHEET AND SHALL HAVE INDIVIDUAL SLOTS ALONG THE INNER EDGES TO SUPPORT THE WOVEN ROD PANEL. THE CORNERS OF THE MAIN FRAME SHALL BE NOTCHED FOR SELF-ALIGNING AND ROBOTICALLY WELDED.

B. CONCEALMENT PLATES OF 13-GAUGE TYPE 304 STAINLESS STEEL SHALL BE WELDED TO THE BACK OF THE MAIN FRAME APPROXIMATELY 8” 203.2 ON CENTER TO COMPLETE THE TUBULAR SHAPE.

C. BRACES SHALL BE BUILT-UP TUBULAR TYPE, MEASURING 8-1/2” 215.9 X 2-1/2” 63.5, WITH FIXED CONCEALMENT PLATES. BRACES SHALL BE FORMED OF NOT LESS THAN 13-GAUGE TYPE 304 STAINLESS SHEET STEEL.

2.3. FINISH

A. BOTH FACE SIDES OF THE MAIN FRAME SHALL BE DIRECTIONAL BELT SANDED. (SATIN)

B. WOVEN ROD WILL REMAIN MILL FINISH.

2.4. RODS

A. WOVEN ROD PANELS SHALL BE FABRICATED FROM DOUBLE CRIMPED, TYPE 304 STAINLESS STEEL 1/4” 6.35 DIAMETER RODS, WOVEN WITH 2” 50.8 INCH OPEN SPACE.

B. WOVEN ROD PANELS SHALL BE FABRICATED FROM DOUBLE CRIMPED, TYPE 304 STAINLESS STEEL 3/8” 9.52 DIAMETER RODS, WOVEN WITH 2” 50.8 INCH OPEN SPACE.

2.5. ROD ATTACHMENT

A. WOVEN ROD PANELS SHALL BE INSTALLED SYMMETRICALLY INTO THE SLOTTED MAIN FRAME. SLOTS SHALL BE CENTERED ACCORDING TO THE ROD PATTERN. EACH ROD SHALL PENETRATE INTO EACH SLOT WHERE IT CONTACTS THE MAIN FRAME. EVERY OTHER ROD SHALL BE WELDED INTO THE SLOT AT BOTH ENDS WHERE IT PENETRATES THE MAIN FRAME.

2.6. HARDWARE

A. EACH BARRIER SHALL COME FULLY ASSEMBLED AND TESTED FROM THE FACTORY.

PART 3 EXECUTION

3.1. INSPECTION

A. VERIFY THAT OPENINGS FIT ALLOWABLE TOLERANCES ARE PLUMB, LEVEL, PROVIDE A SOLID ANCHORING SURFACE AND COMPLY WITH APPROVED SHOP DRAWINGS.

3.2. INSTALLATION

A. INSTALL IN ACCORDANCE WITH APPROVED SHOP DRAWINGS AND SPECIFICATIONS.

B. PLUMB AND ALIGN FACES IN A SINGLE PLANE AND ERECT BARRIERS SQUARE AND TRUE, ADEQUATELY ANCHORED.

C. AFTER COMPLETION OF INSTALLATION, BARRIERS SHALL BE ADJUSTED, IN WORKING ORDER AND CLEAN.

PART 4 ENVIROMENTAL REPORTING

4.1. LEED MATERIALS AND RESOURCES

A. RECYCLED CONTENT: THIS PRODUCT CONTRIBUTES TOWARD SATISFYING CREDIT 4 UNDER LEED.

B. REGIONAL MATERIAL: THIS PRODUCT CAN CONTRIBUTE TOWARD SATISFYING CREDIT 5 UNDER LEED.

END OF SECTION 08 34 63

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SECTION 08 41 13 - ENTRANCE, STOREFRONT AND CURTAIN WALLS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Aluminum Storefront, including:
   1. YKK AP Series YES 45 XT Storefront System. Or approved equal

B. Related Sections:
   1. Sealants: Refer to Division 7 Joint Treatment Section for sealant requirements.
   2. Glass and Glazing: Refer to Division 8 Glass and Glazing Section for glass and glazing requirements.
   3. Single Source Requirement: All products listed below shall be by the same manufacturer.
      a. Section 08 32 13 Sliding Aluminum-Framed Glass Doors.
      b. Section 08 51 13 Aluminum Windows.
      c. Section 08 44 13 Glazed Aluminum Curtain Walls.
      d. Section 08 44 33 Sloped Glazing Assemblies.

1.02. SYSTEM PERFORMANCE DESCRIPTION

A. Performance Requirements: Provide aluminum storefront systems that comply with performance requirements indicated, as demonstrated by testing manufacturer's assemblies in accordance with test method indicated.
   1. air Infiltration: Completed storefront systems shall have 0.06 CFM/FT² 1.2 yard (1.10 meter)³/h•m²) maximum allowable infiltration when tested in accordance with ASTM E 283 at differential static pressure of 6.24 PSF (299 Pa).
   2. Water Infiltration: No uncontrolled water when tested in accordance with ASTM E 331 at test pressure differential of: 12 PSF (575 Pa) (or when required, field tested in accordance with AAMA 503). Fastener Heads must be seated and sealed against Sill Flashing on any fasteners that penetrate through the Sill Flashing.
   3. Wind Loads: Completed storefront system shall withstand wind pressure loads normal to wall plane indicated:
      a. Exterior Walls:
         1) Positive Pressure:
         2) Negative Pressure:
      b. Interior Walls (Pressure Acting in Either Direction):
   4. Deflection: Maximum allowable deflection in any member when tested in accordance with ASTM E 330 with allowable stress in accordance with AA Specifications for Aluminum Structures.
      a. Without Horizontals: L/175 or 3/4" (19.1mm) maximum.
      b. With Horizontals: L/175 or L/240 + 1/4" (6.4mm) for spans greater than 13'-6" (4.1m) but less than 40'-0" (12.2m).
   5. Thermal Movement: Provide for thermal movement caused by 180 degrees Fahrenheit (82.22 degrees Celsius). (179.96 degrees Fahrenheit (82.2 degrees Celsius).) surface temperature, without causing buckling stresses on glass, joint seal failure, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or detrimental effects.
   6. Thermal Performance: When tested in accordance with AAMA 507, AAMA 1503, and NFRC 100:

a. Condensation Resistance Factor (CRFf): A minimum of 66 (with a CRFg of 64.)
b. Thermal Transmittance U Value: 0.36 (0.36)/HR/FT²/°F or less.

7. Acoustic Performance: Acoustical Performance: When tested in accordance with AAMA 1801:
   a. Sound Transmission Class (STC) shall not be less than 32 for 1" standard insulating unit; 36 for laminated glazing.
   b. Outdoor–Indoor Transmission Class (OITC) shall not be less than 27 for 1" standard insulating Unit; 30 for laminated glazing.

PART 2 PRODUCTS

2.01. MANUFACTURERS (ACCEPTABLE MANUFACTURERS/PRODUCTS)

A. Acceptable Manufacturers: YKK AP America Inc. Or approved equal.
   1. Storefront System: YKK AP YES 45 XT Storefront System. Or approved equal.

B. Storefront Framing System:
   1. Description: Center set, exterior flush glazed; jambs and vertical mullions continuous; head, sill, intermediate horizontal attached by screw spline joinery.
   2. Components: Manufacturer's standard extruded aluminum mullions, 90 degree corner posts, entrance door framing, and indicated shapes.
   3. Dual Thermal Barrier: Provide dual continuous thermal barriers by means of poured and debridged pockets consisting of a two-part, chemically curing high density polyurethane which is bonded to the aluminum by YKK ThermaBond Plus®. Systems employing non-structural thermal barriers are not acceptable.

2.02. MATERIALS

A. Extrusions: ASTM B 221 (ASTM B 221M), 6063-T5 Aluminum Alloy.

B. Aluminum Sheet:
   1. Anodized Finish: ASTM B 209 (ASTM B 209M), 5005-H14 Aluminum Alloy, 0.050" 0.05 inch (1.27 mm) minimum thickness.
   2. Painted Finish: ASTM B 209 (ASTM B 209M), 3003-H14 Aluminum Alloy, 0.080" 0.08 inch (1.95 mm) minimum thickness.

2.03. ACCESSORIES

A. Manufacturer's Standard Accessories:
   1. Fasteners: Zinc plated steel concealed fasteners; Hardened aluminum alloys or AISI 300 series stainless steel exposed fasteners.
   2. Glazing: Setting blocks, edge blocks, and spacers in accordance with ASTM C 864, shore durometer hardness as recommended by manufacturer; Glazing gaskets in accordance with ASTM C 864.
   3. 0.050 Aluminum Sill Flashing End Dams must have 3 point attachment.

2.04. RELATED MATERIALS (SPECIFIED IN OTHER SECTIONS)

A. Glass: Refer to Division 8 Glass and Glazing Section for glass materials.

2.05. FABRICATION

A. Shop Assembly: Fabricate and assemble units with joints only at intersection of aluminum members with uniform hairline joints; rigidly secure, and sealed in accordance with manufacturer's recommendations.

1. Hardware: Drill and cut to template for hardware. Reinforce frames and door stiles to receive hardware in accordance with manufacturer's recommendations.
2. Welding: Conceal welds on aluminum members in accordance with AWS recommendations or methods recommended by manufacturer. Members showing welding bloom or discoloration on finish or material distortion will be rejected.

2FINISHES AND COLORS

A. YKK AP America Anodized Plus® Finish as basis of design or approved equal: YB5N* Dark Bronze Anodized Plus®

*INDICATES STANDARD FINISH USUALLY CARRIED AS INVENTORY.

ANODIZED PLUS® IS AN ADVANCED SEALING TECHNOLOGY THAT COMPLETELY SEALS THE ANODIC FILM YIELDING SUPERIOR DURABILITY (SEE AAMA 612).

A. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:
   1. Anodic Coating: Electrolytic color coating followed by an organic seal applied in accordance with the requirements of AAMA 612. Aluminum extrusions shall be produced from quality-controlled billets meeting AA-6063-T5.
      a. Exposed Surfaces shall be free of scratches and other serious blemishes.
      b. Extrusions shall be given a caustic etch followed by an anodic oxide treatment and then sealed with an organic coating applied with an electrodeposition process.
      c. The anodized coating shall comply with all of the requirements of AAMA 612: Voluntary Specifications, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum. Testing shall demonstrate the ability of the finish to resist damage from mortar, salt spray, and chemicals commonly found on construction sites, and to resist the loss of color and gloss.
      d. Overall coating thickness for finishes shall be a minimum of 0.7 mils (0.01778 mm).
         1) CASS Corrosion Resistance Test, CASS 240/ASTM B368 Test Method.
         2) Other AAMA 2605 Performance Tests specified in these specifications, such as: 7.3 Dry Film Hardness; 7.8.2 Salt Spray Resistance; 7.9.1.2 Color Retention, South Florida; 7.9.1.4 Gloss Retention, South Florida.

B. High Performance Organic Coating Finish:
   1. Type Factory applied two-coat 70% Kynar resin by Arkema or 70% Hylar resin by Solvay Solexis, fluoropolymer based coating system, Polyvinylidene Fluoride (PVF-2), applied in accordance with manufacturer's procedures and meeting AAMA 2605 specifications.
   2. Colors: Selected by Architect from the following:
      a. Standard coating color charts.
      b. Custom coating color charts.
      c. Color Name and Number:

C. Finishes Testing:
   1. Apply 0.5% solution NaOh, sodium hydroxide, to small area of finished sample area; leave in place for sixty minutes; lightly wipe off NaOh; Do not clean area further.
   2. Submit samples with test area noted on each sample.

PART 3 EXECUTION

3.0MANUFACTURER'S INSTRUCTIONS / RECOMMENDATIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, installation instructions, and product carton instructions. The latest installation manual for the basis of design product is available at www.ykkap.com.

3.02. EXAMINATION

A. Site Verification of Conditions: Verify conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

3.03. PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
   1. Aluminum Surface Protection: Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

3.04. INSTALLATION

A. General: Install manufacturer's system in accordance with shop drawings, and within specified tolerances.
   1. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylon pads or bituminous coating.
   2. Shim and brace aluminum system before anchoring to structure.
   3. Provide sill flashing at exterior storefront systems. Extend extruded flashing continuous with splice joints; set in continuous beads of sealant.
   4. Verify storefront system allows water entering system to be collected in gutters and wept to exterior. Verify metal joints are sealed in accordance with manufacturers' installation instructions.
   5. Locate expansion mullions where indicated on reviewed shop drawings.
   6. Seal metal to metal storefront system joints using sealant recommended by system manufacturer.

3.05. FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Upon request, provide manufacturer's field service consisting of site visits for inspection of product installation in accordance with manufacturer's instructions.

B. Field Test: Conduct field test to determine watertightness of storefront system. Conduct test in accordance with AAMA 501.2.

3.06. ADJUSTING AND CLEANING

A. Adjusting: Adjust swing doors for operation in accordance with manufacturer's recommendations.

B. Cleaning: The General Contractor shall clean installed products in accordance with manufacturer's instructions prior to owner's acceptance and remove construction debris from project site. Legally dispose of debris.

C. Protection: The General Contractor shall protect the installed product's finish surfaces from damage during construction.

END OF SECTION

THIS DOCUMENT SUPERSEDES ALL PREVIOUS VERSIONS.

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SECTION 08 51 13 - WINDOWS

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes: Operable Aluminum Window Systems
   1. YKK AP Series YOW 350 XT MegaTherm® Fixed Aluminum Window System or approved equal.
   2. YKK AP Series YOW 350 XT MegaTherm® Operable Aluminum Window System or approved equal.

B. Related Sections:
   1. Sealants: Refer to Division 7 Joint Treatment Section for sealant requirements.
   2. Glass and Glazing: Refer to Division 8 Glass and Glazing Section for glass and glazing requirements.
   3. Single Source Requirement: All products listed below shall be by the same manufacturer.
      a. Section 08 32 13 Sliding Aluminum - Framed Glass Doors.
      b. Section 08 41 13 Aluminum - Framed Entrances and Storefronts.
      c. Section 08 44 13 Glazed Aluminum Curtain Walls.
      d. Section 08 44 33 Sloped Glazing Assemblies.

1.02. TEST AND PERFORMANCE REQUIREMENTS

A. All test unit sizes and configurations shall conform to the minimum sizes in accordance with AAMA/WDMA/CSA/I.S.A 440, with a performance class of AW-PG 80 (Operable), AW-PG 80 (Fixed/Fixed and Fixed/Operable Combinations), AW-PG 100 (Fixed). Windows shall also comply with the following specific performance requirements indicated.
   1. Air Infiltration: When tested in accordance with ASTM E 283-91 at differential static pressure of 6.24 PSF (299 Pa), completed window systems shall have maximum allowable infiltration of 0.10 CFM/FT² 2.02 yard (1.85 meter)³/h·m²).
   2. Water Infiltration: No uncontrolled water other than condensation on indoor face of any component when tested in accordance with ASTM E 331-93 and E 547-86 at a minimum test pressure differential of 12 PSF (575 Pa) operable, 15 PSF (718 Pa) fixed.
   3. Uniform Load Structural Test: Provide aluminum window systems that comply with AAMA/WDMA/CSA 101/I.S. A440, voluntary specifications for aluminum and polyvinylchloride (PVC) prime windows and glass doors, guidelines for specified AW rated product.
   4. Thermal Cycling Test: When tested in accordance with AAMA 910, All AW products shall be subjected to six thermal cycles, ranging from 0 degrees Fahrenheit (-17.78 degrees Celsius) to 180 degrees Fahrenheit (82.22 degrees Celsius), at 8 hours per cycle per AAMA 501.5.
   5. Thermal Performance: When tested in accordance with AAMA 1503 and NFRC 100:
      a. Condensation Resistance Factor (CRFf): A minimum of 75 (Casement), 76 (Project), and 77 (Fixed).
      b. Thermal Transmittance U Value: 0.35 (Casement), 0.35 (Project), 0.34 (Fixed) BTU/HR/FT²/°F or less.
   6. Acoustical Performance: When tested in accordance with ASTM E 1425, the Sound Transmission Class (STC), and Outdoor–Indoor Transmission Class (OITC) shall not be less than 32 STC and 26 OITC.

7. Life Cycle Testing: When tested in accordance with AAMA 910, there shall be no damage to fasteners, hardware parts, or any other damage that would cause the specimen to be inoperable. Resistance to air leakage and water penetration resistance test results shall not exceed the gateway performance.

NOTE: PERFORMANCE BASED ON LAB TESTING AND WILL VARY BY CONFIGURATION AND GLASS TYPE; CONTACT YKK AP ENGINEERING FOR AAMA 507 CERTIFICATE OF COMPLIANCE, TO DEMONSTRATE COMPLIANCE WITH NFRC FOR VARIOUS GLASS TYPES.

1.03. SUBMITTALS

A. General: Prepare, review, approve, and submit specified submittals in accordance with "Conditions of the Contract" and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in "Conditions of the Contract".

B. Product Data: Submit product data for each type of window series specified.

C. Substitutions: Whenever substitute products are to be considered, supporting technical data, samples, and test reports must be submitted ten (10) working days prior to bid date in order to make a valid comparison.

D. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage, accessories, finish colors and textures.

E. Samples: Submit verification samples for colors on actual aluminum substrates indicating full color range expected in installed system.

F. Quality Assurance / Control Submittals:
   1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
   2. Installer Qualification Data: Submit installer qualification data.

G. Closeout Submittals:
   1. Warranty: Submit warranty documents specified herein.
   2. Project Record Documents: Submit project record documents for installed materials in accordance with Division 1 Project Closeout (Project Record Documents) Section.

1.04. QUALITY ASSURANCE

A. Qualifications:
   1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project. If requested by Owner, submit reference list of completed projects.
   2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction process.

B. Mock-Ups (Field Constructed): Install at project site a job mock-up using acceptable products and manufacturer approved installation methods. Obtain Owner's and Architect's acceptance of finish color, and workmanship standard.
   1. Mock-Up Size:
   2. Maintenance: Maintain mock-up during construction for workmanship comparison; remove and legally dispose of mock-up when no longer required.
   3. Incorporation: Mock-up may be incorporated into final construction upon Owner's approval.

C. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

1.PROJECT CONDITIONS / SITE CONDITIONS

A. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

1.03. WARRANTY

A. Project Warranty: Refer to "Conditions of the Contract" for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by an authorized company official.
   1. Warranty Period: Manufacturer’s one (1) year standard warranty commencing on the substantial date of completion for the project provided that the warranty, in no event, shall start later than six (6) months from the date of shipment by manufacturer.

EDITOR NOTE: LONGER WARRANTY PERIODS ARE AVAILABLE AT ADDITIONAL COST.

PART 2 PRODUCTS

3.1 MANUFACTURERS (ACCEPTABLE MANUFACTURERS/PRODUCTS)

A. Acceptable Manufacturers: YKK AP America Inc. or approved equal
   1. Fixed Window System: YKK AP YOW 350 XT MegaTherm® Aluminum Window System. Or approved equal.
   2. Operable Window System: YKK AP YOW 350 XT MegaTherm® Aluminum Window System. Or approved equal
   3. Window Framing System:
   4. AAMA Designation: AW-PG100-FW (fixed), AW-PG80-FW (fixed/fixed), AW-PG80-C (casement/casement combinations), AW-PG80-AP (project out/project out combinations). Or approved equal
   5. Description: The windows shall be extruded aluminum with integral structural thermal barrier; 3-1/2" frame depth; Vents shall be flush with frame and have mitered corner construction; Factory- assembled.
   6. Configuration: The thermally broken windows shall be (select one or more) Fixed, Fixed by Fixed, Casement, Outswing, Project Out, Fixed and Operable, or Operable Combination.
   7. Thermal Barrier: Provide YKK AP MegaTherm® continuous thermal barrier or approved equal by means of 6/6 nylon polyamide glass fiber reinforced pressure extruded bars. Systems employing nonstructural type thermal barriers are not acceptable.
   8. Glazing: Exterior glazing tape with silicone cap bead; 1" insulated units; Interior EPDM wedge gaskets; Aluminum interior glazing beads; Factory or bench glazed. Glazing thickness as specified in Division 8 glass and glazing sections.

3.2 MATERIALS

A. Extrusions: ASTM B 221 (ASTM B 221M), 6063-T5 Aluminum Alloy, typical wall thickness 0.125”

B. Aluminum Sheet:

1. Anodized Finish: ASTM B 209 (ASTM B 209M), 5005-H14 Aluminum Alloy, 0.050" 0.05 inch (1.27 mm) minimum thickness.
2. Painted Finish: ASTM B 209 (ASTM B 209M), 3003-H14 Aluminum Alloy, 0.080" 0.08 inch (1.95 mm) minimum thickness.

3.3 ACCESSORIES

A. Manufacturer's Standard Accessories:
1. Hardware: YKK AP 4 bar hinges for casement outswing and projected vents or approved equal, exposed white bronze butt hinges for casement outswing vents, white bronze cam handles and strikes; stainless steel support arms for casement outswing vents, aluminum/white bronze push bars for project out vents, white bronze custodial locks or multi-locks in lieu of cam handles, stainless steel limit stop device.
2. Fasteners: All fasteners shall be AISI 300 series (except for self-drilling, which are to be series 400) stainless steel.
3. Sealant: Non-skinning type, AAMA 803.3
4. Glazing: Setting blocks, edge blocks, and spacers in accordance with ASTM C 864, shore durometer hardness as recommended by manufacturer; Glazing gaskets in accordance with ASTM C 864.

3.4 RELATED MATERIALS (SPECIFIED IN OTHER SECTIONS)

A. Glass: Refer to Division 8 Glass and Glazing Section for glass materials.

3.5 FABRICATION

A. Shop Assembly: Fabricate and assemble units with joints only at intersection of aluminum members with uniform hairline joints; rigidly secure and sealed in accordance with manufacturer's recommendations.

3.6 FINISHES AND COLORS

A. YKK AP America Anodized Plus® Finish or approved equal:
1. CODE DESCRIPTION: YB5N* Dark Bronze Anodized Plus® * Indicates standard finish usually carried as inventory. Anodized Plus® is an advanced sealing technology that completely seals the anodic film yielding superior durability (See AAMA 612).

B. Anodized Finishing: Prepare aluminum surfaces for specified finish; apply shop finish in accordance with the following:
1. Anodic Coating: Electrolytic color coating followed by an organic seal applied in accordance with the requirements of AAMA 612-02. Aluminum extrusions shall be produced from quality-controlled billets meeting AA-6063-T5.
a. Exposed Surfaces shall be free of scratches and other serious blemishes.
b. Extrusions shall be given a caustic etch followed by an anodic oxide treatment and then sealed with an organic coating applied with an electrodeposition process.
c. The anodized coating shall comply with all of the requirements of AAMA 612-02: Voluntary Specifications, Performance Requirements and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum. Testing shall demonstrate the ability of the finish to resist damage from mortar, salt spray, and chemicals commonly found on construction sites, and to resist the loss of color and gloss.
d. Overall coating thickness for finishes shall be a minimum of 0.7 mils (0.01778 mm).

C. High Performance Organic Coating Finish:

1. Type Factory applied two-coat 70% Kynar resin by Arkema or 70% Hylar resin by Solvay Solexis, fluoropolymer based coating system, Polyvinylidene Fluoride (PVF-2), applied in accordance with YKK AP procedures and meeting AAMA 2605 specifications.
2. Colors: Selected by Architect from the following:
   a. Standard coating color charts.
   b. Custom coating color charts.
   c. Color Name and Number:

D. Finishes Testing:
1. Apply 0.5% solution NaOh, sodium hydroxide, to small area of finished sample area; leave in place for sixty minutes; lightly wipe off NaOh; Do not clean area further.
2. Submit samples with test area noted on each sample.

PART 3 EXECUTION

4.1 MANUFACTURER'S INSTRUCTIONS / RECOMMENDATIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, installation instructions, and product carton instructions. The latest installation manual is available at www.ykkap.com.

4.2 EXAMINATION

A. Site Verification of Conditions: Verify conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer's instructions.

4.3 PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.
1. Aluminum Surface Protection: Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

4.4 INSTALLATION

A. General: Install manufacturer's system in accordance with shop drawings, and within specified tolerances.
1. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylon pads or bituminous coating.
2. Shim and brace aluminum system before anchoring to structure.
3. Verify window system allows water entering system to be collected in gutters and wept to exterior. Verify weep holes are open, and metal joints are sealed in accordance with manufacturer’s installation instructions.
4. Locate expansion mullions where indicated on reviewed shop drawings.
5. Seal metal to metal window system joints using sealant recommended by system manufacturer.

4.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Upon request, provide manufacturer's field service consisting of site visits for inspection of product installation in accordance with manufacturer's instructions.

B. Field Test: Conduct field test to determine watertightness of window system. Conduct test in accordance with AAMA 501.2-03.

4.6 ADJUSTING AND CLEANING

A. Adjusting: Adjust swing doors for operation in accordance with manufacturer's recommendations.

B. Cleaning: The General Contractor shall clean installed products in accordance with manufacturer's instructions prior to owner's acceptance and remove construction debris from project site. Legally dispose of debris.

C. Protection: The General Contractor shall protect the installed product's finish surfaces from damage during construction.

END OF SECTION

THIS DOCUMENT SUPERSEDES ALL PREVIOUS VERSIONS.

SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Insulating glass units.

B. Glazing units.

C. Glazing compounds.

1.2 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers.

B. Section 07 27 00 - Air Barriers.

C. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

D. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.

1.3 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2026).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

F. ASTM C1036 - Standard Specification for Flat Glass; 2021.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).

I. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.

J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.

K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.

L. GANA (SM) - GANA Sealant Manual; 2008.

M. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.

N. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

O. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data on Insulating Glass Unit, Glazing Unit, Plastic Sheet Glazing Unit, Plastic Film, and _____ Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples ___ by ___ inch (___ by ___ mm) in size of glass units.

E. Samples: Submit ____ inch (____ mm) long bead of glazing sealant, color as selected.

F. Manufacturer's qualification statement.

G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

1.6 MOCK-UPS

1.7 FIELD CONDITIONS

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Glass Fabricators:
1. GGI - General Glass International; _____: www.generalglass.com/#sle.
2. Tecnoglass; Insulating Glass: www.tecnoglass.com/#sle.
3. Thompson I.G., LLC: www.thompsonig.com/#sle.
4. Viracon, Inc: www.viracon.com/#sle.

B. Float Glass Manufacturers:
1. Guardian Glass, LLC; _____: www.guardianglass.com/#sle.
2. Pilkington North America Inc; _____: www.pilkington.com/na/#sle.
3. Saint Gobain North America; _____: www.saint-gobain.com/#sle.
4. Vitro Architectural Glass (formerly PPG Glass); _____: www.vitroglazings.com/#sle.

C. Laminated Glass Manufacturers:
1. Cardinal Glass Industries; _____: www.cardinalcorp.com/#sle.
2. Tecnoglass; Laminated Glass: www.tecnoglass.com/#sle.
3. Viracon, Architectural Glass segment of Apogee Enterprises, Inc; _____: www.viracon.com/#sle.

D. Spandrel Glass Manufacturers:

E. Wired Glass Manufacturers:
   1. GGI - General Glass International; _____: www.generalglass.com/#sle.

2.2 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
   1. Design Pressure: Calculated in accordance with ASCE 7.
   2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
   4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
   5. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.
   1. In conjunction with weather barrier related materials described in other sections, as follows:
      a. Water-Resistive Barriers: See Section 07 25 00.
      b. Air Barriers: See Section 07 27 00.

C. Thermal and Optical Performance: See Drawings. Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
   2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 7 computer program.
   3. Solar Optical Properties: Comply with NFRC 300 test method.

2.3 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
   4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.4 INSULATING GLASS UNITS

A. Manufacturers:
   1. Glass: Any of the manufacturers specified for float glass.
   2. Guardian Glass, LLC; _____: www.guardianglass.com/#sle.
   3. Pilkington North America Inc; _____: www.pilkington.com/na/#sle.Pilkington North America Inc; _____: www.pilkington.com/na/#sle.
   4. Viracon, Apogee Enterprises, Inc; _____: www.viracon.com/#sle.

B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

C. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Spacer Color: Black.
   4. Edge Seal:
      a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
      b. Color: Black.
   5. Purge interpane space with dry air, hermetically sealed.

D. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Clear.
      b. Coating: Low-E (passive type), on #2 surface.
   4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Clear.
   5. Total Thickness: 1 inch (25.4 mm).
   6. Thermal Transmittance (U-Value), Summer - Center of Glass: _____, nominal.
   7. Visible Light Transmittance (VLT): _____ percent, nominal.
   8. Solar Heat Gain Coefficient (SHGC): _____, nominal.

E. Type IG-2 Insulating Glass Units: Spandrel glazing.
   1. Applications: Exterior spandrel glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
      a. Tint: Clear.
      b. Coating: Same as on vision units, on #2 surface.
   4. Inboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick.
      a. Tint: Clear.
      b. Opacifier: Ceramic frit, on #4 surface.
      c. Opacifier Color: _____.
      d. Opacifier: Elastomeric coating, on #4 surface.
   5. Total Thickness: 1 inch (25.4 mm).
   6. Thermal Transmittance (U-Value), Summer - Center of Glass: _____, nominal.

2.5 BASIS OF DESIGN - INSULATING GLASS UNITS

A. Basis of Design - Insulating Glass Units: Vision glazing, with low-e coating.
   1. Applications: Exterior insulating glass glazing unless otherwise indicated.
   2. Space between lites filled with air.
   3. Total Thickness: 1 inch (25.4 mm).

4. Thermal Transmittance (U-Value), Summer - Center of Glass: _____, nominal.
5. Visible Light Transmittance (VLT): _____ percent, nominal.
6. Shading Coefficient: _____, nominal.
7. Solar Heat Gain Coefficient (SHGC): _____, nominal.
8. Visible Light Reflectance, Outside: _____ percent, nominal.
9. Glazing Method: Dry glazing method, gasket glazing.
10. Durability: Certified by an independent testing agency to comply with ASTM E2190.
11. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
12. Spacer Color: Black.
13. Edge Seal:
14. Color: Black.
15. Purge interpane space with dry air, hermetically sealed.

2.6 GLAZING UNITS

A. Type G-1 - Monolithic Exterior Vision Glazing:
   1. Applications: Exterior glazing unless otherwise indicated.
   2. Glass Type: Annealed float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

B. Type G-2 - Monolithic Interior Vision Glazing:
   1. Applications: Interior glazing unless otherwise indicated.
   2. Glass Type: Annealed float glass.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

C. Type G-3 - Monolithic Safety Glazing: Non-fire-rated.
   1. Applications:
      a. Glazed lites in doors, except fire doors.
      b. Glazed sidelights to doors, except in fire-rated walls and partitions.
      c. Other locations required by applicable federal, state, and local codes and regulations.
      d. Other locations indicated on drawings.
   2. Glass Type: Fully tempered safety glass as specified.
   3. Tint: Clear.
   4. Thickness: 1/4 inch (6.4 mm), nominal.

D. G-1 Wired Glass: Flat glass with embedded wire mesh.
   1. Applications: Locations as indicated on drawings.
   2. Form: Form 1 - Wired glass, polished both sides; ASTM C1036.
   3. Mesh: M1 - Diamond; ASTM C1036.
   4. Tint: Clear, Class 1.
   5. Glass Type: Annealed.
   6. Thickness: 1/4 inch (6.4 mm), nominal.
   7. Location: Stair access doors
   8. Glazing Method: Wet glazing method, compound and compound.

2.7 GLAZING COMPOUNDS

A. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; _____ color.

2.8 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.

B. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

C. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.2 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch (610 mm) centers, kept 1/4 inch (6 mm) below sight line.

C. Locate and secure glazing pane using glazers' clips.

D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.6 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements for additional requirements.

B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

C. Monitor and report installation procedures and unacceptable conditions.

3.7 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove nonpermanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.8 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION 08 80 00

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SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Resilient sound isolation clips.

E. Acoustic insulation.

F. Gypsum sheathing.

G. Cementitious backing board.

H. Gypsum wallboard.

I. Joint treatment and accessories.

J. Plenum space sound control.

K. Bullet resistant sheathing and wallboard.

1.2 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

B. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

C. Section 09 22 16 - Non-Structural Metal Framing.

D. Section 09 30 00 - Tiling: Tile backing board.

1.3 REFERENCE STANDARDS

A. AISI S201 - North American Standard for Cold-Formed Steel Framing - Product Data; 2017.

B. AISI S220 - North American Standard for Cold-Formed Steel Nonstructural Framing; 2020.

C. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).

D. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.

F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

G. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.

H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.

I. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

J. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).

K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

M. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

N. ASTM E413 - Classification for Rating Sound Insulation; 2022.

O. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).

P. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Sequencing: Install service utilities in an orderly and expeditious manner.

1.5 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Steel Framing Industry Association (SFIA) Certification:
   1. Submit documentation that metal studs and connectors used on project meet or exceed requirements of International Building Code.

C. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

D. Ballistic Test Reports: Indicate compliance of bullet-resistant sheathing and wallboard assemblies with specified requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

B. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

B. Store metal products to prevent corrosion.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.
   1. See PART 3 for finishing requirements.

B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
   1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:

1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft (0.24 kPa) with maximum mid-span deflection of L/240.
2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.

D. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:

E. Grid Suspension Systems: Provide grid suspension systems in accordance with ASTM C840 and GA-216 complying with the following:
1. ICC-ES Evaluation Report No. _____.

F. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.

2.2 METAL FRAMING MATERIALS

A. Material and Product Requirements Criteria: AISI S201.

B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220 or equivalent.
1. Corrosion Protection Coating Designation: G40, or equivalent in accordance with AISI S220.

C. Manufacturers - Metal Framing, Connectors, and Accessories:
1. CEMCO; ____: www.cemcosteel.com/#sle.
2. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
3. Jaimes Industries; ____: www.jaimesind.com/#sle.
4. MarinoWARE; ____: www.marinoware.com/#sle.
5. Phillips Manufacturing Co; ____: www.phillipsmfg.com/#sle.
6. R-stud; _____: www.rstud.com/#sle.
7. SCAFCO Corporation; _____: www.scafco.com/#sle.
8. Steel Construction Systems; _____: www.steelconsystems.com/#sle.
9. Telling Industries; ____: www.tellingindustries.com/#sle.

D. Nonstructural Framing System Components: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf (L/120 at 240 Pa).
1. Studs: C-shaped with knurled or embossed faces.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.
4. Flexible Track: Flexible framing consisting of adjustable leg straps and pivoting, hinged track brackets designed to provide curved framing assemblies of varying radii.
5. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
6. Furring Members: U-shaped sections, minimum depth of 3/4 inch (19 mm).
7. Furring Members: Zee-shaped sections, minimum depth of 1 inch (25 mm).
8. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (13 mm) channel depth.
9. Resilient Sound Isolation Clips: Steel resilient clips with molded rubber isolators, attaches to framing; improves noise isolation performance of wall and floor-ceiling assemblies.

10. Sill Plate Isolation Pads: Acoustical separation between sole plate and subfloor.
11. Security Barriers: Type II, expanded and flattened, Class 1 carbon steel mesh complying with ASTM F1267 in gauge indicated; applied between studs and gypsum board where indicated.

E. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.

F. Area Separation Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with specified performance requirements.

G. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.

H. Deflection and Firestop Track: Intumescent strip factory-applied to track flanges expands when exposed to heat or flames to provide a perimeter joint seal.

I. Preformed Top Track Firestop Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

J. Preformed Top of Wall Firestop Gasket:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.

K. Preformed Bottom of Wall Firestop Track Seal:
1. Provide components UL-listed for use in UL-listed fire-resistance-rated bottom of partition joint systems indicated on drawings.

L. Non-structural Framing Accessories:
1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.
4. Drywall Corner Clips: Drywall clips help support drywall to reduce wood blocking on top plates, end walls, and corners.
5. Steel Column and Beam Drywall Clip: UL-listed slip-on clips to connect gypsum board to steel beams and columns for fireproofing.

M. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. American Gypsum Company; ____: www.americangypsum.com/#sle.
2. CertainTeed Corporation; ____: www.certainteed.com/#sle.
3. Georgia-Pacific Gypsum; ____: www.gpgypsum.com/#sle.
4. Gold Bond Building Products, LLC provided by National Gypsum Company; ____: www.goldbondbuilding.com/#sle.
5. PABCO Gypsum; ____: www.pabcogypsum.com/#sle.
6. USG Corporation; ____: www.usg.com/#sle.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
   3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
   4. Thickness:
      a. Vertical Surfaces: 5/8 inch (16 mm).
      b. Ceilings: 5/8 inch (16 mm).
      c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire-resistance-rated Type X, UL or WH listed.
   4. Thickness: 5/8 inch (16 mm).
   5. Edges: Tapered.

D. Impact Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire-resistance-rated Type X, UL or WH listed.
   4. Thickness: 5/8 inch (16 mm).
   5. Edges: Tapered.

E. Backing Board For Wet Areas: One of the following products:
   1. Application: Surfaces behind tile in wet areas, including tub and shower surrounds and shower ceilings.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 5/8 inch (16 mm).

F. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Edges: Tapered.

2.4 GYPSUM BOARD ACCESSORIES

END OF SECTION 09 21 16

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SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior partitions.
   2. Suspension systems for interior ceilings and soffits.
   3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:
   1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:
   1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For embossed, high-strength steel studs and tracks firestop tracks post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Horizontal Deflection: For composite non-composite wall assemblies, limited to 1/360 of the wall height based on horizontal loading of 5 lbf/sq. ft.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for steel unless otherwise indicated.
   2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

C. Studs and Tracks: ASTM C 645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
   1. Steel Studs and Tracks:
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) CEMCO; California Expanded Metal Products Co.
         2) ClarkDietrich.
         3) MarinoWARE.
      b. Minimum Base-Steel Thickness: As indicated on Drawings.
      c. Depth: As indicated on Drawings.
   2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C 645 steel studs and tracks.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) CEMCO; California Expanded Metal Products Co.
         2) ClarkDietrich.
         3) MarinoWARE.
      b. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.
      c. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:
   1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) CEMCO; California Expanded Metal Products Co.
         2) ClarkDietrich.
         3) MarinoWARE.

E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CEMCO; California Expanded Metal Products Co.
b. ClarkDietrich.
c. MarinoWARE.
d. SCAFCO Steel Stud Company.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. MarinoWARE.
c. MBA Building Supplies.
2. Minimum Base-Steel Thickness: 0.032 inch (0.81 mm).

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich.
b. MarinoWARE.
c. MBA Building Supplies.
2. Minimum Base-Steel Thickness: As indicated on Drawings.
3. Depth: As indicated on Drawings.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 or AC308 as appropriate for the substrate.
a. Uses: Securing hangers to structure.
b. Type: Torque-controlled, expansion anchor or .
c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 , Class Fe/Zn 5, unless otherwise indicated.
d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 Group 2 stainless-steel bolts, ASTM F 593 , and nuts, ASTM F 594.
2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.06 mm) in diameter.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch (19.05 mm) deep.

2. Steel Studs and Tracks: ASTM C 645.
    a. Minimum Base-Steel Thickness: As indicated on Drawings.
    b. Depth: As indicated on Drawings.
3. Embossed, High-Strength Steel Studs and Tracks: ASTM C 645.
    a. Minimum Base-Steel Thickness: As indicated on Drawings.
    b. Depth: As indicated on Drawings.
4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.22 mm) deep.
    a. Minimum Base-Steel Thickness: As indicated on Drawings.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Armstrong Ceiling & Wall Solutions.
    b. Rockfon (Rockwool International).
    c. USG Corporation.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.18 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:
1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (609.6 mm) o.c.
2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-

resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
   2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
   3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
   4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Single-Layer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
   2. Multilayer Application: As required by horizontal deflection performance requirements unless otherwise indicated.
   3. Tile Backing Panels: As required by horizontal deflection performance requirements unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:
   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (152.4 mm) o.c.

E. Direct Furring:
1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (609.6 mm) o.c.

F. Z-Shaped Furring Members:
1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches (609.6 mm) o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (609.6 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (304.8 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3.18 mm) from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
1. Hangers: 48 inches (1219.2 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches (1219.2 mm) o.c.
3. Furring Channels (Furring Members): 16 inches (406.4 mm) o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch (3.18 mm) in 12 feet (365.76 cm) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

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SECTION 09 30 13 - TILING

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ANSI A108.01 - General Requirements: Structures, Substrates, and Preparation of Tile; 2023.

B. ANSI A108.02 - General Requirements: Workmanship for Tile Installation; 2023.

C. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar; 2023.

D. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.

E. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:
   1. Ceramic tile.
   2. Porcelain tile.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

D. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Full-size units of each type of trim and accessory for each color and finish required.
   3. Stone thresholds in 6-inch (150-mm) lengths.
   4. Metal edge strips in 6-inch (150-mm) lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile from one source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Crack isolation membrance.
   2. Joint sealants.
   3. Cementitious backer units.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

E. Preinstallation Conference: Conduct conference at Project Site.
   1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements unless otherwise indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Floor and Wall Tiles: As indicated in drawings and available trim.
   1. Grout Color: As selected by Architect from manufacturer's full range.

2.3 SETTING MATERIALS

A. Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Boiardi Products; a QEP company.

b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.
f. Jamo Inc.
g. Laticrete International, Inc.
h. MAPEI Corporation.
i. Southern Grouts & Mortars, Inc.
j. Summitville Tiles, Inc.
k. TEC; a subsidiary of H. B. Fuller Company.

2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

2.4 GROUT MATERIALS

A. Standard Cement Grout: ANSI A118.6.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
a. Boiardi Products; a QEP company.
b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. C-Cure.
e. Custom Building Products.
f. Jamo Inc.
g. Laticrete International, Inc.
h. MAPEI Corporation.
i. Southern Grouts & Mortars, Inc.
j. Summitville Tiles, Inc.
k. TEC; a subsidiary of H. B. Fuller Company.

2.5 MISCELLANEOUS MATERIALS

A. Backer Boards: As indicated in Division 09 Section "Gypsum Board."

B. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Tile Sealer: Manufacturer’s standard or recommended product for sealing tile pores if required. Confirm all sealing requirements with Manufacturer prior to installation.

E. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.6 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
   2. Verify that concrete substrates for tile floors installed with adhesives comply with surface finish requirements in ANSI A108.01 for installations indicated.
      a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
      b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
   3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
   4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

C. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Ceramic Mosaic Tile: 1/16 inch (1.59 mm).
   2. Porcelain Tile: 1/4 inch (6.35 mm).

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

H. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

I. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 09 30 13

SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM A580/A580M - Standard Specification for Stainless Steel Wire; 2023.

B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019 (Reapproved 2025).

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

D. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.

E. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site ???Insert location???.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches (152.4 mm) in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- (150-mm-) long Samples of each type, finish, and color.
3. Clips: Full-size hold-down clips.

D. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.

3. Method of attaching hangers to building structure.
    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Access panels.
7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch (3.18 mm) = 1 foot (30.48 cm) .

B. Qualification Data: For testing agency.

C. Field quality-control reports.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
    1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 PRODUCTS

2.1 ACOUSTICAL PANEL CEILINGS

A. Products: Provide the Products listed in the drawings.

2.2 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

B. Products: Provide the Products listed in the drawings.

2.3 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:
   1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
   2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
   3. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400.

C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch (22.22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

F. Hold-Down Clips: Manufacturer's standard hold-down.

G. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

H. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

I. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.4 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
   6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
   7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   8. Do not attach hangers to steel deck tabs.
   9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
   10. Space hangers not more than 48 inches (1219.2 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (203.2 mm) from ends of each member.
   11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
   1. Arrange directionally patterned acoustical panels as follows:
      a. As indicated on reflected ceiling plans.
      b. Install panels in a basket-weave pattern.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
6. Install seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
7. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch (3.18 mm) in 12 feet (365.76 cm), non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch (3.18 mm) in 12 feet (365.76 cm), non-cumulative.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

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SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.

C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.2 SUMMARY

A. Section Includes:
   1. Solid vinyl floor tile.
   2. Resilient Base and Accessories.
   3. Vinyl composition floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each type of resilient floor tile.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

D. Product Schedule: For floor tile. Use same designations indicated on Drawings.

E. Qualification Data: For qualified Installer.

F. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

B. Fire-Test-Reaponse Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Close spaces to traffic during floor tile installation.

C. Close spaces to traffic for 48 hours after floor tile installation.

D. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

PART 2 PRODUCTS

2.1 PRODUCTS

A. Products: As Indicated in the Drawings.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
1. Limit VOC content to the following:
a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.
1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.

3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay tiles in pattern indicated.

C. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
1. Apply two coat(s).

E. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

F. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 68 13 - TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following, including installation recommendations for each type of substrate:

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of carpet cushion.
6. Type of subfloor.
7. Type of installation.
8. Pattern of installation.
9. Pattern type, location, and direction.
10. Pile direction.
11. Type, color, and location of insets and borders.
12. Type, color, and location of edge, transition, and other accessory strips.
13. Transition details to other flooring materials.

C. Samples: 12" x 12" minimum, for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.8 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, the following:
      a. More than 10 percent edge raveling, snags, and runs.
      b. Dimensional instability.
      c. Excess static discharge.
      d. Loss of tuft-bind strength.
      e. Loss of face fiber.
      f. Delamination.
   3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 CARPET TILE

A. As indicated in the drawings.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
   1. 1. Use adhesives with VOC content not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

D. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Concrete Slabs: Verify that concrete slabs comply with ASTM F 710 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet manufacturer.
   2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet.
   3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3.18 mm) wide or wider, and protrusions more than 1/32 inch (0.79 mm) unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 72 00 - WALL COVERINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes Wall coverings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Samples for Verification: 12" x 12" section of wall covering.

D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

E. Qualification Data: For qualified testing agency.

F. Maintenance Data: For wall coverings to include in maintenance manuals.

1.3 QUALITY ASSURANCE

A. A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: As follows, per ASTM E 84:
    a. Flame-Spread Index: As indicated in drawings.
    b. Smoke-Developed Index: As indicated in drawings.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 PRODUCTS

2.1 VINYL WALL COVERING

A. Products: As Indicated in the Drawings.

2.2 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer and with a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.

D. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
   1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
   2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
   3. Metals: If not factory primed, clean and apply primer recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
   4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
   5. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

G. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.3 WALL-COVERING INSTALLATION

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Match pattern 72 inches (1828.8 mm) above the finish floor.

F. Install seams vertical and plumb at least 6 inches (152.4 mm) from outside corners and 3 inches (76.2 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 72 00

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SECTION 09 77 23 - FABRIC-WRAPPED PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, fabric-wrapped wall panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include fabric facing, panel edge, core material, and mounting indicated.

B. Shop Drawings: For panel assembly and installation.
   1. Include plans, elevations, sections, and mounting devices and details.
   2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
   3. Include details at cutouts and penetrations for other work.
   4. Include direction of fabric weave and pattern matching.

C. Samples for Verification: For the following products:
   1. Fabric: Full-width by approximately 36-inch- (900-mm-) long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.

D. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Electrical outlets, switches, and thermostats.
   2. Items penetrating or covered by fabric-wrapped wall panels including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Sprinklers.
      d. Alarms.
      e. Sprinklers.
      f. Access panels.

E. Product Certificates: For each type of fabric-wrapped wall panel, from manufacturer.

F. Maintenance Data: For fabric-wrapped wall panels to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

G. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain fabric-wrapped wall panels from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide fabric-wrapped wall panels meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

C. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and panel manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and panels in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not install panels until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install panels until a permanent level of lighting is provided on surfaces to receive the panels.

C. Air-Quality Limitations: Protect panels from exposure to airborne odors such as tobacco smoke, and install panels under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify panel locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace panels and components that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Fabric sagging, distorting, or releasing from panel edge.
      b. Warping of core.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 FABRIC-WRAPPED WALL PANELS

A. Fabric-Wrapped Wall Panel
   1. Indicated as Drawing
   2. Panel Shape: Flat .
   3. Mounting: Back mounted with manufacturer's standard adhesive, adhesive tape strips, metal clips or bar hangers, secured to substrate.
   4. Core: Mineral Fiber Board.
   5. Edge Profile: Square.
   6. Corner Detail in Elevation: Custom as indicated on Drawings with continuous edge profile indicated.
   7. Reveals between Panels: Recessed reveals as indicated on Drawings.
   8. Facing Material: As indicated on Drawings.
   9. Nominal Core Thickness: As indicated on Drawings.
   10. Panel Width: As indicated on Drawings.
   11. Panel Height: As indicated on Drawings.

2.2 MATERIALS

A. Core Materials: Manufacturer's standard.

1. Mineral-Fiber Board: Maximum flame-spread and smoke-developed indexes of 25 and 10, respectively; minimum density of 13 lb/cu. ft. (208 kg/cu. m).

B. Facing Material: Fabric from same dye lot; color and pattern as indicated on Drawings.

C. Mounting Devices: Concealed on back of panel, recommended by manufacturer to support weight of panel, and as follows:
1. Splines: Manufacturer's standard concealed metal or plastic splines that engage the kerfed edges of the panel, with other moldings and trim for interior corners, exterior corners, and exposed edges, with factory-applied finish on exposed items.
2. Adhesives: As recommended by fabric-wrapped, wall panel manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive Tape Strips: Manufacturer's standard 1/16-inch- (1.6-mm-) thick, double-sided foam tape.

2.3 FABRICATION

A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Edge Hardening: For mineral-fiber board cores, chemically harden core edges and areas of core where mounting devices are attached.

C. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

D. Facing Material: Apply fabric fully covering visible surfaces of panel; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
1. Square Corners: Tailor corners. Heat-seal vinyl fabric seams at corners.
2. Radius and Other Nonsquare Corners: Attach material so there are no seams or gathering of material.
3. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches in adjacent panels.

E. Dimensional Tolerances of Finished Panels: Plus or minus 1/16 inch (1.59 mm) for the following:
1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated panels, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting panel performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panels in locations indicated. Unless otherwise indicated, install panels with vertical surfaces and edges plumb, top edges level and in alignment with other panels, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with manufacturer's written instructions for installation of panels using type of mounting devices indicated. Mount panels securely to supporting substrate.

C. Align fabric pattern and grain with adjacent panels.

3.3 INSTALLATION TOLERANCES

A. Variation from Plumb and Level: Plus or minus 1/16 inch (1.59 mm)

B. Variation of Joint Width: Not more than 1/16 inch (1.59 mm) wide from hairline

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 77 23

SECTION 09 78 00 - INTERIOR WALL PANELING

PART 1 GENERAL

1.1 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturer's descriptive literature for each specified product; include data to indicate _____. Include anchorage devices specific to project substrate types.

C. Shop Drawings: Submit elevations for each application and location. Indicate details of joints and attachments.
   1. Scale of Drawing Elevations: 1/4 inch to 1 foot (1:50), minimum.
   2. Scale of Drawing Details: 1-1/2 inches to 1 foot (1:8), minimum.

D. Samples: Submit two samples 12 by 12 inches (300 by 300 mm) in size, indicating finish, surface design, and color for each type of panels; _____.

E. Manufacturer's Instructions: Provide manufacturer's installation instructions.

F. Maintenance Data: Include recommended instructions, methods, and materials for cleaning glass, aluminum framing, and FRP panels.

G. Warranty Documentation: Manufacturer warranty; ensure that forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panels in accordance with manufacturer's instructions.

B. Apply adhesive to back side of panel using trowel recommended by adhesive manufacturer.

C. Apply panels to wall with vertical joints plumb and horizontal joints level and pattern aligned with adjoining panels.

D. Using a roller, apply pressure to panel face to ensure proper adhesion between surfaces.

E. Install panels with manufacturer's recommended gaps for panel field and corner joints.

F. Install trim with adhesive.

G. Seal joints at wall base and between panels with approved sealant to prevent moisture intrusion.

H. Remove excess sealant after paneling is installed and prior to curing.

3.2 CLEANING

A. Clean panel faces using cleaning agents and methods recommended by manufacturer to remove soiling.

3.3 PROTECTION

A. Protect installed interior wall paneling from subsequent construction operations.

END OF SECTION 09 78 00

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SECTION 09 91 13 - EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.
   2. Guardrails and handrails

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

1.3 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
   1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
   2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:
   1. Basis of Design Manufacturer: Sherwin-Williams Company: www.sherwin-williams.com/#sle.
   2. Dunn-Edwards Corporation: www.dunnedwards.com/#sle.
   3. Pittsburgh Paints: www.ppgpaints.com/#sle.

C. Primer Sealers: Same manufacturer as top coats.

D. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

2.3 PAINT SYSTEMS - EXTERIOR

A. _____ Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including primed metal.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Alkyd Enamel; MPI #9, 81, 94, or 96.
   3. Top Coat Sheen:
      a. Satin: MPI gloss level 4; use this sheen at all locations.

B. Paint E-TR-C - Transparent Finish on Concrete Floors:
   1. 1 coat stain.
   2. Stain: Solid Color Stain for Concrete.
   3. Sealer: Water Based Sealer for Concrete Floors; MPI #99.
   4. Sealer Sheen:
      a. Eggshell: MPI gloss level 3; use this sheen at all locations.

2.4 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
   1. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
   2. Water Based Primer for Galvanized Metal; MPI #134.
   3. Rust-Inhibitive Water Based Primer; MPI #107.

2.5 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Exterior Plaster and Stucco: 12 percent.
   2. Concrete Floors and Traffic Surfaces: 8 percent.

3.2 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:

G. Exterior Plaster: Fill hairline cracks, small holes, and imperfections with exterior patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM D523 - Standard Test Method for Specular Gloss; 2025.

B. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024, with Errata (2025).

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.
   1. Steel and iron.
   2. Wood.
   3. Gypsum board.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches (203.2 mm) square.
   2. Apply coats on Samples in steps to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:
   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
   3. VOC content.

1.5 EXTRA MATERIALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: One un-opened gallon of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
      a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      b. Other Items: Architect will designate items or areas required.
   2. Final approval of color selections will be based on mockups.
      a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: As Indicated in the drawings.

B. Products: As Indicated in the drawings.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction or the following:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

D. Colors: As Indicated in the Drawings.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

B. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.

C. Primer, Latex, for Interior Wood: MPI #39.

D. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.

2.6 WATER-BASED PAINTS

A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.

B. Latex, Interior, (Gloss Level 3): MPI #52.

C. Latex, Interior, Semi-Gloss, (Gloss Level 5): MPI #54.

D. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

E. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): MPI #145.

F. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Wood: 15 percent.
4. Gypsum Board: 12 percent.
5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.
   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
   1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 09 91 23

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SECTION 09 97 25 - MINERAL-BASED COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Mineral-based coatings.

1.2 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.

B. Section 09 91 23 - Interior Painting.

1.3 REFERENCE STANDARDS

A. ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films; 2013 (Reapproved 2021).

B. ASTM D6904 - Standard Practice for Resistance to Wind-Driven Rain for Exterior Coatings Applied on Masonry; 2003 (Reapproved 2022).

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating coating materials.

C. Samples: Submit two samples 12 x 12 inches in size illustrating colors for selection.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience and approved by manufacturer.

1.6 MOCK-UP

A. Provide mock-up, 8 feet (____ m) long by 4 feet (____ m) illustrating color, texture, and quality of work .

B. See Section 01 40 00 - Quality Requirements for additional requirements.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.7 FIELD CONDITIONS

A. Do not install materials when temperature is below 41 degrees F (5 degrees C) or above 113 degrees F (45 degrees C).

B. Maintain this temperature range, 24 hours before, during, and 48 hours after installation of coating.

C. Restrict traffic from area where coating is being applied or is curing.

1.8 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Mineral-Based Coatings:
   1. KEIM Mineral Coatings of America, Inc: www.keim-usa.com/#sle.
   2. PermaTint Limited: www.permatint.com/#sle.
   3. Beeck Mineral Paints; BeeckMineralPaints.com
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 MINERAL-BASED COATINGS

A. Provide mineral-based coating systems that meet the following minimum performance criteria:
   1. Water Vapor Transmission Rate: _____ grains/sq ft/hour (_____ grams/sq m/hour) when tested according to ASTM D1653, method B.
   2. Water Vapor Permeance Rate: _____ perms (_____ ng/Pa s sq m) when tested according to ASTM D1653, method B.
   3. Wind Driven Rain Resistance: Passing, when tested according to ASTM D6904 at 98 miles per hour (158 km/h) for 24 hours.
   4. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.

2.3 MATERIALS

A. General:
   1. Provide mineral-based coatings formulated to chemically bond with the substrate to produce a water-repellent, vapor permeable, fire retardant finish.

B. Paint: Water and potassium silicate based paint with earthen and mineral pigments and fillers; quartz binder.
   1. Dilute with _____ percent, maximum, mineral-based primer/thinner.
   2. Color: As indicated on drawings.
   3. Coverage: _____ sq ft (_____ sq m) per gallon.
   4. Products:
      a. KEIM Mineral Coatings of America, Inc; Innostar: www.keim-usa.com/#sle.

C. Primer/Thinner: Water and potassium silicate based primer with acrylate stabilizer. Use as recommended by coating manufacturer to stabilize loose or powdery mineral surfaces, to condition unevenly or highly absorbent surfaces, or as a thinner for silicate coatings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

C. Cementitious Substrates: Do not begin application until substrate has cured 28 days minimum and measured moisture content is not greater than 4 percent.

3.2 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Existing Painted and Sealed Surfaces:
   1. Strip existing paint and coatings from surface.
   2. Remove loose, flaking, and peeling paint.
   3. Clean with mixture of trisodium phosphate and water to remove surface grease and foreign matter.

C. Protect adjacent surfaces and materials not receiving coating from splatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.3 PRIMING

A. Prior to priming, patch holes and indentations and fill cracks with manufacturer's recommended crack repair material.

B. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

C. If surface is highly absorbent, apply second coat of primer. Allow to dry 8 hours, minimum, before recoating.

3.4 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's instructions.

3.5 CLEANING

A. Clean surfaces immediately of overspray, splatter, and excess material.

3.6 PROTECTION

A. Protect finished work from damage.

END OF SECTION 09 97 25

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SECTION 10 21 13.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:
   1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
   2. Section 061000 "Rough Carpentry" for blocking.
   3. Section 102800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories mounted on toilet compartments.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For toilet compartments.
   1. Include plans, elevations, sections, details, and attachment details.
   2. Show locations of cutouts for compartment-mounted toilet accessories.
   3. Show locations of centerlines of toilet fixtures.
   4. Show locations of floor drains.
   5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.
   1. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for toilet compartments, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One door bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: Ten fasteners of each size and type.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

A. Phenolic Toilet Compartments:
   1. All American Metal Corp - AAMCO; _____: www.allamericanmetal.com/#sle.
   2. ASI Accurate Partitions; _____: www.asi-accuratepartitions.com/#sle.
   3. ASI Global Partitions; _____: www.asi-globalpartitions.com/#sle.

B. Toilet-Enclosure Style: Floor and ceiling anchored.

C. Entrance-Screen Style: Floor and ceiling anchored.

D. Urinal-Screen Style: Wall hung.

E. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

F. Pilaster Shoes and Sleeves (Caps): Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76.2 mm) high, finished to match hardware.

G. Brackets (Fittings):
   1. Stirrup Type: Ear or U-brackets, stainless steel.
   2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

H. Phenolic-Panel Finish:
   1. Facing Sheet Finish: One color and pattern in each room.
   2. Color and Pattern: As selected by Architect from manufacturer's full range with manufacturer's standard dark color core.
   3. Edge Color: Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's heavy-duty operating hardware and accessories.
   1. Hinges: Manufacturer's minimum 0.062-inch- (1.59-mm-) thick stainless-steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees allowing emergency access by lifting door. Mount with through-bolts.
   2. Latch and Keeper: Manufacturer's heavy-duty surface-mounted cast-stainless-steel latch unit designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through-bolts.
   3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless-steel hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories. Mount with through-bolts.
   4. Door Bumper: Manufacturer's heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors and entrance-screen doors. Mount with through-bolts.
   5. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B26/B26M.

B. Aluminum Extrusions: ASTM B221 (((ASTM B221M))).

C. Brass Castings: ASTM B584.

D. Brass Extrusions: ASTM B 455.

E. Stainless-Steel Sheet: ASTM A666/A666M, Type 304, stretcher-leveled standard of flatness.

F. Stainless-Steel Castings: ASTM A743/A743M.

G. Zamac: ASTM B86, commercial zinc-alloy die castings.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
   1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
   1. Maximum Clearances:
      a. Pilasters and Panels: 3/8 inch (12.7 mm).
      b. Panels and Walls: 3/8 inch (25.4 mm).
   2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
      a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
      b. Align brackets at pilasters with brackets at walls.
   3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
      a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
      b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of

panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (50.8 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

E. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 10 21 13.17

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SECTION 10 22 39 - FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Top-supported, folding, horizontal opening, electrically operated and continuously hinged partitions.

1.2 RELATED REQUIREMENTS

A. Section 26 05 33.13 - Conduit for Electrical Systems: Empty conduit from partition motor controller to disconnect and from motor controller to control buttons.

B. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections; control buttons .

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

C. ASTM E413 - Classification for Rating Sound Insulation; 2022.

D. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2026).

E. ASTM E596 - Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures; 2022.

F. ASTM F793/F793M - Standard Classification of Wall Coverings and Ceiling Coverings by Use Characteristics; 2025.

G. NEMA MG 00001 - Motors and Generators; 2024.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, track switching components, and colors and finishes available.

C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.

1. Include Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.

D. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.

E. Samples for Selection: Submit two samples of full manufacturer's color range for selection of colors.

F. Samples for Review: Submit two samples of surface finish, 12 by 12 inches (300 by 300 mm) size, illustrating quality, colors selected, texture, and weight.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.

C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 *Standard Practice for Architectural Application and Installation of Operable Partitions*.

D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

B. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.

C. Protect panels during delivery, storage, and handling to comply with manufacturer’s direction and as required to prevent damage.

1.7 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within 1 year period after Date of Substantial Completion.

C. Provide 3 year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Folding Panel Partitions - Horizontal Opening:
   1. Modernfold, (Basis Of Design); Acousti-seal Encore-Automated #14: www.modernfold.com/#sle.
   2. Kwik-Wall Company; 3000 Series Operable Walls: www.kwik-wall.com/#sle.
   3. Moderco, Inc; 800 Series Model 842: www.moderco.com/#sle.

2.2 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panel Partitions: Side opening; continuous hinged panels; side stacking; motor operated.

B. Panel Construction:
   1. Nominal 4-1/4-inch (108 mm) thick panels in manufacturer’s standard 51-inch (1295 mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so

that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.

2. Panel Skin Options:
3. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction (select one):
4. 56 STC - 16-gage steel
5. Hinges for Pass Doors, and Pocket Doors shall be (select one):
6. Full leaf butt hinges, attached directly to panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime Warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
7. Concealed laminated hinge with antifriction segments mounted between each heat-treated link. Hinge to be attached directly to panel frame. Welded internal hinge bracket shall support the hinge and allow for adjustment of hinge plates. Concealed hinges mounted into panel edge or vertical astragal are not acceptable.
8. Panel Trim: No vertical or horizontal trim required or allowed on edges of panels; minimal groove appearance at panel joints.
9. Panel Weight:
    a. Steel Skin
        1) 54 STC – 9.5 lbs./square foot

C. Panel Finishes:
    1. Facing: See Finish Schedule.

D. Panel Seals:
    1. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with tongue and groove configuration in each panel edge. Aluminum astragals or rigid plastic astragals are not acceptable.
    2. Horizontal Top Seals shall be Modernfold SureSet™ automatic operable top seals, manually operated operable top seals and/or fixed seals are not required or permitted.
    3. Horizontal Bottom Seals shall be Modernfold SureSet™ bottom seal (select one):
        a. SA2E - Automatic bottom seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to –1-1/2-inch (38 mm) which automatically drop as panels are positioned and final closure made, without the need for tools or cranks.
    4. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.

E. Suspension System:
    1. Suspension Tracks: Minimum 7-gage, 0.18-inch (5 mm) roll-formed steel. Track shall be supported by adjustable steel hanger brackets connected to structural support by pairs of 1/2-inch (13 mm) diameter threaded rods. Brackets must support the load bearing surface of the track.
        a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.
    2. Carriers: All-steel trolleys with steel-tired ball bearing wheels.
    3. Warranty period: Ten (10) years.

F. Performance:

1. Acoustic Performance:
    a. Noise Reduction Coefficient (NRC): ASTM E596, NRC of 0.65 minimum.
    b. Sound Transmission Class (STC): 54 min. calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft (9.3 sq m).
2. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

G. Operation:
1. Electric Operator: 12 inches (300 mm) per second traveling speed; adjustable friction clutch brake actuated by solenoid controlled motor starter; enclosed limit switch; enclosed magnetic reversing starter.
    a. Motor: NEMA MG 1 ____.
    b. See drawings for motor power information.
2. Control Station: Two standard keyed, three button OPEN-STOP-CLOSE type; 24 volt circuit; recess mounted. See drawings.
    a. Key switch prepared for mortise lock cylinder.
    b. Key switches alike.
3. Safety Features:
    a. Limit Switches: Automatic type, at both extremes of travel, to prevent over-travel.
    b. Emergency Release: Mechanism to disengage motor drive system and permit manual operation.

H. Accessories:
1. Ceiling Closure: White enameled ceiling closure; aluminum jamb and head molding, fittings and attachments.
2. Pass/Egress Door: Single door, 36" clear min wide by 7'-0" high opening; same design and construction as panel; fit door with perimeter acoustic gaskets and concealed closer.
3. Acoustic Sealant: As recommended by partition manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.

C. Verify track supports are laterally braced and will permit track to be level within 1/4 inch (6.4 mm) of required position and parallel to the floor surface.

D. Verify floor flatness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

E. Verify wall plumbness of 1/8 inch in 10 feet (3 mm in 3 m), non-cumulative.

3.2 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.

B. Install electric operator, wiring, and controls. Locate control station(s) as indicated.

C. Fit and align partition assembly _____ level and plumb.

D. Lubricate moving components.

E. Install acoustic sealant to achieve required acoustic performance.

F. Coordinate electrical connections.

3.3 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.

C. Adjust partition assembly to achieve lightproof seal.

3.4 CLEANING

A. Clean finish surfaces and partition accessories.

B. Condition markerboard surfaces in accordance with manufacturer's instructions.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION 10 22 39

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SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial toilet accessories.

B. Commercial shower accessories.

C. Institutional ligature-resistant toilet accessories.

D. Diaper changing stations.

E. Utility room accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 30 00 - Tiling: Ceramic washroom accessories.

B. Section 102113.17 Phenolic-Core Toilet compartments.

C. Section 22 40 00 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. ASTM C1036 - Standard Specification for Flat Glass; 2021.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

E. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

F. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Coordinate the work of each accessory with locations and wall types identified on the plans.Indicated such mounting requirement applicable to each submittal and installation instruction to be provided for every application.EndFragment

D. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. See drawings for schedule for basis of design fixtures.

B. Commercial Toilet, Shower, Bath and Custodial Accessories: As indicated on Drawings.

1. Bobrick Washroom Equipment, Inc. : https://www.bobrick.com/
2. American Specialties, Inc: www.americanspecialties.com/#sle.
3. Bradley Corporation: www.bradleycorp.com/#sle.

4. Georgia-Pacific Professional: www.gppro.com/#sle.

C. Institutional Security and Ligature-Resistant Toilet and Bath Accessories: As indicated on Drawings.
1. American Specialties, Inc: www.americanspecialties.com/#sle.
2. Whitehall Manufacturing: www.whitehallmfg.com/#sle.

D. Diaper Changing Stations: As indicated on Drawings.
1. American Specialties, Inc: www.americanspecialties.com/#sle.
2. Bradley Corporation: www.bradleycorp.com/#sle.
3. Koala Kare Products: www.koalabear.com/#sle.

2.2 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.

B. Keys: Provide 4 keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666/A666M, Type 304.

D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.

F. Fasteners, Screws, and Bolts: Hot dip galvanized; As indicated on Drawings.

2.3 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.4 TOILET ACCESSORIES

A. See drawings for accessories schedule.

B. Grab Bars: Stainless steel, smooth surface.
1. Heavy Duty Grab Bars: Floor supports are acceptable if necessary to achieve load rating.
a. Push/Pull Point Load: Minimum 1000 pound-force (4448.2 N), minimum.
b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.125 inch (3.17 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
c. Length and Configuration: As indicated on drawings.

2.5 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain: See Finish Schedule.
1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.

B. ADD Recessed shower niche: See Finish Schedule.

C. Coat Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.6 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.
   2. Hooks: Two, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
   4. Length: Manufacturer's standard length for number of holders/hooks.
   5. Products:
      a. American Specialties, Inc: www.americanspecialties.com/#sle.
      b. Bobrick Washroom Equipment, Inc. : https://www.bobrick.com/
      c. Bradley Corporation;[____]: www.bradleycorp.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
   1. Grab Bars: As indicated on drawings.
   2. Other Accessories: As indicated on drawings.

3.4 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION 10 28 00

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SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Field paint finish.

1.2 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

B. FM (AG) - FM Approval Guide; Current Edition.

C. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

D. UL (DIR) - Online Certifications Directory; Current Edition.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fire Extinguishers:
   1. Fire-End & Croker Corporation; Multipurpose ABC: www.croker.com/#sle.
   2. Kidde, a unit of United Technologies Corp; Multipurpose ABC: www.kidde.com/#sle.
   3. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: www.ovalfireproducts.com/#sle.
   4. Potter-Roemer; Multipurpose ABC: www.potterroemer.com/#sle.

B. Fire Extinguisher Cabinets and Accessories:
   1. Fire-End & Croker Corporation: www.croker.com/#sle.
   2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
   3. Larsen's Manufacturing Co: www.larsensmfg.com/#sle.
   4. Potter-Roemer: www.potterroemer.com/#sle.

2.2 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to ___ degrees F (___ degrees C).

2.3 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

B. Fire Rated Cabinet Construction: One-hour fire rated.
   1. Steel; double wall or outer and inner boxes with 5/8 inch (15.9 mm) thick fire barrier material.

C. Cabinet Configuration: Recessed type.

D. Door: 0.036 inch (0.9 mm) metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.

E. Door Glazing: Float glass, clear, 1/8 inch (3 mm) thick, and set in resilient channel glazing gasket.

F. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.

G. Fabrication: Weld, fill, and grind components smooth.

H. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

I. Finish of Cabinet Interior: White colored enamel.

2.4 ACCESSORIES

A. Cabinet Signage: Fire Extinguisher.

B. Lettering: “FIRE EXTINGUISHER” decal, or vinyl self-adhering, prespaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cabinets plumb and level in wall openings, 24 inches (609.6 mm) from finished floor to inside bottom of cabinet.

C. Secure rigidly in place.

D. Place extinguishers in cabinets.

3.3 MAINTENANCE - SELF-SERVICE FIRE EXTINGUISHERS

A. Monthly Inspections: Inspect self-service fire extinguishers on monthly basis in accordance with manufacturer’s instructions, and requirements of the authorities having jurisdiction (AHJ).

B. Annual Inspections: Inspect self-service fire extinguishers on annual basis in accordance with manufacturer’s instructions, and requirements of the authorities having jurisdiction (AHJ).

C. Inspection Certification Tag: Provide new tag indicating acceptable condition of fire extinguisher, date of inspection, and name of self-service inspector for each inspection.

END OF SECTION 10 44 00

SECTION 10 44 13 - FIRE PROTECTION CABINETS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

B. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.

C. ASTM B36/B36M - Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar; 2023.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.

E. ASTM C1036 - Standard Specification for Flat Glass; 2021.

F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.

G. ASTM D4802 - Standard Specification for Poly(Methyl Methacrylate) Acrylic Plastic Sheet; 2016.

H. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:
   1. Fire-protection cabinets for the following:
      a. Portable fire extinguishers.
      b. Fire hose valves.
      c. Fire hoses and racks.

B. Related Requirements:
   1. Section 104416 "Fire Extinguishers."
   2. Section 211200 "Fire-Suppression Standpipes" for fire-hose connections.

1.4 UNIT PRICES

A. Work of this Section is affected by N/A.

1.5 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site
   1. Review methods and procedures related to fire-protection cabinets including, but not limited to, the following:
      a. Schedules and coordination requirements.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
   1. Show location of knockouts for hose valves.

B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Samples for Initial Selection: For each type of exposed finish required.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches (150 by 150 mm) square.

F. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.8 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.9 SEQUENCING

A. Apply decals on field-painted fire-protection cabinets after painting is complete.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
   1. Double click here to find, evaluate, and insert list of manufacturers and products.

B. Cabinet Construction: Nonrated.
   1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch- (1.09-mm-) thick cold-rolled steel sheet lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.
   1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:
   1. Trimless with Concealed Flange: Surface of surrounding wall finishes flush with exterior finished surface of cabinet frame and door, without overlapping trim attached to

cabinet. Provide recessed flange, of same material as box, attached to box to act as plaster stop.

2. Trimless with Hidden Flange: Flange of same metal and finish as box overlaps surrounding wall finish and is concealed from view by an overlapping door.
3. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
   1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
   2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Steel sheet.

H. Door Material: Steel sheet.

I. Door Style: Fully glazed, frameless, backless, acrylic panel.

J. Door Glazing: Clear float glass.
   1. Acrylic Sheet Color: Clear transparent acrylic sheet.
   2. Acrylic Sheet Color: Clear transparent acrylic sheet painted white on unexposed side.
   3. Acrylic Bubble Color: Clear, transparent.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide projecting lever handle with cam-action latch.
   2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

L. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
   3. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
   4. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
   5. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated .
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER "
         1) Location: Applied to cabinet door.
         2) Application Process: Silk-screened.
         3) Lettering Color: Red.
         4) Orientation: Vertical.

6. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by batteries.

M. Materials:
1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
a. Finish: Factory primed for field painting.
b. Color: As selected by Architect from full range of industry colors and color densities .
2. Aluminum: ASTM B221 (((ASTM B221M))), with strength and durability characteristics of not less than Alloy 6063-T5 for aluminum sheet. ASTM B221 (((ASTM B221M))) for extruded shapes.
a. Finish: Clear anodic.
b. Color: As selected by Architect from full range of industry colors and color densities .
3. Stainless Steel: ASTM A666/A666M, Type 304.
a. Finish: No. 4 directional satin finish .
4. Copper Alloy, Brass: ASTM B36/B36M, alloy as standard with manufacturer .
a. Finish: Polished .
5. Copper Alloy, Bronze: ASTM B36/B36M, alloy as standard with manufacturer .
a. Finish: Mirror polish ???Insert finish???.
6. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 3 mm thick.
7. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 0.12 inch (3 mm) thick, Class 1 (clear).
8. Break Glass: Clear annealed float glass, ASTM C1036, Type I, Class 1, Quality q3, 0.06 inch (1.5 mm) thick, single strength.
9. Tempered Break Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 0.06 inch (1.5 mm) thick.
10. Wire Glass: ASTM C1036, Type II, Class 1, Form 1, Quality q8, Mesh m1 (diamond), 0.24 inch (6 mm) thick.
11. Transparent Acrylic Sheet: ASTM D4802, Category A-1 (cell-cast sheet), 1.5 mm thick, with Finish 1 (smooth or polished).

2.3 SECURITY FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
1. Double click here to find, evaluate, and insert list of manufacturers and products.

B. Cabinet Construction: Nonrated.
1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls lined with minimum 5/8-inch- (16-mm-) thick fire-barrier material.

C. Cabinet Material: 0.068-inch- (1.72-mm-) thick steel sheet.
1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:
1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
1. Square-Edge Trim: 1-1/4- to 1-1/2-inch (32- to 38-mm) backbend depth.
2. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Steel sheet.

H. Door Material: 0.097-inch- (2.45-mm-) thick steel sheet.

I. Door Style: Solid opaque panel with frame.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated, and as follows:
   1. Recessed door pull.
   2. Continuous Hinge: Same material and finish as trim, permitting door to open 180 degrees.
   3. Mechanical Deadlock: Lockbolt retracted and extended by five-tumbler paracentric cylinder; keyed one side.
      a. Lockbolt: 1-1/2 inches (38 mm) high by 3/4 inch (19.05 mm) thick; 5/8-inch (16-mm) throw.
   4. Mechanical Deadlock: As specified in Section 087163 "Detention Door Hardware."
   5. Mechanical Snaplatch: Automatic snaplatch when closed; latchbolt retracted by five-tumbler paracentric cylinder; keyed one side.
      a. Lockbolt: 1 inch (25.4 mm) high by 7/16 inch (11.11 mm) thick; 5/16-inch (8-mm) throw.
   6. Mechanical Snaplatch: As specified in Section 087163 "Detention Door Hardware."

K. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to security fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated .
      a. Identify fire extinguisher in security fire-protection cabinet with the words "FIRE EXTINGUISHER ."
         1) Location: Applied to cabinet door.
         2) Application Process: Silk-screened.
         3) Lettering Color: Red.
         4) Orientation: Vertical.
   3. Keys: Three per door lock.

L. Materials:
   1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
      a. Finish: Factory primed for field painting.
      b. Color: Match Architect's sample .
   2. Stainless Steel: ASTM A666/A666M, Type 304.
      a. Finish: No. 4 directional satin finish .

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.

2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.
4. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (12.7 mm) thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose valves and cabinets to verify actual locations of piping connections before cabinet installation.

B. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
1. Fire-Protection Cabinets: 54 inches (1371.6 mm) Refe to G series drawings for dimension above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

4. Fire-Rated Hose and Valve Cabinets:
    a. Install cabinet with not more than 1/16-inch (1.6-mm) tolerance between pipe OD and knockout OD. Center pipe within knockout.
    b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."

C. Identification: Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

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SECTION 10 44 16 - FIRE EXTINGUISHERS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Owner-Furnished Material: Hand-carried fire extinguishers.

C. Related Requirements:
   1. Section 104413 "Fire Protection Cabinets."
   2. Section 233813 "Commercial-Kitchen Hoods" for fire-extinguishing systems provided as part of commercial-kitchen exhaust hoods.

1.4 UNIT PRICES

A. Work of this Section is affected by N/A.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .
   1. Review methods and procedures related to fire extinguishers including, but not limited to, the following:
      a. Schedules and coordination requirements.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.7 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.9 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
   1. Kidde, Potter Roemer, Fire-End & Croker
   2. Valves: Manufacturer's standard.
   3. Handles and Levers: Manufacturer's standard.
   4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Stored-Pressure Water Type : UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water in stainless-steel container; with pressure-indicating gage.

C. Stored-Pressure Antifreeze Water Type : UL-rated 2-A, 2.5-gal. (9.5-L) nominal capacity, with water and approved antifreeze solution mixed for temperatures as low as minus 40 deg F (minus 40 deg C) in stainless-steel container; with pressure-indicating gage.

D. Stored-Pressure Water-Mist Type: UL-rated 2-A:C, 2.5-gal. (9.5-L) nominal capacity, with water in enameled-steel container; with pressure-indicating gage.

E. Pressurized, AFFF-Foam Type: UL-rated 2-A:10-B, 1.6-gal. (6-L) nominal capacity, with AFFF foam in stainless-steel container; with pressure-indicating gage.

F. Pressurized, FFFP-Foam Type : UL-rated 3-A:20-B, 2.5-gal. (9.5-L) nominal capacity, with FFFP foam in stainless-steel container; with pressure-indicating gage.

G. Wet-Chemical Type : UL-rated 2-A:1-B:C:K, 1.6-gal. (6-L) nominal capacity, with potassium acetate-based chemical in stainless-steel container; with pressure-indicating gage.

H. Regular Dry-Chemical Type : UL-rated 10lb nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

I. Regular Dry-Chemical Type in Steel Container: UL-rated 2-B:C, 1-lb (0.4-kg) nominal capacity, with sodium bicarbonate-based dry chemical in enameled-steel container.

J. Regular Dry-Chemical Type in Aluminum Container: UL-rated 2-B:C, 1-lb (0.4-kg) nominal capacity, with sodium bicarbonate-based dry chemical in enameled-aluminum container.

K. Regular Dry-Chemical Type in Brass Container: UL-rated 40-B:C, 6-lb (2.7-kg) nominal capacity, with sodium bicarbonate-based dry chemical in chrome-plated-brass container.

L. Multipurpose Dry-Chemical Type in Steel Container : UL-rated 1-A:10-B:C, 2.5-lb (1.1-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

M. Multipurpose Dry-Chemical Type in Aluminum Container: UL-rated 1-A:10-B:C, 2.5-lb (1.1-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

N. Multipurpose Dry-Chemical Type in Brass Container : UL-rated 2-A:10-B:C, 5-lb (2.3-kg) nominal capacity, with monoammonium phosphate-based dry chemical in chrome-plated-brass container.

O. Purple-K Dry-Chemical Type in Aluminum Container: UL-rated 10-B:C, 2.5-lb (1.1-kg) nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

P. Purple-K Dry-Chemical Type in Brass Container : UL-rated 80-B:C, 10-lb (4.5-kg) nominal capacity, with potassium bicarbonate-based dry chemical in chrome-plated-brass container.

Q. Carbon Dioxide Type : UL-rated 5-B:C, 5-lb (2.3-kg) nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

R. Dry-Powder Type: FM approved, UL-rated Class D, 30-lb (13.6-kg) nominal capacity, with sodium chloride-based powder in enameled-steel container; with pressure-indicating gage.

S. Halon Type: UL-rated 5-B:C, 2.5-lb (1.1-kg) nominal capacity, in enameled-steel container; with pressure-indicating gage.

T. Clean-Agent Type in Aluminum Container: UL-rated 1-B:C, 1.4-lb (0.6-kg) nominal capacity, with HCFC Blend B agent and inert material in enameled-aluminum container; with pressure-indicating gage.

U. Clean-Agent Type in Brass Container : UL-rated 1-A:10-B:C, 11-lb (5-kg) nominal capacity, with HCFC Blend B agent and inert material in chrome-plated-brass container; with pressure-indicating gage.

V. Clean-Agent Type in Steel Container : UL-rated 5-B:C, 4.75-lb (2.2-kg) nominal capacity, with HFC blend agent and inert material in enameled-steel container; with pressure-indicating gage.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.
   1. Kidde, Potter Roemer, Fire-End & Croker

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
      a. Orientation: Vertical.

2.4 WHEELED FIRE EXTINGUISHERS

A. Wheeled Fire Extinguishers: Type, size, and capacity for locations indicated, complete with carriage.
   1. Kidde, Potter Roemer, Fire-End & Croker.
   2. Carriage: Fabricated from enameled-steel pipe, complete with hanger assembly, long-range nozzle, hose, and semipneumatic solid-rubber tires.
      a. Hose: 15 feet (457.2 cm).

B. Pressurized, FFFP-Foam Type: UL-rated 20-A:160-B, 33-gal. (125-L) nominal capacity, with FFFP foam in stainless-steel container.

C. Regular Dry-Chemical Type: UL-rated 160-B:C, 50-lb (23-kg) nominal capacity, with sodium bicarbonate-based dry chemical in regulated-pressure, enameled-steel container.

D. Multipurpose Dry-Chemical Type: UL-rated 20-A:160-B:C, 30-lb (13.6-kg) nominal capacity, with monoammonium phosphate-based dry chemical in regulated-pressure, enameled-steel container.

E. Purple-K Dry-Chemical Type: UL-rated 160-B:C, 50-lb (23-kg) nominal capacity, with potassium bicarbonate-based dry chemical in regulated-pressure, enameled-steel container.

F. Carbon Dioxide Type: UL-rated 20-B:C, 50-lb (23-kg) nominal capacity, with carbon dioxide in manufacturer's standard enameled-metal container.

G. Dry-Powder Type: FM approved, UL-rated Class D, sodium chloride-based powder, 150-lb (68-kg) nominal capacity, in regulated-pressure, enameled-steel container; with pressure-indicating gage.

H. Clean-Agent Type: UL-rated 4-A:40-B:C, 65-lb (29-kg) nominal capacity, with HCFC Blend B agent and inert material in stored-pressure, enameled-steel container; with pressure-indicating gage.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: 54 inches (1371.6 mm) above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 44 16

SECTION 10 51 13 - METAL LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal lockers.

B. Locker benches.

1.2 RELATED REQUIREMENTS

A. Section 06 20 00 - Finish Carpentry: Bench tops for locker bench support brackets.

1.3 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.

C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.

D. Samples: Submit two samples 3 by 6 inches (75 by 150 mm) in size showing color and finish of metal locker material.

E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Metal Lockers:
1. Art Metal Products: www.artmetalproducts.com/#sle.
2. ASI Storage Solutions: www.asi-storage.com/#sle.
3. Best Access Doors: www.bestaccessdoors.com/#sle.
4. DeBourgh Manufacturing Co; Apex Series Lockers: www.debourgh.com/#sle.
5. Hadrian; Hadrian Emperor Series: www.hadrian-inc.com/#sle.
6. List Industries, Inc; ____: www.listindustries.com/#sle.
7. Lockers MFG; KnockDown Lockers: www.lockersmfg.com/#sle.
8. Lyon Workspace Products; ____: www.lyonworkspace.com/#sle.
9. Penco Products, Inc; ____: www.pencoproducts.com/#sle.
10. Republic Storage Systems Co; ____: www.republicstorage.com/#sle.
11. Spacesaver Corporation; Day Use Lockers: www.spacesaver.com/#sle.
12. Tennsco Storage; Steel Lockers: www.tennsco.com/#sle.
13. WEC Manufacturing; _____: www.itswec.com/#sle.

2.2 LOCKER APPLICATIONS

A. LK-1 Metal lockers, free-standing for base indicated on drawings.
1. Width: 12 inches (305 mm).
2. Depth: 21 inches (533 mm).
3. Height: 72 inches (1830 mm).
4. Configuration: Single tier.
5. Fittings: Size and configuration as indicated on drawings.
a. Hat shelf.

b. Single shoe shelf.
c. Coat rod.
d. Hooks: One double prong.

6. Ventilation: Louvers at top and bottom of door panel.
7. Locking: Built-in combination locks.

2.3 METAL LOCKERS

A. Accessibility: Design units to comply with ICC A117.1 and ADA Standards.

B. Locker Case Construction:
1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.
b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
1) Legs: Manufacturer's standard
(a) Height: 6 inches (152 mm).

C. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
1. Door Thickness: 16 gauge, 0.0598 inch (1.52 mm), minimum.
2. Form recess for operating handle and locking device.

D. Latches and Door Handles: Manufacturer's standard.

E. Coat Hooks: Stainless steel or zinc-plated steel.

F. Number Plates: Provide oval shaped aluminum plates. Form numbers 1 inch (25 mm) high of block font style with ADA designation, in contrasting color.

G. Locks: Locker manufacturer's standard type indicated in Applications article above.

2.4 LOCKER BENCHES

A. LKB-1 Locker Benches: Stationary; satin stainless steel pedestals.
1. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Locker Bench Support Brackets: Welded structural aluminum single arm floor mount pedestal bench support brackets; pre-drilled for bench top material attachment and for wall anchorage.
1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Load Capacity per Bracket: 400 pounds (181 kg).
3. Finish: Black powdercoat.
4. Bracket Spacing: 30 inches on center (), maximum. Project-specific spacing to be determined based on field measurements.
5. Bracket-to-Wall Attachment: Fasteners/anchors recommended by bracket manufacturer for wall construction conditions encountered. Provide solid blocking.
6. Bench Top: Selected by architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that prepared bases are in correct position and configuration.

B. Verify bases are properly sized.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Place and secure on prepared base.

C. Install lockers plumb and square.

D. Bolt adjoining locker units together to provide rigid installation.

E. Install end panels and filler panels.

F. Install fittings if not factory installed.

G. Replace components that do not operate smoothly.

3.3 CLEANING

A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 51 13

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SECTION 11 30 13 - RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site ???Insert location???.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Sustainable Design Submittals:

C. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of appliance.

C. Field quality-control reports.

D. Sample Warranties: For manufacturers' special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Accessibility: Comply with ICC/ANSI A117.1

C. Preinstallation Conference: Conduct conference at Project Site.

1.7 WARRANTY

A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 REFRIGERATOR/FREEZERS

A. EQ-1 Refrigerator/Freezer, as scheduled in drawings

2.2 COFFEE MAKER

A. EQ-2 Coffee Maker, as scheduled in drawings

2.3 COUNTERTOP WATER COOLER

A. EQ-3 Countertop water cooler, as scheduled in drawings

2.4 MICROWAVE

A. EQ-4 Microwave,as scheduled in drawings

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install appliances according to manufacturer's written instructions.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
   2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After installation, start units to confirm proper operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

B. An appliance will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 11 30 13

SECTION 12 24 13 - ROLLER WINDOW SHADES

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. NEMA IA 10030 - Industrial Control and Systems: Enclosures; 2024.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

D. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.2 SUMMARY

A. Section Includes:
   1. Motor-operated roller shades with single rollers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
   1. Motor-Operated Shades: Include details of installation and diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (254 mm) long.

D. Samples for Initial Selection: For each type and color of shadeband material.
   1. Include Samples of accessories involving color selection.

E. Product Schedule: For roller shades.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Bead Chains: Stainless steel rated to 90lb. minimum breaking strength.
      a. Loop Length: Full length of roller shade
      b. Limit Stops: Provide upper and lower ball stops.
      c. Chain-Retainer Type: Clip, jamb mount .
   2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
      a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
   1. Roller Drive-End Location: Right side of interior face of shade
   2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
   3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube .

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
   1. Provide hardware capable for installation of a removable fascia, for both regular and/or reverse roll, which shall be installed without exposed fastening devices of any kind.
   2. Provide shade hardware system that allows for removable regular and/or reverse roll fascia to be mounted continuously across two or more shade bands.
   3. Brackets: Constructed of minimum 1/8-inch thick plated steel or heavier as required to support 150 percent of the full weight of each shade.
   4. Provide shade hardware system that allows multi-banded manually operated shades to be capable of smooth operation when the axis is offset a maximum of 6 degrees on each side of the plane perpendicular to the radial line of the curve, for a 12 degree offset.
   5. Pull Force: Algorithm based spring lift assist coil formula to limit pull force between 3.5 lbs. and 8 lbs. with a load capacity up to 30 lbs. for consistent smooth operation of shades regardless of size and within ADA standards
   6. Pull Angle: Expanded pull angle up to 26 degrees to allow for flexible use of pull chains when access to windows is obstructed.

7. Capable of operating single or multi-banded shades up to 288” wide and 120” tall.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
   1. Provide shade hardware system that allows for multi-banded manually operated shades to have clearances no greater than 5/8-inch between shade bands.
   2. Drive sprocket and brake assembly shall rotate and be supported on a welded 3/8-inch steel pin. The brake shall be an over-running clutch design which disengages to 90 percent during the raising and lowering of a shade. The brake shall withstand a pull force of 50 lbs. in the stopped position.
   3. The entire roller shade assembly shall be fully mounted on the steel support bracket and fully independent of the shade tube assembly, which may be removed and reinstalled without effecting the roller shade limit adjustments.

E. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      a. Shape: L-shaped.
      b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches (101.6 mm) .
   2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
      a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches (101.6 mm) .
   3. Endcap Covers: To cover exposed endcaps.
   4. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
      a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 6 inches (152.4 mm) .
      b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
   5. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
      a. Closure-Panel Width: As indicated on Drawings .
   6. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
   7. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
   8. Installation Accessories Color and Finish: As selected from manufacturer's full range .

2.3 MANUALLY OPERATED SHADES WITH DOUBLE ROLLERS

A. Mechoshade, Lutron

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
   1. Bead Chains: Manufacturer's standard .
      a. Loop Length: Full length of roller shade .

b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
   a. Provide for shadebands that weigh more than 10 lb (4.5 kg) or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.
   1. Crank-Handle Type: Detachable.
   2. Crank-Handle Length: 6 feet (182.88 cm) .

D. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
   1. Double-Roller Mounting Configuration: Side by side.
   2. Inside Roller:
      a. Drive-End Location: Right side of interior face of shade
      b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
   3. Outside Roller:
      a. Drive-End Location: Right side of interior face of shade
      b. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
   4. Shadeband-to-Roller Attachment: Manufacturer's standard method

E. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller mounting configuration, roller assemblies, operating mechanisms, installation accessories, and installation locations and conditions indicated.

F. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

G. Inside Shadebands:
   1. Shadeband Material: Light-filtering fabric
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      a. Type: Enclosed in sealed pocket of shadeband material .
      b. Color and Finish: As selected by Architect from manufacturer's full range

H. Outside Shadebands:
   1. Shadeband Material: Light-blocking fabric .
   2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
      a. Type: Enclosed in sealed pocket of shadeband material .
      b. Color and Finish: As selected by Architect from manufacturer's full range .

I. Installation Accessories:
   1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
      a. Shape: L-shaped .
      b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches (101.6 mm) .

2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
    a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches (101.6 mm) .
3. Endcap Covers: To cover exposed endcaps.
4. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
    a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 6 inches (152.4 mm) .
    b. Provide pocket with lip at lower edge to support acoustical ceiling panel.
5. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
    a. Closure-Panel Width: As indicated on Drawings .
6. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
7. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
8. Installation Accessories Color and Finish: As selected from manufacturer's full range .

2.4 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
    1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
    2. Electric Motor: Manufacturer's standard, enclosed in roller.
        a. Electrical Characteristics: 110-V ac or 24-V/ 12-V dc
        b. Maximum Total Shade Width: As required to operate roller shades indicated
        c. Maximum Shade Drop: As required to operate roller shades indicated
    3. Remote Control: Electric controls with NEMA IA 10030, Type 1 enclosure for surface or flush mounting. Provide the following for remote-control activation of shades:
        a. Group Control Station: Maintained-contact, three-position, rocker-style, wall-switch-operated control station with open, close, and center off functions for single-switch group control.
        b. Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features; isolated from voltage spikes and surges.
        c. Color: As selected by Architect from manufacturer's full range
    4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
    5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.

6. Operating Features:
    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
    b. Capable of interface with audiovisual and multiroom control system.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
    1. Roller Drive-End Location: Right side of interior face of shade
    2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
    3. Shadeband-to-Roller Attachment: Manufacturer's standard method .

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

E. Shadebands:
    1. Shadeband Material: Light-filtering fabric as selected by Architect from manufacturer's full range.
    2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
        a. Color and Finish: As selected by Architect from manufacturer's full range .

F. Installation Accessories:
    1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
        a. Shape: L-shaped .
        b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches (101.6 mm) .
    2. Endcap Covers: To cover exposed endcaps.
    3. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
        a. Closure-Panel Width: As indicated on Drawings.
    4. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
    5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
    6. Installation Accessories Color and Finish: As selected from manufacturer's full range .

2.5 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701 . Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
    1. Source: Roller shade manufacturer .
    2. Type: PVC-coated fiberglass .

3. Weave: Basketweave .
4. Thickness: Manufacturer standard
5. Openness Factor: 3 percent.
6. Color: As indicated on Drawings

C. Light-Blocking Fabric: Opaque fabric, stain and fade resistant.
1. Source: Roller shade manufacturer .
2. Type: PVC-coated fiberglass with bonded PVC film.
3. Thickness: Manufacturer standard.
4. Color: As indicated on Drawings .

2.6 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6.35 mm) per side or 1/2-inch (13-mm) total, plus or minus 1/8 inch (3.18 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6.35 mm), plus or minus 1/8 inch (3.18 mm).
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4 , provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, locations of connections to building electrical system, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
   1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (50.8 mm) to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: At exterior windows.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 24 13

SECTION 12 31 00 - MANUFACTURED METAL CASEWORK

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

B. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.

C. NFPA 30 - Flammable and Combustible Liquids Code; 2024, with Amendment.

PART 2 PRODUCTS

2.1 FABRICATION

A. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
   1. Style: Flush overlay - square edge.
   2. Steel Sheet Metal:
      a. Gables, Front and Back Panels, Gusset Plates, Aprons, and Rails: 18 gauge, 0.0478 inch (1.21 mm) minimum thickness.
      b. Drawers, Cabinet Floors, Shelves, Filler Panels and Drawer Dividers: 20 gauge, 0.0359 inch (0.91 mm) minimum thickness.
      c. Backing Sheet to Door and Door Fronts: 22 gauge, 0.0299 inch (0.76 mm) minimum thickness.
   3. Structural Performance: Provide components that safely support the following minimum loads, without deformation or damage:
      a. Base Units: 500 pounds per linear foot (744 kg/linear m) across the cabinet ends.
   4. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
   5. Edges and Seams: Smooth. Form counter tops, shelves, and drain boards from continuous sheets.
   6. Shelf Edges: Turned down 3/4 inch (19 mm) on each side and returned 3/4 inch (19 mm) front and back.
   7. Ends: Close open ends with matching construction.
   8. Welding: Electric spot welded; joints ground smooth and flush.
   9. Drawers and Doors: Fabricate drawer and door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware.
      a. Fill with sound-deadening core.
   10. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials, and to separate dissimilar metals.

2.2 SPECIAL PURPOSE UNITS

A. Mailroom Special Units.
   1. Primary Construction, Type ___: Manufacturer's standard, with manufacturer's standard material countertops.

2.3 SOLVENT (FLAMMABLE AND COMBUSTIBLE LIQUIDS) STORAGE CABINETS

A. Construct to NFPA 30 and applicable OSHA requirements.

B. Fire Resistance: Maximum internal temperature of 325 degrees F (163 degrees C) at the center, and 1 inch (25.4 mm) from top of the cabinet when cabinet is subjected to a ten minute fire test that simulates fire exposure of a standard time-temperature curve specified in ASTM E119.

C. Steel sheet, 18 gauge, 0.0478 inch (1.21 mm) minimum thickness, double panel construction with 1-1/2 inch (38 mm) space between panels and electrical grounding connection.

D. Shelves: Full depth, adjustable metal shelf.

E. Bottom Pan: 2 inches (50.8 mm) deep liquid-tight pan covering entire bottom of cabinet.

F. Cabinet Hardware: UL-listed.

G. Vents: Provide venting capable of achieving at least ten air changes per hour.
   1. Tie into building hazardous exhaust system.
   2. Vent Connections: 1-1/2 inch (38 mm) minimum diameter, corrosion resistant piping having flame spread index of 25 or less, when tested in accordance with ASTM E84.
   3. Provide minimum of two vents with fire arrestors for each cabinet.

H. Signage: Provide manufacturer's standard signage reading "FLAMMABLE - KEEP FIRE AWAY" or similar message in bright red color.

2.4 MATERIALS

A. General: Manufacturer's standard materials for units specified, unless otherwise indicated.

2.5 FINISHES

A. Metal (Except Stainless Steel): Degrease and phosphate etch followed by primer; minimum two coats baked epoxy; _____ color as selected.

B. Shop finish all components.

END OF SECTION 12 31 00

SECTION 12 36 61.16 - SOLID SURFACING COUNTERTOPS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.

B. AWI/AWMAC/WI - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

C. PS 1 - Structural Plywood; 2023.

1.2 SUMMARY

A. Section Includes:
   1. Solid surface material countertops.
   2. Solid surface material apron fronts.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Samples: For each type of material exposed to view.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

PART 2 PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
   1. Colors and Patterns: As indicated by manufacturer's designations.

B. Particleboard: ANSI A208.1, Grade M-2.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
   1. Grade: Custom.

B. Countertops: 3/4-inch- (19-mm-) thick, solid surface material with front edge built up with same material.

C. Countertops: 1/4-inch- (6.4-mm-) thick, solid surface material laminated to 3/4-inch- (19-mm-) thick particleboard with exposed edges built up with 3/4-inch- (19-mm-) thick, solid surface material.

D. Joints: Fabricate countertops without joints.

E. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.

F. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 EXECUTION

3.1 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

F. Install aprons to backing and countertops with adhesive.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Carpet mat.

1.2 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating properties of walk-off surface, component dimensions.

C. Shop Drawings: Indicate dimensions and details for recessed frame.
   1. For recessed frames located within a dimensionally restricted area, show dimensions of space within which the frame will be installed.

D. Samples: Submit two samples, 4'x4' size illustrating pattern, color, finish and edging.

E. Maintenance Data: Include cleaning instructions and stain removal procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Entrance Floor Grilles and Gratings:
   1. Balco, Inc; _____: www.balcousa.com/#sle.
   2. Construction Specialties, Inc; Entrance Grids: www.c-sgroup.com/#sle.
   3. Nystrom, Inc; _____: www.nystrom.com/#sle.
   4. Pawling Corporation; ____: www.pawling.com/#sle.

B. Floor Mats:
   1. Balco, Incwww.balcousa.com.
   2. Construction Specialties, Inc; Entrance Mats: www.c-sgroup.com.
   3. Nystrom, Inc; _____: www.nystrom.com/#sle.
   4. Pawling Corporation; _____: www.pawling.com/#sle.

2.2 FLOOR MATS

A. Entrance Mat: Carpet roll, and perimeter trim for surface-mounted installation.
   1. Thickness: .50 inches (11.94 mm).
   2. Tread Surfaces: 100% UV resistant polypropylene fibers with a face weight of 44 oz..
   3. All-weather non-skid rubber backing.
   4. Colors: As indicated on drawings.

2.3 FABRICATION

A. Fabricate mats in single unit sizes; fabricate multiple mats where indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that floor opening for mats are ready to receive work.

3.2 PREPARATION

A. Mats: Verify size of floor recess before fabricating mats.

B. Vacuum clean floor recess.

3.3 INSTALLATION

A. Install walk-off surface in floor recess flush with finish floor after cleaning of finish flooring.

3.4 TOLERANCES

A. Maximum Gap Formed at Recessed Frame From Mat Size: 1/4 inch (6 mm).

END OF SECTION 12 48 13

SECTION 14 24 00
HYDRAULIC ELEVATORS

PART 1 – GENERAL

1.01 SUMMARY

A. Work performed of this section shall include all labor, materials, tools, and services required to install the units as specified herein and in accordance with the drawings, general conditions, AIA documents/current Edition, supplementary conditions, and all other requirements of the contract documents. The contract is for a complete job in every respect; bidders are cautioned to familiarize themselves with all project related documents.

B. All work will be in accordance applicable ASME-A 17.1 – Safety Code for Elevators and Escalators and building code with all applicable local adoptions.

C. Passenger Elevator shall be configured as follows:

1.	Quantity:	One (1)
2.	Usage:	Passenger– C1 Loading
3.	Dispatch Operation:	Simplex
4.	Capacity:	2,500 lbs.
5.	Speed:	125 fpm
6.	Landings Served:	1, 2
7.	Clear Inside Hoistway:	9’-0” W x 5’-10” D
8.	Clear Pit Depth:	4’-0”
9.	Clear Overhead:	13’-0”
10.	Clear Inside Interior	6’-8” W x 4’-4” D
11.	Clear Cab Height:	8’-0”
12.	Car & Hoistway Door Size:	3’-6 W x 7’-0” H
13.	Car & Hoistway Door Type:	Single-speed Side-slide
14.	Installation Type:	Above-ground hydraulic
15.	Jack Assembly Type:	Twin jack direct
16.	Pump Type:	Submersible
17.	Controller Type:	Solid state
18.	Motion Control Type:	Soft start
19.	Power Supply:	208V 3PH 60 HZ
20.	Seismic Zone:	2

D. Contractor shall provide their equipment dimensions required for specified capacity and speed if they cannot accommodate these dimensions.

E. Direct questions relating to the intent of the specifications, drawings or quality of work required of the Architect. In the event of disagreement, the Architect's interpretations become final, conclusive, and binding on all parties.

F. In case of disagreement between drawings and specifications, or within either document itself, the better quality, greater quantity, the stringent standards, or more costly work shall be included in contract price and the matter referred to the Architect's attention.

1.02 RELATED WORK BY OTHER TRADES

A. Provide new code compliant hoistway:

1. The hoistway shall be fire-rating and comply with BC requirements for impact resistant hoistway construction.
2. Where applicable provide 75 degree bevel guards on all projections, recess or setbacks over 2” except for the loading or unloading side.
3. Maintain a clear, plumb, substantially flush hoistway with variations not to exceed 1” at any point.

B. Lifeline attachments capable of withstanding 10000 lbs. load in accordance with OSHA 29 CFR 1926.502. Provide a minimum of 2 at the top, front of hoistway.

C. Provide new elevator machine room. Machine room walls shall have 2 hr. fire rating.

D. Provide access doors as required by code for access to the machine room. Access doors to machine room shall be self-closing and self-locking, openable from inside without a key and properly labeled.

E. Provide adequate load bearing guide rails supports, machine supports, hoist beam and pit supports to withstand rail reactions, jack reactions, and buffer loads. Provide all related structural steel work. Guide Rail Support shall be structurally adequate to extend from pit floor to top of hoistway with spans in accordance with requirements of authority having jurisdiction and final layouts. Elevator Contractor will provide rail support inserts, to be installed in the hoistway by others.

F. Provide removable barricades at all hoistway openings, in compliance with OSHA 29 CFR 1926.502 in addition to any local code requirements.

G. Provide temporary lighting in hoistway with switch located in hoistway on the strike jamb side of top landing door.

H. Required electrical power to the elevator system(s) shall be provided by owner. Power to be evaluated based on contractor’s bid submission. This shall include the following:

1. Provide main line disconnect switches in the machine room. Mainline disconnect switches shall be fused and lockable in the open position, with fuses as required and shall also include a ground wire. he mainline disconnect shall be provided with an auxiliary contact to signal to the controller when the disconnect switch is in the “open” position.
2. Provide new individual 120V single phase fused and lockable disconnect switches located in the machine room for elevators car lights and fan.
3. Provide new individual 120V single phase fused and lockable disconnect switches located in the machine room for the elevator oil cooler.
4. Provide new individual 120V single phase fused and lockable disconnect switches located in the machine room for the elevator door controller.
5. Machine Room

a. Provide illuminated light switch for elevator machine rooms.
b. Provide lighting with illumination level equal to or greater than that required by ASME A17.1 and local building codes for each elevator.
c. Provide duplex GFI protected outlets in machine rooms.

6. Pit:

a. Provide new illuminated light switch for each elevator pits.
b. Provide lighting with illumination level equal to or greater than that required by ASME A17.1 and local building codes for each elevator.
c. Provide duplex GFI protected outlets in pits.

I. Provide the required mechanical ventilation in the machine room to maintain ambient temperature between 45- and 95-degrees Fahrenheit with relative humidity not to exceed 85% based upon scheduled heat generation, or to maintain temperature as required by equipment proposed to be installed if different. Contractor must specify environmental requirements for the proposed equipment along with their bid package.

J. Provide telephone lines and ethernet for the in-cab communication system. The lines shall be acquired by the building and terminated in the machine room at a terminal point. Contractor shall install wiring from unit to the master stations. Contractor shall install all wiring/cables from unit to the terminal point in the control. Communication system shall be capable of sending emergency text communication to security and emergency service personnel.

K. Products-of-combustion sensor (NFPA No 72, Chapter 5-3) in each elevator lobby, for each group of elevators or single elevator and machine room to initiate fire fighters' return feature. Provide sensor signal wiring from controller room connection point to elevator controller terminals.

L. Sprinkler systems in machine rooms are not permitted.

M. Provide code-approved fire extinguisher in machine room.

N. Provide sump pit and pumps in pits that shall comply with the applicable plumbing code. They shall be provided with a positive means to prevent water, gases, and odors from entering the hoistway. Where sumps and sump pumps in the pits are provided, they shall be covered. The sumps and sump pumps cover shall be secured and level with the pit floor. A single receptacle supplying a permanently installed sump pump shall not require ground-fault interrupter protection.

O. Provide sill support for every elevator entrance

P. Provide door lintels to support walls above elevator entrances.

Q. Construct an elevator corridor at all landings.

R. If required by Contractor and depending on the method of the entrances installation, provide minimum sill recess pocket of 2 ½" high by 8" wide, full length of the hoistway. Provide grouting full length and width after sills are set in place.

S. Provide final wall finish around new hoistway entrances.

T. Protect hoistway entrance assemblies and special metal finishes from damage after installation.

U. Provide suitable storage space for tools and materials brought to the site by the Contractor. Contractor must specify at the beginning of the project the details of storage space required. Storage space requested shall be reasonable and in accordance with the projected schedule.

V. Owner to determine if the elevator is in a flood zone.

W. If code-mandated fire egress signage will not be incorporated into hall station fixtures, Owner is responsible to provide signage as required by code.

1.03 SPARE PARTS

A. Elevator Contractor must provide a reasonably complete list of all parts and current prices for every component installed prior to close-out of the project. In particular, the list must include detailed lists of controller, drive, dispatcher, and door operator boards, and related electronic components, and any other parts that are only available for purchase from the Elevator Contractor and related companies.

1.04 OEM EQUIPMENT AND DIAGNOSTIC TOOLS

A. Elevator Contractor shall provide the Owner all special tools required for another competent maintenance contractor to perform a complete maintenance program. This shall include their field service tool, laptop computer, interface to connect to their control equipment and any other hardware and/sort required for diagnostics, adjustments, and testing.

B. If a separate tool is provided, Elevator Contractor must provide a flat price for replacement of the tool if accidentally damaged or rendered inoperable in the future. Price will escalate by no more than 5% per year. A published price list must be provided establishing reasonable prices for sale of parts to other maintenance contractors. There shall be no licensing or other fee charged for the maintenance tool during the life of the equipment.

C. Tools may be designed by the Elevator Contractor to work only in the building for which they are intended.

D. Elevator Contractor must provide to the Owner three copies of all manuals required for proper operation of the diagnostic and adjustment tools.

E. If a SIM card or any other card that are used for either adjusting, troubleshooting, or testing will be used, Elevator Contractor should also be required to provide the Owner with a copy of such a card after demonstrating it is operational in front of the Owner’s consultant.

F. Elevator Contractor shall provide to the owner one (1) complete set of adjusting, trouble shooting and testing manuals for each type of controller installed.

G. Owner shall be provided with a complete set of controller, dispatcher, and motor control boards that will be turned over at completion of the installation. These boards should be tested on the actual controllers being installed in the building prior to submission to the client. This set should include at least one of every type of board and controller component to be installed in the building including drive boards for each drive size. Any boards unique to a particular elevator, bank of elevators or dispatcher shall be included. The boards must be provided in a manner appropriate for long-term storage and include two copies of a detailed inventory list (one to keep with the boards, one for the Owner's records).

H. Elevator Contractor must provide three archive backup copies to the Owner of controller software on separate USB flash drives or other digital media if the equipment is not capable of backing up to USB drives.

I. Elevator Contractor must provide and install all software updates available for the equipment within thirty days of release, throughout the entire life of this equipment. If the Elevator Contractor is the Original Equipment Manufacturer, any updates the Elevator Contractor installs on the same model of equipment where the Elevator Contractor is still performing maintenance must be made available for installation, even if maintenance is being performed on these devices by another company.

J. Elevator Contractor affirms that it will make available for purchase every possible replacement part for every piece of equipment manufactured by the Elevator Contractor and installed on these elevators for a period of no less than twenty years to any maintenance contractor providing maintenance on these elevators at a fair market price, with a lead time similar to the lead time available to the manufacturer's own branch offices in the region within which the building is located. If subcomponents made by other vendors that are used in the manufacture of a particular part are no longer available, Elevator Contractor shall make all reasonable efforts to find an equivalent subcomponent.

K. The Original Equipment Manufacturer must commit to providing engineering support to any future maintenance contractor designated by the Owner.

1.05 SUMBITTALS

A. Once the contract has been awarded and signed, the Elevator Contractor shall provide submittals based upon the manufactures and model as accepted with their bid. Any changes in manufacturer or model from those accepted with their bid shall be immediately submitted in written to Owner and Consultant for review.

B. The Elevator Contractor shall submit all required submittals within the timeframe agreed upon within the contract schedule. The Elevator Contractor shall not proceed with ordering equipment or performing any on-site work prior to obtaining all necessary approvals from the Owner and/or the Owner's architect and receiving written confirmation from the Consultant that all exceptions noted on the submittals have either been addressed or that the Elevator Contractor can proceed as noted.

C. The Elevator Contractor shall be responsible for providing all requested submittals as stated including but not limited to the following:

1. Cut sheets of all equipment/components being replaced.

2. Wiring diagrams and manuals.
3. Power Reports
4. Scaled Shop Drawings including but not limited to the following:

    a. Listing of all components of the elevator system including any devices and sub-systems including with indication of:

        (1) Manufacture
        (2) Model
        (3) Quantity
        (4) Sizing

    b. Machine room plans that are fully dimensioned and indicate:

        (1) Location of all equipment
        (2) Equipment size and weight
        (3) Mounting details of all components
        (4) Machine beams
        (5) All reaction/loads concurring in the machine room
        (6) Service connections
        (7) Ancillary components
        (8) Equipment and maintenance clearances
        (9) Ventilation and/or smoke holes
        (10) Points of access

    c. Hoistway plans that are fully dimensions and indicate:

        (1) Location of all equipment
        (2) Equipment size and weight
        (3) Required clearances.
        (4) Location of all fixtures
        (5) Location of inserts
        (6) All reactions/load concurring in the hoistway

    d. Pit plans that are fully dimensions and indicate:

        (1) Location of all equipment
        (2) Equipment size and weight
        (3) Required clearances.
        (4) Location of all fixtures
        (5) Location of inserts
        (6) All reactions/load concurring in the pit.

    e. Hoistway section elevations that are fully dimensions and indicate:

        (1) Location of all equipment
        (2) Equipment size and weight
        (3) Required clearances.
        (4) Location of all fixtures
        (5) Location of inserts
        (6) All reactions/load concurring in the hoistway.

    f. All fixture drawings

g. Fully dimensioned cab drawing indication:

(1) Additional and total weight are added to the system.
(2) Ventilation calculations
(3) Location of all equipment
(4) Listing all components, material, and finishes.
(5) Mounting details of all components
(6) Fully dimension entrance drawing where replacement is being performed.

h. Reaction/load calculations stamped by Professional Engineer for:

(1) Machine beams
(2) Overhead sheave beams
(3) Car and counterweight rails
(4) Car and counterweight buffers
(5) Rail Stacks
(6) Seismic Forces

i. Engineering calculations stamped by Professional Engineer for:

(1) Machines
(2) Hoist ropes
(3) Heat emissions
(4) Electrical Loads

5. Ancillary equipment that are not the responsibility of the elevator contractor shall be indicated with “To be provided/installed by others.”
6. Final drawings stamped by a Professional Engineer shall be submitted for record.
7. Final As-Built drawings stamped by a Professional Engineer shall be submitted with closeout package.

D. All submittals should be submitted electronically. Hard copy prints, and AutoCAD layout drawings should be available upon request.

E. All submittals generated by subcontractors or vendors shall be reviewed and approved by the primary Contractor prior to submission to the Consultant for approval.

1.06 PRE-APPROVED MANUFACTURERS

A. Submit The following manufacturer’s equipment are pre- approved for use on this project:

1. Controllers: GAL, MCE
2. Motor Control: Magnetek, KEB, Yaskawa
3. Machines: HW, Imperial
4. Motors: Imperial, Reuland, Baldor
5. Hydraulic Power Unit: MEI, Canton, Mongrain
6. Hydraulic Jack: ITI
7. Wire Ropes: Bethlehem, Draka, Brugg
8. Hoistway / Car door equipment: GAL, ECI, Wittur

9. Door Protective Device: Janus, Tri- tronics, Cedes
10. Traveling Cables: Draka, James Monroe
11. Guide Shoes/Rollers: Elsco, HW
12. Fixtures: GAL, EPCO, Monitor, MAD, C.E. Electronics, Innovation
13. Intercommunication: Ringcomm, Janus, Wurtec, Rath

B. All other equipment manufacturers will be considered on an individual basis and be required to be approved by Owner's representative and Consultant.

1.07 SPECIAL REQUIREMENTS BY ELEVATOR CONTRACTOR

A. All work and the required permits shall identify the applicable ASME A17.1 Safety Code for Elevators and Escalators and all local codes and ordinances as codes to be followed for this project.

B. All new lobby, car, hall fixture type, design, finish as well as braille, cab type, design, finish, and any other finishes shall be chosen by a building representative. Failure to gain approval of the owner prior to ordering fixtures may result in contractor having to reorder fixtures acceptable to the owner.

C. Cutting and patching of walls for the purpose of installing new hall fixtures and any other cutouts in hoistway or machine room walls required for elevator equipment installation shall be provided. Any cutting or patching of walls shall be fire stopped per building's requirements. Decorative finish shall be completed by the Owner.

D. Contractor must submit complete layout drawing sets including all contract data, machine room plan, hoistway plan, pit plan, machine room / hoistway / pit section elevation, details plans / section elevations, engineering and equipment sheets for traction machines, machine bedplates and unitized bases brackets along with engineering calculations for machine reactions, deflector/secondary sheaves, rope grippers, governors, guide rails, guide rail brackets and their spacing, engineering calculations for rails reactions, buffer reactions, compensation forces, pit, bottom and top of elevator hoistway equipment dimensions with respective required vertical and horizontal clearances. Identify any structural modifications of walls, floors, supports for machine beams that need to take place in order for the equipment to be properly installed.

E. Contractor must specify environmental requirements for the proposed equipment along with their bid package.

F. Contractor must file for and perform a Category 5 test when the acceptance test is performed. Such test will be witnessed by the Owner's third-party witnessing agent.

G. Old equipment shall be taken away from premises as it is removed and will not be allowed to be stockpiled in building except for needed critical replacement parts and all controller spare parts during the modernization.

H. Ensure non-elevator equipment is not located in elevator spaces.

I. Identify all projections, recess, or setbacks over 2" except for the loading or unloading side.

PART 2 – PRODUCTS

2.01 CONTROLLER

A. Provide solid-state microprocessor controllers designed to provide operation as required by the project and to meet the current elevator code as modified by Authority Having Jurisdiction (AHJ).

B. The Elevator Contractor shall run the electrical wiring/conduit from the electrical disconnect switch to each elevator controller.

C. All memory chips shall be of the non-volatile type to provide for an automatic restart on power-up conditions.

D. Electromechanical relays shall be used on safety circuits where required by Code. Relays shall be of the direct-current type designed to insure long life and quiet reliable operation without overheating or excessive wear. Contacts supplying highly inductive loads shall be provided with arc deflectors or suppressers.

E. Large resistors shall be mounted such that any heat generated is dissipated from the enclosure without heating other components or wiring.

F. Equipment shall be provided to protect the drive motor and generator or drive unit as applicable against overload, phase reversal, low voltage, and single phase in all three phases.

G. Wiring: All controller wiring shall be copper and installed in a neat workmanlike manner. All connections shall be made to studs or terminals by means of solder-less connections lugs or similar connections. All studs and terminals shall be labeled for connections of board and external wiring.

H. Marking: All devices on the controller shall be identified with symbols or letters permanently marked on or adjacent to each device. All fuse holders shall be permanently marked with ampere rating.

I. Speed Regulation: Car speed shall be regulated to +/ - 5 % of contract velocity in either direction with any load up to full load. Controllers shall provide efficient, smooth operation with step-less acceleration and deceleration of the elevator-hoisting machine independent of the load in the car.

J. Controller shall contain door monitoring capabilities per ASME A17.1: 2.26.5 as modified by the AHJ.

K. Contractor shall be responsible for identifying all special service operations and tagging them on each controller.

L. All date-sensitive functions of the elevator control system shall use a 4-digit year-tracking system.

M. All car and group variables can be displayed and altered. Parameters are displayed, when selected, with a full explanation, including minimum, maximum and current values.

N. The system provides interactive control of features provided in the elevator control system. These features may be revised as the requirements of the building change. Some of these interactive controls may include but are not limited to: security floor lockouts, entering car and hall calls, Fireman's return service, lobby recall, Up/Down peak or hospital Code Blue service. Local codes may affect the availability or operation of these features. All field adjustable variables shall be adjustable through a user interface provided with the controller and also with a lap top computer.

O. Fire Emergency Operation: Elevator shall completely comply with the applicable ASME code as adopted and modified by local and state law. All fixtures, operations, and provisions necessary for proper operation must be provided and installed.

P. Emergency Power Operation: The elevator system shall be made to operate properly with the building Emergency Power system, based on the capabilities of that system and according to Code requirements for sequencing and operation. The Contractor will coordinate the emergency power system with building management. Elevator will be able to run on alternate acceleration and deceleration, speed profile when on emergency operation and have all chokes and filters installed to minimize line harmonic line distortion. Sequencing of multiple car banks shall also be provided to match the capabilities of the building's emergency generator system.

Q. Dispatch Operation: Simplex

1. The elevator shall automatically travel to landings for which a call demand exists. Stops in response to calls that are registered in either the car or corridor push button stations shall occur in the natural order of progression in which the floors are encountered, depending on the direction of car travel, and irrespective of the order in which calls are registered. In responding to corridor calls, the elevator shall answer only those demands that correspond to the direction in which the car is traveling.
2. Call acknowledgment lights provided in both the car and corridor push button fixtures shall be extinguished as the car begins its slowdown approach to the corresponding landing. Immediately after its cancellation, a corridor call shall be inoperative until the elevator doors have completed their dwell time in the open position and commenced their closing cycle.

R. Provide a monitor in the machine room or an LCD display that allows troubleshooting and can display the status of the elevators. The monitor display will include each car's position, hall and car calls registered, status of the cars, etc. The troubleshooting functions should include the ability to register car calls and hall calls. Controllers shall include security features in order to allow any maintenance contractor to lock out car calls or hall calls on an individual basis without software changes. All lockouts would be overridden by fire service as required by Code. Any passwords or passcodes set on either the monitor or the control system itself must be provided in writing to the building owner and consultant. Updates should be given any time changes are made to passwords or passcodes.

S. For remote monitoring the system needs to be connected to the internet and programmed with an IP address. All data collection, data storage and real - time monitoring is then provided by accessing the system with a web browser, no “special” software or licenses are required.

T. The controller shall be approved to the latest edition of CAN/CSA-B44.1 / ASME-A17.5. The controller manufacturer shall provide a complete procedure for testing and demonstrating compliance to the latest edition of CAN/CSA-B44 / ASME A17.1.

U. Provide “Low Oil Control Feature” which automatically returns cars to lowest level, opens doors and prevents operation of elevator until oil supply has been replenished.

V. Motor starter shall be of solid-state type and shall be contained within the new control system cabinet.

2.02 EMERGENCY BATTERY LOWERING SYSTEM

A. Provide an Electronic Emergency Return system that automatically activates during a power failure and will provide back-up power for the elevator.

B. The system shall provide sufficient power to support the controller, as well as providing power for the control valves, door motor and power to the hydraulic motor for movement of the elevator at inspection speed. The elevator car shall be capable of lowing to an available floor and opening the doors.

C. The system shall recharge automatically when normal power is present.

D. The unit shall include:

1. On board controller
2. Onboard three-phase power-loss detection circuit
3. Restart input from COP Door Open Button
4. Test button to simulate power loss.
5. UPS bypass control
6. Monitors disconnect switch.
7. Lockable shut-off switch for additional safety while working on the elevator.
8. Input: Three-phase, 208/480VAC, 50/60Hz
9. Bypass switch to allow power to the elevator when the system is shut off.
10. Fully rated means of disconnecting elevator system from main power during emergency power mode.
11. Diagnostic LED bank to allow troubleshooting.
12. Low battery light.

2.03 HYDRAULIC JACK UNIT AND PIPING

A. Provide and install above ground twin jack hydraulic jack unit. Jacks shall be of the proper size to lift the gross load to the height specified. Jacks shall be factory tested to insure adequate strength and freedom from leakage. No brittle materials shall be used in the jack construction. The units shall consist of the following components:

1. Heavy seamless steel tubing plungers accurately turned and polished.
2. Stop ring shall be electrically welded to the plungers to positively prevent plunger leaving the cylinder.
3. Internal guide bearing.
4. Packing or seal of suitable design and quality.
5. Drip ring around cylinders top.
6. Cylinders made of steel pipe and provided with a pipe connection and air bleeder.
7. Weld brackets to the jack cylinder for supporting the elevator on pit channels and hoistway steel support. Provide base mounting plate and stabilizer bracket for each jack.

B. Piping: Provide all necessary piping for the hydraulic elevator system.

1. Piping shall be of the size, type and weight recommended by the manufacturer and as required by Code.
2. Protect underground piping by coating and wrapping same as specified for cylinder.
3. Provide sound-isolating couplings for connections of piping to power unit.
4. Support all horizontal piping with hangers spaced no more than 10 feet apart.
5. Provide pit rupture valve compliant with applicable code.
6. Provide oil line shut off valve in the pit.

2.04 HYDRAULIC POWER UNIT

A. Provide manufacturer's dry type hydraulic power unit, including electric motor, non-pulsating constant-displacement type pump, piping, control valve assembly, self-cleaning strainers, oil gauge, overhead oil storage tank on steel support frame, oil drip pan and bed plate. Provide auxiliary devices and fittings required for performance as specified or required by code including manual valve for return of car to lowest landing and manual shut off valves in machine room and in the elevator pit.

B. Provide high-starting-torque, single speed, A.C. motor, sized for continuous elevator operation at full rated capacity and speed. Provide a soft starter for reduced current starts.

C. Control Valves: Solenoid-operated, designed for slow opening and closing, as required for controlled acceleration and deceleration and for smooth stopping and starting of car, both for "up" and "down" travel (automatic two-way leveling).

D. Mounting: Mount hydraulic power unit bedplate and steel frame assembly onto floor or foundation with efficient, fail-safe isolation mounts, designed to effectively eliminate the transfer of vibrations to the building structure.

E. Provide viscosity control unit complete with electric heating element in reservoir.

F. Oil: Provide full supply of new hydraulic oil, of the type and grade recommended by the manufacturer.

G. Muffler: Provide in discharge oil line near pump unit. Design shall dampen and absorb pulsation and noise in the flow of hydraulic fluid.

H. Valves: Provide and install relief valve, up and stop valve, check valve, lowering and leveling valves.

I. Vibration Pads: Provide vibration pads to be installed under the power unit assembly.

J. The contractor is responsible for the proper code-compliant handling of hydraulic oil.

K. Provide oil cooling system.

2.05 TOP OF CAR RUN BOX

A. Top of car run box shall have an inspection switch which overrides all other inspection switches, the switch shall be labeled “NORMAL” and “INSPECTION”.

B. The run box shall include continuous-pressure type up and down push buttons along with a separate continuous-pressure type device labeled “ENABLE”.

C. A stop switch shall be provided and located so it is readily accessible to a person standing at the hoistway entrance.

D. The top of the car should be properly lighted and the light should be properly guarded. Steel light guards shall be grounded.

2.06 CAR GUIDES

A. Provide car roller guides that shall be a minimum of 6 inches in diameter for the car.

B. They shall be assembled on a metal base, designed and mounted so as to provide continuous contact of all rollers with the guide rail surfaces under all conditions of load and operation.

C. The rollers shall be neoprene or polyurethane.

D. Equip with 16 gauge cover guards.

2.07 GUIDE RAILS

A. Provide machined standard T section guide rails with tongue and grooved joints for the car.

B. Provide full section modulus steel machined fishplates to form rail joints. Connect rails to fishplate with four (4) bolts.

C. For concrete and concrete block hoistways furnish rail brackets and provide inserts and insert location drawing to Construction Manager.

D. Brackets shall be used to support the rails from the hoistway framing and/or inserts. The rails shall be attached to the brackets by heavy claps or clips. Brackets shall be designed to meet seismic requirements. Extended brackets shall be provided where necessary.

E. Provide rail backing where the vertical distance between support framing is greater than as required by code and no intermediate support framing is shown on the drawing.

F. All guide rails shall be erected plumb and parallel to a maximum deviation of 1/16 inch post to post.

G. Stop rails short of overhead to allow for building compression.

H. Provide horizontal and vertical guide rail loads for normal running, loading and safety application on Contractor's drawings.

2.08 HOISTWAY LIMITS

A. Normal and final terminal stopping devices shall be provided for the elevator and conforming with Code requirements. Terminal stopping devices located in hoistway of the car and operated by cams shall be fitted with rollers having a rubber or other approved composition tread to provide practically silent operation when actuated by the cam.

B. Upper and lower terminal slowdown limit devices shall be provided and arranged to stop the car automatically from any speed obtained under normal operation within the top and bottom overtravels independent of the operating device.

2.09 DOOR OPERATOR

A. Door operator shall be GAL Model MOVFR II or approved equal heavy-duty closed-loop door operator. The unit shall have the ability to adjust torque, opening speeds, closing speeds, nudging speed and soft start. It shall be properly filtered to eliminate audible noises.

B. The door shall be designed to operate at an average opening speed of 2' per second. This type of operator shall be designated as a high-speed operator. Automatic closing of the car and hoistway door shall be required, and the closing speed shall be approximately 1' per second. This closing speed shall be reduced as required to limit the kinetic energy of the closing doors to the values permitted by the ASME Code.

C. The doors shall operate smoothly without a slam in both the opening and closing direction. They shall be cushioned in their final movement in both directions of travel either by individual dash pots or by other equally effective approved methods. Electrical power shall be used to open and close doors.

D. In case of interruption or failure of electric power from any cause, the door operating mechanism shall be so designated that it shall instantly permit emergency manual operation of both the car door and the hoistway door within the floor landing zones, and the hoistway door shall continue during emergency operation to be self-locking and self-closing. The door operator shall operate in conjunction with or be equipped with all interlocks and safety contacts specified.

E. All door operating linkage shall be constructed of heavy steel members. All pivot points shall have either ball or roller bearings, or bronze bushed bearings of ample size. All brackets and other supports required to support door operating mechanism shall be furnished and installed.

F. The door operation shall be adjustable to allow for adjustment of the premature door opening time within the landing zone. The amount of time the door remains open shall be controlled through the door operator or through an electric beam device (as further specified).

G. Car Door Electrical Contact: Electrical contact shall be provided and arranged to operate with the car doors so that the elevator cannot be operated unless the doors are closed or within the tolerance allowed by ASME Code.

H. Provide car door hangers and tracks, compatible with the door operators.

I. Provide car door clutch compatible with release roller assembly.

J. Provide door restrictor compatible with applicable code.

K. Provide door astragals as applicable.

L. Door operator equipment must be properly labeled as required by current code and modified by local jurisdictional authority.

2.10 HOISTWAY ENTRANCE DOOR

A. Provide elevator entrances at prescribed levels that are 3’-6” wide by 7’-0” high single speed side slide type and as specified herein.

B. Provide unit steel frames. The door frames, with integral trim, shall be made of No. 14 USSG Cold Rolled Furniture Steel for all landings. Angles are spot welded to frame for fastenings to sill.

C. The frames shall be set flush with the edge of the sill on the hoistway side and shall be mortised and reinforced for all necessary hardware, rubber bumpers and interlock devices.

D. Typical frames shall have the surfaces coated with an acid and water resisting filler. All voids between wall and buck on hoistway side shall be filled with mortar, made smooth and finished to match adjacent surfaces.

E. Fire Rating: Entrance and doors shall be UL fire-rated for 1-1/2 hour.

F. Provide extruded nickel silver sills with safety tread and groove to receive door guides for each entrance. Support each sill on steel anchors securely fastened to the floor construction.

G. Provide sill supports for all entrances.

H. Fascia plates will be installed and will be 10 inches wider than the clear opening.

I. Sight guards will be provided at all doors and shall be constructed from same materials as the door material.

J. Toe guard will be provided at all landing. The guard shall be No. 14 USSG sheet steel, secured to the sill and shall be one foot wider than the door opening.

K. The frames and sills will be masoned into place. This proposal does not include any plaster or marble work, wood trim, molding, painting, decorating or any protective device at the floor landings.

L. Door Panels: Doors shall be of the single speed side slide type made of No.16 USSG Cold Rolled Furniture Steel at typical floors and of Stainless Steel Finish at main egress floor. Doors shall be reinforced with continuous vertical members and fire rated for 1 ½ hours. Doors will be filled with sound deadening material. Provide sight guards to match material of the doors. Provide escutcheon holes with metal ferrules at all floors.

M. Provide hangers for hoistway doors of the heavy-duty sheave type, consisting of two (2) ball bearing sheaves not less than 3 ¼ inches in diameter enclosed in steel housings. All sheave wheels shall rotate in a grease packed precision ball bearing. Each hanger shall be equipped with two (2) ball bearing upthrust rollers not less than 1 inch diameter with eccentric adjustment.

N. Provide tracks, which shall be of high carbon cold rolled or drawn steel, shaped, and finished to permit free movement of sheaves. Tracks shall not be less than 3 ½" in height. Provide dust covers for the entire length of the track at all floors.

O. Provide each hoistway entrance with an approved positive electro-mechanical interlock. Interlock release roller assembly will include one fixed roller attached to the door mounting plate and one moveable roller which activates the interlock release assembly. Interlock shall prevent operation of elevator by normal operating devices, unless all hoistway doors are locked in closed position. Interlock shall also prevent opening of hoistway doors from landing side, unless car is within that landing zone and is either stopping or stopped. Interlocks shall be unlockable from elevator car in case of power failure, only within the landing zone.

P. Door Closers: Install mechanical closers to assure self-closing of all shaft doors, independently and irrespective of the position of the car. Closers shall be of the sill-mounted type. Each hall door panel shall be equipped with a mechanical closer.

Q. Door Gibs: Provide each door panel with two removable plastic composition guides, arranged to run in sill grooves with a minimum clearance. The guide mounting shall permit their replacement without removing the door from the hangers. A steel fire stop shall be encased in each guide.

R. Hoistway Door "Z" Bracket: Provide one 8" steel safety "Z" bar guide on the underside of all doors and securely fasten to the underside of the door with steel countersunk machine screws. Mount the safety "Z" guide adjacent to and in between the removable guides.

S. Provide safety retainer on all openings as prescribed by code.

T. Provide door bumpers at all floors. Stick-on bumpers shall not be accepted.

U. Floor Numbers - Provide floor numbering on the hoistway side of the hoistway doors and/or walls at intervals as required by Code.

2.11 DOOR REOPENING DEVICE

A. Provide an infrared matrix door reopening device system with independent power supplies.

B. Nudging Action: In the event a detector edge is continually obstructed for a predetermined time interval (no less than 20 seconds) after automatic door closing has been initiated, a buzzer shall sound and the doors shall be closed at a gentle reduced speed. Timers shall be individually adjustable. This feature must be adjustable for reduced car door closing force. This feature must also have the capability of being turned off on demand.

C. The unit shall be wired such that if power to the unit fails, the doors shall remain open.

2.12 TRAVELERS AND WIRING

A. All wiring including, high voltage, low voltage, intercom, fiber optic, plenum, shielded, etc, installed under this contract must be installed in pipe conduit. This pertains to wires installed both inside and outside of the elevator hoistway.

B. Provide elevator with all necessary wiring in the hoistway, pit and controller room adequate for the proper operation of the equipment. Conductor shall be copper. The minimum size of conductors, exclusive of those which form an integral part of control devices and/or cabinets, shall be a minimum no. 14 for lighting or power circuits and no. 18 for operating, control and signal circuits. All material used and method of installation shall conform to the NFPA National Electrical Code and/or local building code. All insulated wiring, control wiring and wiring in traveling cables shall be tag coded at their terminal in the machine room, shaft box, elevator cab junction box and push-button stations within the cab and shall agree with the submitted wiring diagrams.

C. Wire raceway shall be zinc-coated rigid steel conduit, intermediate electrical conduit, electrical metallic tubing (EMT), or metal wireways and outlet boxes except for traveling cables. Flexible metal conduit may be used for the short connections not subject to moisture, oil or embedment in concrete. Connections to the controller shall be made in a manner that minimizes transmission of vibration or noise to the building. Hoistway raceway may be in rigid steel wiring duct. Threadless fittings shall not be used with rigid galvanized steel conduit. Electrical connections to machinery shall allow for one foot of lateral motion.

D. Travelers: Traveling cables shall be provided for all elevators and designed for elevator service in accordance with the NFPA National Electrical Code and/or local Building Department Code and shall be sufficiently flexible to readily adapt to all changes in the position of the elevator cab and hang straight without twist. The cables shall be capable of bending 360 degrees with an inside radius of one (1) foot without any permanent set and without cracking of the outer covering. The open loop shall show no tendency to twist upon itself. Cables shall have a flame-retarding and moisture-resistant outer cover. Each traveling cable shall contain 10 percent (10%) spare wires and, in any event, not less than two (2) spare wires per each type and size of wire. Traveling cables shall contain sufficient shielded wires for the intercommunication system, speaker system, video screens, and cabling sufficient for a CCTV system including but not limited to (2) four conductor cables.

E. The coaxial cable shall be terminated in the elevator pit in a separately identified box. The other end of the coax cable shall be dead ended on one of the top corners of the elevator cab in an identified junction box or trough. In addition a duplex GFCI outlet shall be located on the top corner of the elevator cab dedicated for camera power only.

F. Cameras will be provided and installed by others. All provisions and coordination are to be provided by the contractor.

G. Traveling cables exceeding 100 feet in length shall have steel supporting core cables and shall be suspended directly from them to relieve the conductors of strain.

H. Provide twenty percent (20%) spare wires between the controller, selector, hatchway junction box and starter's panel and also provide twenty percent (20%) spare wires in each traveling cable. All spares shall be properly tagged or otherwise identified with clear and indelible markings. Install beam pads as necessary to prevent chafing of traveling cables.

I. All wiring for card readers shall be included.

J. Strain boxes shall be installed not over 80 feet apart.

2.13 PIT BUFFERS

A. Provide spring buffers for the car.

B. Buffers shall comply with code for car striking speed and capacity.

2.14 PIT DEVICES

A. Provide pit stop switches as per code requirements.

B. Provide pit ladders as per code requirements.

2.15 PROVIDE CAR FRAME AND ISOLATED CAR PLATFORM

A. The car frame shall be made of steel members, with a factor of safety as required by the Code.

B. The car platform shall consist of a steel frame with necessary steel stringers all securely welded together. The frame and platform shall be so braced and reinforced that no strain will be transmitted to the elevator car.

C. The car platform shall be isolated. Platform shall be manufactured so rubber isolation pads can be easily replaced.

D. Provide platform with two layers of 3/4" exterior grade marine plywood. Cover the underside of the car platform with sheet steel.

E. Recess the passenger elevator platforms to receive finished flooring as directed by the Architect.

F. Crosshead must contain a data plate indicating the speed, capacity, percentage counterbalance, number and size of ropes, breaking strength of ropes and individual weights of: car frame, platform and safety, and for cab enclosure.

G. The platform shall be constructed to Freight Loading Class C1 requirements.

H. A platform toe guard shall be provided at car entrance opening to extend below each car entrance opening for safety as per codes requirements. The guard shall be No. 14 USSG sheet steel, one foot wider than the width of the widest door opening and extend down 48”.

2.16 CAB ENCLOSURES

A. Contractor shall include in their price the Contractor’s portion of the work as described in Part C of this subsection. Contractor shall also include an allowance of $40,000.00 per elevator for the Cab Company’s portion of the work as described in Part B of this subsection. The owner reserves the right to deduct the allowance for Section B from the Contractor’s price and obtain the cab interiors separately. In either event, the Contractor would still be responsible for their entire scope of work as indicated in Part C, including all required coordination to complete the installation of the cabs.

B. Pricing shall include but not be limited to all ventilation, lighting, emergency lighting with battery back-up, doors, flooring, base wainscoting, handrails, entrance columns, returns, strikes, transoms, all necessary cutouts and other cab associated appurtenances as requested by the Owner.

C. Contractor Coordination Scope of Work:

1. The Contractor shall perform all work required to install the cab.
2. The Contractor must provide all information necessary to the Cab Company and Architect to ensure that the equipment to be installed by the Contractor is accommodated in the design and manufacture of the cab.
3. Provide all necessary cab drawings and material samples to ensure efficient and timely manufacturing and installation of the cab.
4. The Contractor is responsible to perform all work required to install and wire all elevator equipment being installed in the cab.
5. Provide all necessary coordination to ensure efficient and timely installation of the cab.
6. Contractor is to include the following in their price:
7. Cab Sub-Flooring
8. Car Door Sill (assume Nickel Silver -finish to be approved by Owner)
9. Car Door Hangers
10. Gate Switches
11. Top Emergency Exit Switch with manual reset that stops the elevator when hatch is open or dislodged as per code requirements
12. Two-speed cab ventilation fan.
13. One set of hanging cab wall pads for the service elevator. The pads shall be appropriate for protection of the cab interior when the elevator is used as a service car. Each set must contain all accessories required for building personnel to easily hang the pads.
14. Provide car top guard safety rails per local and state code requirements.

15. Provide kick plates at the perimeter of cab top.
16. Provide dog house of the largest possible size complying with all cods.

D. Contractor is responsible for provided provisions for card readers, cameras, speaker systems and video screens as required by Ownership.

E. Contractor is responsible to include in their price all permits, tests, fees, and all other costs required by the authorities having jurisdiction to complete the installation according to Code.

F. Comply with all applicable elevator and fire codes as well as ADAAG

G. A balanced load test will be conducted when all work including door equipment, wiring, cab, etc. has been completed.

H. Contractor shall statically balance the cab after installation is completed.

2.17 ALARM BELLS

A. Provide 110 Volt alarm bells, two (2) per elevator. Lobby bell to be located inside shaft at the entry level and the other bell shall be mounted underneath the platform. The bell located inside the shaft at the entry level shall be located at the rear of the hoistway wall and approximately eight (8) feet from the finished pit floor and shall not be obstructed by the frame.

B. Bells shall not be less than six inches (6”) in diameter.

C. All required bells shall ring when either the Alarm Button inside the elevator is operated or when the Emergency Stop Switch is activated.

2.18 CAR BUTTON STATIONS

A. The car station shall contain a series of push buttons to correspond to the landings served. The push buttons shall become individually illuminated as a button for the desired floor is pressed. These lights shall be extinguished as the call is answered. It shall also contain a door open and door close button.

B. The car station shall contain an emergency stop switch with red operating handles or buttons, which when activated shall be arranged to remove electric power from the driving-machine motor and brake. While the emergency stop switch is activated, the emergency alarm bell(s) shall sound. Activation of this switch shall not cancel registered car or corridor calls, and after the switch is released, the car shall continue to answer its registered calls. Also included shall be an alarm button connected to a bell under the car and at the lobby level.

C. The car station shall contain a service cabinet shall include a fan or blower key switch, an inspection key switch to make normal operation inoperative for the purpose of using the top-of-car operation station, an independent, attendant key switch with direction buttons (as required for service elevators), emergency light test button, a car light key switch and a GFI outlet. These key switches shall be located behind a locked panel door.

D. Independent Service Operation

1. Each new car operating station shall be equipped with a key-operated switch labeled “IND”. When placed in the “on” position, this switch shall cause the elevator to by-pass all corridor calls and to travel directly to any floor chosen by registration of a car call. During independent Service Operation, the elevator doors shall remain open at any landing until the door close push button, is pressed.
2. In case elevator is operating on the Independent Service mode and the Fire Emergency Recall system becomes activated, following a period not less than 10 seconds nor more than 30 seconds, the elevator shall automatically override Independent Service Operation and engage Phase I - Fire Emergency Recall Operation.

E. Firefighter’s operation controls, auxiliary signals and mandated engraving shall be incorporated in each elevator to comply with all applicable elevator and fire codes as well as ADAAG.

F. Emergency lighting and audible and visual means of indication for overload shall be incorporated in each elevator to comply with all applicable elevator and fire codes as well as ADAAG.

G. Car Position Indicator (New): Provide an LED type readout in each car station to show floor locations. The LED characters shall be 2” high with a screen flush with panel surface of the fixture cover. One transmitter per elevator will be installed to supply the digital position indicators.

H. Provide an in-car voice annunciator system for each elevator in accordance with the following:

1. Multitude of standard messages such as but not limited to:

a. Next direction of travel (i.e. “Going Up” of “going Down”)
b. Nudging Operation (i.e. “please stand clear of the doors)
c. Floor designation (i.e. “Fourth Floor”)
d. Emergency Messages (initiated by fire service, emergency power, etc.)
e. Floor Passing Signal

2. Custom Message Recordings Possible
3. Human Female or Male Voices-To Be Available in English or Spanish
4. Discrete Inputs
5. Include Hidden In-Car Speaker
6. Conforms to ADAAG 407.4.8.2

2.19 COMMUNICATION

A. Provide an automatic dialing, hands-free telephone in the car station. The system shall be in compliance with ADA requirements. The system shall provide audio and visual intercommunication and include display provisions shall be provided on the same panel as the “PHONE” push button to with passenger who cannot verbally communicate.

B. The telephone shall be turned on by pressing the emergency alarm or stop switch or a separate call button in the car panels. It shall automatically dial a

programmed number to alert the security personnel that there is a problem in the elevator. Calls shall not be terminated from within the car; the call must be ended externally. Pressing any button that initiates the call twice shall NOT stop the call from being made.

C. If the first number dialed does not answer, a second programmable number must be dialed.

D. The system shall have a ring-back feature to allow calls to be placed to the elevator. It shall answer the incoming call automatically and shut off after an adjustable programmed time.

E. Provide an audible and visual signal to indicate that a communication link has been established.

F. Provide means to display video to observe passengers at any location on the car floor to emergency personnel for entrapment assessment shall be provided. The system shall be located at the fire command center where one is provided.

G. Ni Cad batteries shall ensure operation under all conditions.

H. Install the unit in the elevator and wiring within the hoistway, terminating the wiring in the elevator machine room. A suitable and identified junction box in the machine room shall be installed.

I. Install interface unit and phone handset in each machine room and lobby security desk to allow for communication between each machine room and lobby security desk to each elevator.

2.20 HOISTWAY ACCESS SWITCH

A. Install an approved key switch at top terminal landings for both elevators to permit the elevator to be moved at inspection speed with the hoistway doors open at that particular landing only. The car will only travel a distance necessary for authorized persons to obtain access to the top of car.

B. The access key switch shall be located and installed in the door frame.

2.21 HALL BUTTON STATIONS

A. Provide flush-mounted and standard plates hall button stations for all landings served by the elevators. Surface mounted and extended plates hall button stations shall NOT be permitted.

B. Stations shall include up and down push-buttons at all intermediate landings and single button at terminal landings. All buttons will have acknowledging lights.

C. The cover plates shall be standard size, and the location shall be set to ADA compliant height.

D. In the lobby fixture, provide fire key switch, fire service indicator, communication failure, emergency power indicator for the compatible elevator, and fire service signage all in compliance with applicable code requirements.

2.22 HALL LANTERNS

A. Furnish and install lantern fixtures over each entrance to indicate visually and audibly the arrival and direction of travel of the elevator. A gong mounted in each lantern unit will sound once to indicate that the car will be traveling in the “UP” direction and will sound twice to indicate that the elevator will be traveling in the “DOWN” direction.

2.23 SEISMIC REQUIREMENTS

A. Contractor shall meet all code requirements for the seismic zone applicable to the location of the project, including installation of all seismic related devices required by code.

PART 3 – EXECUTION

3.01 EQUIPMENT ISOLATION

A. Provide effective sound isolation between machines, secondary deflector sheaves, motor generators and solid state drive units and filters from building structure to reduce noise transmission to occupied spaces and elevators and elevator cabs.

B. When operating under normal conditions the elevator equipment shall not exceed a level of NC-35 in adjacent commercial spaces and NC-30 for residences measured at a distance of not more than 5 feet from a wall or floor/ceiling assembly. This shall include spaces adjacent to machine rooms and elevator shafts. In addition, no vibration shall be perceptible under the same conditions in tenant spaces. For the purposes of this specification, vibration shall be considered acceptable provided it is less than 8000 microinches per second, velocity (per ISO Standard 2631) for commercial spaces, and 4000 microinches per second for residences.

C. In order to achieve these standards, the following are required as a minimum:

1. Hoist motors and secondary deflector sheaves shall be mounted on a unitized base supported on vibration isolation in the form of neoprene pads providing at least 0.35 inches of static deflection.
2. For elevators using underslung hoists, isolation systems shall allow for any horizontal forces, and sheave beams shall also be provided with vibration isolation, similar to the hoist motors.
3. Transformers and reactance units shall be provided with vibration isolation pads similar to Mason Industries ND mounts sized for 0.35 inch static deflection. Transformers greater in capacity than 150 kVA shall be supported on spring isolators similar to Mason Industries type SLF, with minimum 1 inch static deflection. Provide a loop in the connecting electrical conduit and/or support resiliently with appropriate neoprene isolators. Do not wall support such equipment without isolation.

4. Elevator controllers shall be provided with vibration isolation pads similar to Mason Super W sized for 0.10 inch static deflection.
5. Isolate the hitch plates to the elevator cab by means of an elastomeric pad in compression designed to provide 1/8" deflection under dynamic loading.
6. Solid-state rectification units shall be mounted on 3/4" thick minimum, neoprene-in-shear pad isolators and an effective electrical filter/reactance limiting electrical noise shall be provided.
7. Conduits and electrical connections shall not be fastened to or supported by elevator machinery or solid-state rectification units, except by approved flexible connections.
8. Provide the elevator car and counterweight with high quality low noise guide wheels with rubber tires, as per below based on speed:
9. High Speed (>800 fpm) : Elsco Express 3 or 6 for passenger car, Model A or Express 3 counterweight
10. Low – Moderate Speed (250 – 800 fpm) : Elsco Model A passenger car, Model B or C counterweight

3.02 ELECTRICAL REQUIREMENTS BY ELEVATOR CONTRACTOR

A. Elevator Contractor must submit, along with their bid, the electrical requirements for the system(s) being installed.

B. Elevator Contractor shall assist owner as needed in determining requirements for electrical upgrades. If necessary, Elevator Contractor shall be involved in discussions with Owner’s electrical contractor and/or Owner’s engineering group to insure proper electrical work is completed with respect to the new equipment being installed.

C. All wiring including high voltage, low voltage, intercom, fiber optic, plenum, shielded, etc., installed under this contract must be installed in pipe conduit. This pertains to wires being installed both inside and outside of the elevator hoistway.

D. Elevator Contractor to run the electrical wiring/conduit from the electrical disconnect switch to each elevator controller.

3.03 ACCESSIBILITY REQUIREMENTS

A. All elevators to conform to the Code and ADA Accessibility Guidelines requirements, including but not limited to the following:

1. Provide markings on the car panel adjacent to the floor and control buttons on a contrasting color background to the left of the buttons. Letters and numbers shall be a minimum of 5/8" and raised .03" with Braille indications.
2. Provide floor designations at each entrance on both sides of jamb at a height of 60" above the floor. Designations shall be 2" high, raised .03" and shall be selected by the Owner's architect with Braille indications secured with tamperproof hardware.
3. All push buttons shall be designed and configured in accordance with ADA requirements.
4. The centerline of the hall push button station shall be 42" above the floor line.

5. Provide hearing impaired signaling in accordance with ADA requirements.

3.04 PAINTING

A. The following equipment shall be clearly identified by number using four-inch stenciled numerals: crosshead, pit equipment, stop switches, and all machine room and secondary equipment (including but not limited to machines, controllers, drives, transformers, mainline and auxiliary disconnects, etc.)

B. The pit area shall be painted; painting shall include all pit elevator equipment and the rails.

C. The top of the elevator shall be completely cleaned and painted. Painting shall include the top of the cab, stiles, crosshead, and all other top of car related equipment.

3.05 EQUIPMENT AND CITY NUMBER INDENTIFICATIONS

A. Properly identify the following equipment with the car number assigned to it. The number shall be painted, engraved, or securely attached.

1. Driving machine – 2” in height
2. Controller – 2” in height
3. Buffers – 2” in height
4. Main Line Disconnect Switches – 2” in height.
5. Crosshead – 2” in height
6. Adjacent to or on the entrance at the designated level – 3” in height
7. Car station 0.5” in height.

B. Engrave or permanently secure city identification numbers on the following equipment:

1. Main line disconnect switch box.
2. Controller
3. Hoist motor
4. Governor
5. Transformer
6. Crosshead
7. Car station

3.06 PERFORMANCE AND RIDE QUALITY REQUIREMENTS

A. The control system shall be maintained to provide smooth acceleration and retardation. Elevator Contractor must maintain the elevator in accordance with the original equipment manufacturer (O.E.M.) design performance specifications (including floor-to-floor times, door timing, rated speed, group supervisory system, etc.).

B. The door close force must never exceed 30 pounds.

C. The following performance schedule shall be adhered to:

1. Contract Speed: The contract speed shall be provided for up direction travel with full-capacity load in the elevator car. The speed in either direction under any loading condition shall not vary more than 5% of the contract speed.
2. In accordance with the ASME A17.1 Code, the elevator shall be maintained and adjusted to safely lower, stop and hold the car with a load of 125% of the rated capacity.
3. Leveling Accuracy: The elevator shall be adjusted to provide accurate leveling within 1/4" ± of the floor level without releveling regardless of load.
4. The following are the floor-to-floor, door opening, and door closing times the Elevator Contractor shall meet for typical elevator arrangements. These benchmarks should be interpolated as required for other configurations. The floor to floor benchmarks are based on 12’ floor to floor heights.
5. Door Open: 2.7
6. Door Close: 3.8
7. Floor to Floor: 15.5

D. Maintain adjustment of elevator equipment installed to comply with the ride quality requirements of the installation specification, or the following at minimum:

1. Noise levels inside the car shall not exceed the following:

   a. Car at rest with doors closed and fan running – 55 dba.
   b. Car running at high speed and fan off– 50 dba.
   c. Door in operation – 60 dba.

2. The maximum horizontal peak-to-peak vibration (using the ISO-weighted filter) shall not exceed 15.0 milli-g in either the front-to-back or side-to-side direction, under any circumstances or conditions, from the time the elevator begins to move until it comes to rest.
3. The maximum vertical peak-to-peak vibration (using the ISO-weighted filter) shall not exceed 20.0 milli-g under any circumstances or conditions; from the time the elevator begins to move until it comes to rest.

3.07 POST-CONSTRUCTION CLEAN DOWN

A. Elevator Contractor shall perform a complete clean-down of all equipment, especially door operation and hoistway door equipment and tracks, and all equipment enclosures, including hoistways, machine rooms, and pits, after construction is completed and the elevators are turned over for active service, to remove construction dust and debris.

END OF SECTION

SECTION 21 00 00
FIRE PROTECTION TABLE OF CONTENTS

Section No.	Title
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21 31 13	Electric Driven Centrifugal Fire Pumps

END OF SECTION

SECTION 21 00 01
FIRE PROTECTION GENERAL PROVISIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. The General and Supplementary Conditions and Division 1 are a part of the requirements for the work under this Division of the Specification.

1.02 WORK INCLUDED

A. Provide labor and materials required to install, test and place into operation the fire protection systems as called for in the Contract Documents and according to applicable codes and regulations.

B. Provide labor, materials and accessories required to provide complete operating fire protection systems as described or which may be reasonably implied as essential for a complete operating system.

C. The Contractor shall accept delivery of the pre-purchased equipment at the site, inspect the equipment on delivery for damage, and install the equipment. The Contractor shall be responsible for the equipment, provide all labor, material, and accessories as required for a complete functioning system. The Contractor shall have complete responsibility as if he provided the equipment including warranties.

1.03 QUALITY ASSURANCE

A. Comply with current governing codes, ordinances and regulations of the Authority or Authorities Having Jurisdiction over any part of the work and secure all necessary permits. Comply with the regulations and requirements of the Owner's insurance underwriter.

B. Where codes or standards are referenced, the applicable portions apply.

C. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.

D. Should any change in drawings or specifications be required to comply with governing regulations, notify the Architect prior to submitting bid.

E. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, skillful and well-executed manner by competent workers. Provide a competent, experienced full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

F. The Architect or Architect's Representative may conduct unannounced field reviews of any work completed or in progress during the Contractor's working hours. A report will be issued to the Contractor if the field review of the fire protection systems construction has revealed elements of the work, which are inconsistent with the Contract Documents. All items in the report shall be addressed in writing by the Contractor within two (2) weeks and corrections in the field shall be made as directed.

1.04 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1.	AABC	American Association of Balancing Contractors
2.	ABMA	American Boiler Manufacturers Association
3.	AFBMA	Anti-Friction Bearing Manufacturers Association
4.	AGA	American Gas Association
5.	ANSI	American National Standards Institute
6.	ARI	Air Conditioning and Refrigeration Institute
7.	ASA	Acoustical Society of America
8.	ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
9.	ASME	American Society of Mechanical Engineers
10.	ASPE	American Society of Plumbing Engineers
11.	ASSE	American Society of Sanitary Engineers
12.	ASTM	American Society for Testing and Materials
13.	AWS	American Welding Society
14.	AWWA	American Water Works Association
15.	EPA	Environmental Protection Agency
16.	FM	Factory Mutual
17.	FS	Federal Specifications
18.	IEEE	Institute of Electrical and Electronic Engineers
19.	NAPHCC	National Association of Plumbing Heating & Cooling Contractors
20.	NEBB	National Environmental Balancing Bureau
21.	NEC	National Electric Code
22.	NEMA	National Electrical Manufacturers Association
23.	NFPA	National Fire Protection Association
24.	OSHA	Occupational Safety and Health Administration
25.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
26.	UL	Underwriters Laboratories Inc.

B. Definitions:

1. Where it is stated in the specifications to submit to Architect or Engineer for review, refer to Architectural General and Special Conditions for proper procedures.
2. “PROVIDE” means to “Furnish” and “Install”.
3. “INSTALL” means to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.
4. “FURNISH” means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.
5. “AS DIRECTED” means as directed by the Architect, or the Architect’s Representative.
6. “CONCEALED” means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings.
7. “SUBMIT” means submit to the Architect for review.
8. "Piping": pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation and all related accessories.

9. "Wiring": raceway, fittings, wire, boxes and all related accessories.
10. "Indicated," "shown," or "noted": as indicated, shown, or noted on drawings or specifications.
11. "Similar" or "equal": of base bid manufacture, equal in quality materials, weight, size, performance, design, and efficiency of specified product, conforming to "Base Bid Manufacturers."
12. "Reviewed" "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted, or directed by Architect and/or Engineer.
13. "Motor Controllers": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.
14. "Control or Actuating Devices": automatic sensing and switching devices such as thermostats, pressure, float, flow, operation of equipment.
15. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

1.05 GUARANTEE

A. Furnish standard manufacturers' guarantees for work under this Division. Such guarantees shall be in addition to, and NOT in lieu of, other liabilities under the law or by other provisions of the Contract Documents. Refer to individual specification sections for required guarantee/warranty durations.

B. Materials, equipment and workmanship shall carry a warranty against defects in material and workmanship. Failure which may develop due to defective or improper materials, equipment, workmanship or design shall be made good, forthwith, by and at the expense of the Contractor, including damage done to areas, materials and other systems resulting from this failure.

C. Guarantee that all elements of the systems are of sufficient capacity to meet the specified performance requirements as set forth in the Contract Documents.

D. Upon receipt of notice from the Owner of a failure of system(s) or component(s) during the guarantee period, replace affected components within reasonable time period at no additional cost.

E. Guarantee period shall extend for a minimum of two (2) years from Date of Substantial Completion, unless additional duration are indicated in specific specification sections.

1.06 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

A. The Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of AutoCAD, BIM model or compatible format architectural and engineering drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media files.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. If products and materials are specified or indicated on the Contract Drawings for a specific item or system, use those products or materials. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of the Engineer.

B. Provide products and materials that are new, clean, free of defects and free of damage and corrosion.

C. Products and materials shall not contain asbestos, PCBs or any other material that is considered hazardous by the Environmental Protection Agency or any other Authority Having Jurisdiction.

D. Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Engineer.

E. Statically and dynamically balance rotating equipment for minimum vibration and lowest operating noise level.

F. Provide name/data plates on major components of equipment with manufacturer's name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.

G. Install materials and equipment with qualified trades people.

H. Maintain uniformity of manufacture for equipment used in similar applications and sizes.

I. Applicable equipment and materials to be listed by Underwriters Laboratories and manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by Authorities Having Jurisdiction. The energy-using products shall be certified for use in the location installed and meet State energy efficient standards.

J. Fully lubricate equipment when installed.

K. Do not operate water systems until piping has been cleaned, and strainers are in place.

L. Install floor-mounted equipment on a 4-inch high concrete pad. Concrete work shall be provided by another trade. Coordinate size and location with actual equipment used and accepted layout shop drawings.

M. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts to have bottom plate and pipe sleeves. Grout machinery set in concrete under entire bearing surface. After grout has set, remove wedges, shims and jack bolts and fill space with grout.

N. Locate valves, traps, shock absorbers, dielectric unions, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified. Obtain Architect's approval of access panel locations.

O. Follow manufacturers' recommendations and instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.

P. Pressure vessels and relief valves shall be selected, built and labeled in accordance with ASME.

Q. Equipment capabilities, etc., are scheduled or specified for job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on shop drawings.

2.02 ALTERNATIVE EQUIPMENT AND MATERIALS

A. Contract Documents are based on materials specified and on equipment manufacturers indicated. Acceptance of alternative equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, which meet the quality and performance as stated or implied in the Contract Documents.

B. Equipment manufacturers listed in individual sections are acceptable for this project, subject to requirements of Contract Documents.

C. Submit proposals to supply alternate materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain project schedule. Reimburse Owner for costs associated with the review of the proposed alternative whether alternative is accepted or rejected.

D. Include revisions required to adapt alternatives in such proposals, including revisions by other trades. No increase in the contract price will be considered to accommodate the use of alternative equipment.

E. Wherever quality standards (such as serviceability, longevity or durability) and operating results (such as noise levels, quantity delivered or pressure obtained) are specified or scheduled, or when the manufacturer and size of equipment, for which such operating results are published or determinable, is specified, the substitution being proposed must conform substantially to the quality and quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

F. In making a request for a proposal for alternative equipment or materials, the Contractor:

1. Represents that the Contractor has personally examined the Contract Documents and has determined that the proposed substitution is appropriate for the use intended in the Contract Documents, and is equal or superior in all aspects to that specified.
2. Represents that the substitution has received the necessary approvals of the Authorities Having Jurisdiction
3. Will coordinate installation of the accepted substitution into the work, making such changes as may be required for the work to be complete in all aspects.

G. Proposed changes and substitutions of systems, equipment and manufacturers shall be submitted and include the following information with the proposal:

1. A description of the difference between the existing contract requirements and that proposed, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to other trades.
2. Schematic drawings and details to supplement the description.
3. A list of the contract requirements that must be revised if the change is accepted, including any specification revisions.
4. Complete list of materials and equipment proposed for use in the change.
5. Include a description and estimate of costs the Owner may incur in implementing the change, such as additional space requirements, permits, architectural and aesthetic impact, design costs, tests, permits evaluation, operating and support costs.
6. A projection of any effects the proposed change would have on collateral costs to the Owner.
7. A statement of the time by which a contract modification accepting the change must be issued, noting any effect on the contract completion time or the delivery schedule.
8. A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.

PART 3 – EXECUTION

3.01 FEES

A. Pay all required fees and obtain required permits related to the fire protection installation.

B. Pay royalties or fees in connection with the use of patented devices and systems.

C. Provide controlled or witnessed inspection where required by Authorities Having Jurisdiction or by these specifications.

3.02 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer's data, samples and test reports as specified.

B. Within two (2) months after notice to proceed by the Owner or Owner's Representative, or after execution of Owner/Contractor Agreement, submit a complete typed list of all fire protection equipment manufacturers and material suppliers for the equipment proposed to be provided on this project as well as names of all subcontractors.

C. Within three (3) months after notice to proceed by the Owner or Owner's Representative or after execution of Owner/Contractor Agreement, prepare an index of all submittals for the project. Include a submittal identification number, a cross-reference to the specification sections or drawing number, and an item description. Prefix the submittal identification number by the specification sections to which they apply. Indicate, on each submittal, the submittal identification number in addition to the other data specified. All subcontractors shall utilize the assigned submittal identification number.

D. After the Contract is awarded, obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment as specified. Submit data and details of such materials and equipment for review. Prior to submission, certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Check all materials and equipment upon their arrival on the job site and verify their compliance with the Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

E. Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments does not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.

F. No part of the work shall be ordered, procured, started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted, reviewed and returned with either “No Exceptions Noted” or “Exceptions Noted” marked on the submission.

G. A minimum period of ten (10) working days, exclusive of transmittal time, will be required in the Architect/Engineer’s office each time a shop drawing, product data and/or samples are submitted for review. This time period must be considered by the Contractor in the scheduling of the work.

H. Submit digital files (PDF format) of all submittals including sheet metal drawings, piping drawings, and catalog cuts.

I. Submissions will be stamped as follows:

Stamp	**Interpretation**
No Exceptions Noted	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents.
Exceptions Noted: [ ] Resubmit for Record [ ] No Resubmission Required	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents and Engineer’s notations are complied with. Within this category are two options. A resubmission for our records is required when corrections are necessary. A resubmission is not required if there are only minor comments.
Revise and Resubmit	The submittal does not comply with the Contract Documents; do not proceed with fabrication, manufacture, or construction. The work and shop drawings are not permitted at the job site. Resubmit appropriate shop drawings.

J. Submit materials and equipment by manufacturer, trade name and model number. Include clear, legible copies of applicable brochure or catalog material. Maintenance and operating manuals are not suitable substitutes for shop drawings.

K. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as voltages, motor efficiencies, special tank linings, pump seals, materials or paint finishes. Cross out all references to “options”. Cross out statements such as “subject to change without notice” or “not for construction”. Anything not specifically excluded is assumed to be included.

L. Include dimensional data for roughing in and installation, technical data sufficient to verify that equipment meets requirements of the Contract Documents. Include wiring, piping and service connection data, motor sizes complete with voltage ratings, and schedules.

M. Maintain a complete set of the most current reviewed and stamped shop drawings and product data on site.

N. Prepare and submit detailed shop drawings for piping work and other distribution services in minimum ¼-inch to 1-foot scale, including elevations and locations and sizes of openings in floor decks, walls and roofs.

O. The work described in shop drawing and product data submittals shall be carefully checked by all trades for clearances (including those required for code compliance, maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with other trades on the job. Each submitted shop drawing to include a certification that related field conditions and requirements have been checked by all Contractors and Subcontractors and that conflicts do not exist.

P. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions or for deviations from requirements in the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data and samples.

Q. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

R. Indicate the following in the lower right hand corner of each shop drawing, and on the front cover of each product data brochure: the submittal identification number; title of the sheet or brochure; name and location of the Project; names of the Architect, Engineer, Contractor, Subcontractor, Manufacturer, Supplier, and Vendor; the date of submittal; and the date of each correction, version and revision. Number all pages and drawings in product data brochures, test reports or submittals consecutively from beginning to end. Unless the above information is included, the submittal will be returned for resubmission. Resubmittals of shop drawings or product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.

3.03 COORDINATION OF WORK

A. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Drawings are diagrammatic.

B. The Contract Documents show the general arrangement of equipment, ductwork, piping and accessories. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required but not shown on the Drawings. Investigate the site and review drawings of other trades to determine conditions affecting the work and provide such work and accessories as may be required to accommodate such conditions.

C. Certain products will be provided by other trades. Examine the Contract Documents to ascertain the requirements for installation of these products.

D. Carefully check space requirements with other trades to insure that material can be installed in the spaces allotted.

E. Wherever work interconnects with work of other trades, coordinate with other trades to insure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (valves, etc.) requiring access in order that the ceiling and partition contractors can install access doors and panels in the correct locations.

F. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.

G. Furnish and set sleeves for passage of pipes, and conduits through structural masonry and concrete walls, roofs and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.

H. Install firestopping around all pipes, conduits, etc., which pass through rated walls, partitions and floors in strict accordance with the manufacturer’s published approval listing and rating.

I. Provide detailed information on openings and holes required in structural elements and pre-cast panels or components for fire protection work.

J. Provide required structural or architectural supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.

K. Examine and compare the Contract Drawings and Specifications with the drawings and specifications of other trades, report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

L. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Architect for review. At completion include a set of these drawings with each set of record drawings.

M. Before commencing work, examine adjoining work on which this work is in any way dependent and report conditions that prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

N. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.

1. Right-of-Way: Lines which pitch have right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets and changes in direction of pipes as required to maintain proper head room and pitch on sloping lines. Provide traps, air vents, drains, etc., as required to effect these offsets and changes in direction.

O. Install fire protection work to permit removal (without damage to other parts) of heat exchanger, boiler tube bundles, heat exchanger plates, controls, sheaves and drives, and any other parts requiring periodic replacement or maintenance. Arrange pipes and equipment to permit access to valves, cocks, traps, starters, motors, and control components, and to clear the openings of swinging doors and access panels.

P. In cases of doubt as to the work intended, or in the event of need for explanation thereof, request supplementary instructions from the Architect.

3.04 CONTRACTOR'S COORDINATION DRAWINGS

A. The Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Architect) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. The Contractor and all trade contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment actually purchased and the exact routing for all lines such as piping, conduit, ductwork, etc., including conduit embedded in concrete floors and walls. The Coordination Drawings shall be submitted complete to the Architect and the Engineer within three (3) months after notice to proceed is given and in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than ¼-inch to 1-foot, shall serve as the base drawings to which all other Contractors shall add their work. Each separate Trade Contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical, fire protection and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and Coordination Drawings. If the Contractor allows one trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.

C. The Contractor's Coordination Drawings shall indicate structural loads at support points for all piping 10-inch and larger, racked piping, racked conduit. Submit to Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial construction. Penetrations shall be dimensioned for walls, floors and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the Drawings.

D. This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade contractors to make any unauthorized changes to the Contract Documents. Contract document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Architect to change them.

E. Prior to final acceptance of the work, the Contractor shall submit the Coordination Drawings as part of the Record Drawing submittal.

F. Coordination drawings shall not be reviewed by the Engineer.

G. Work installed which interferes with work of any other trade will be corrected at no cost to the project.

H. This Contractor shall not install any work prior to "sign-off" of final coordination drawings by all trades. If fire protection work proceeds prior to this sign-off, this Contractor shall be responsible for all costs resulting to correct interferences and conflicts, along with any schedule implications.

3.05 EXAMINATION OF SITE

A. The Contract Documents do not make representations regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work.

B. Evaluate existing conditions that may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for satisfactory completion of the work.

3.06 EXCAVATION AND BACKFILL

A. Provide excavation for the work of this Division. Excavate all material encountered, to the depths indicated on the Drawings or as required. Remove excavated materials not required or suitable for backfill from the site. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water that accumulates. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel including all OSHA requirements.

B. Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum overdepth of four inches below the trench depths indicated on the Drawings or as required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine tamped to a compaction level of at least 95 percent of standard proctor density or 75 percent relative density or as specified by the Architect. Whenever unstable soil that is incapable of properly supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

C. Excavate trenches for utilities that will provide the required minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown.

D. Trenches shall not be placed within ten (10) feet of foundation or soil surfaces that must resist horizontal forces.

E. Do not backfill trenches until all required tests have been performed and the installation observed by the Architect. Comply with the requirements of other sections of the specifications. Backfill shall consist of non-expansive material with limited porosity. Deposit backfill in 6-inch thick layers and tamp carefully until the fire protection work is covered by not less than 12 inches of material. Backfill and tamp remainder of trench at 1-foot intervals until complete. Uniformly grade the finished surface.

F. Prior to filling in or covering over work, photo document the as-built utilities for record.

G. After filling in or covering over work, provide video inspection of each underground utility's interior to ensure that no damages occurred during the installation.

3.07 CUTTING AND PATCHING

A. Where cutting, channeling, or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of piping or equipment, lay out the work carefully in advance. Repair any damage to the building, piping, equipment or finishes using skilled tradesmen for all required work.

B. Do not cut, channel or drill unfinished masonry, tile, etc. unless written permission is obtained from the Architect. Perform this work in a manner acceptable to the Architect.

C. Where piping or equipment are mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.

D. Provide slots, chases, openings and recesses through floors, walls, ceilings and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.

3.08 RESPONSIBILITY FOR EVALUATION

A. The Engineer makes no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other subsurface conditions which may be encountered during the work. This Contractor must make his own evaluation of existing conditions which may affect methods or cost of performing the work, based on his own examination of the facility or other information. Failure to examine the drawings or other information does not relieve the Contractor of his responsibility for satisfactory accomplishment of the work.

3.09 FIRE ACCESS TO FIRE APPARATUS

A. Do not interfere with access to hydrants and fire alarm boxes. In no case allow material or equipment to be within twenty (20) feet of a hydrant or fire alarm box.

3.10 PROHIBITED LABELS AND IDENTIFICATIONS

A. Prohibited Markings: In all public areas, tenant areas, storage areas and similar locations within the project, the inclusion or installation of any equipment, fixture or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited.

B. Exception: Required Underwriters Laboratories labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.11 EQUIPMENT PAD AND ANCHOR BOLTS

A. Provide concrete pads under all floor-mounted fire protection equipment. This includes electrical components, equipment mounted on legs and pipe support stands. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 2-inch margin around the equipment and supports. Pads shall be a minimum of 4 inches high unless it serves a fire pump which requires a 12-inch high pad and made of a minimum 28-day, 2500-psi concrete reinforced with 6-inch by 6-inch 6/6-gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a ¾-inch radius. Use shop drawings stamped “NO EXCEPTIONS NOTED” or “EXCEPTIONS NOTED” for dimensional guidance in sizing pads.

B. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Verify bolts size, number and embed depth recommended by the manufacturer of the equipment with seismic calculations as specified, and locate by means of suitable templates.

C. Where equipment is mounted on gypsum board partitions, the mounting screws will pass through the gypsum board and be securely attached to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6-inch square, 18-gauge galvanized metal

backplates that are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not acceptable.

3.12 DELIVERY, DRAYAGE AND HAULING

A. Include all drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and introduction of equipment to the project as required by the construction schedule. If any item of equipment is received prior to the time it is required, be responsible for its proper storage and protection until the time it is required. Pay for all costs of demurrage or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc., at no additional cost to the Owner.

3.13 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment and material of other trades from damage by work or workers of this trade, and correct damage caused without additional cost to the Owner.

B. The Contractor shall be responsible for all work, materials and equipment until finally inspected, tested and accepted. Protect work against theft, injury or damage; and carefully store material and equipment received on site that is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of dust, dirt, water or other obstructing material. Cover and protect equipment and materials from damage due to water, moisture, humidity, paint, spray-on fireproofing, construction debris, etc. Store equipment subject to moisture damage, such as insulation or electrical components in dry heated spaces.

C. Provide adequate means for fully protecting finished parts of the materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair. Replace all wet or damp insulation.

3.14 ELECTRICAL EQUIPMENT AND ELECTRICAL ROOM PRECAUTIONS

A. Do not install piping or equipment not included as part of the electrical work, in the following rooms: switchgear, transformer, generator, elevator equipment, telephone, fire command, security, dimmer or electrical equipment rooms.

B. Do not install piping, equipment above switchboards, disconnects, panelboards, dimmers, control panels, VFDs, motor control centers, individual motor controllers, electronics, etc or the code required service space for these electrical devices.

C. Provide drip pans with leak detection under all piping installed in any electrical equipment room. Pan shall be water tight, extending 4" in each direction from the pipe wall and turned up at least one-half the diameter of the pipe, but not less than 2". The pan shall extend at least 1 foot beyond the electrical equipment. Provide a drain pipe to spill into floor drain or service sink in a noticeable area outside of the electrical room. Provide automatic isolation valves on pressurized piping that will close upon leak detection.

3.15 EQUIPMENT GUARDS

A. Provide easily (without tools) removable expanded metal guards for all hot surfaces, belts, couplings, and other moving parts of machinery. Provide tachometer openings in the guards at least 2 inches in diameter, for all belt-driven, gear-driven or variable speed machinery. Comply with OSHA requirements for all equipment guards.

3.16 LUBRICATION

A. Provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a metallic lubrication tube with suitable fitting to an accessible location and identify it with permanent laminated plastic nameplates. Identify this location in the maintenance manual.

B. After installation, properly lubricate all parts requiring lubrication and keep them adequately lubricated with a lubricant recommended by the equipment manufacturer until Owner acceptance.

3.17 DATE OF COMPLETION AND TESTING OF FIRE PROTECTION SYSTEMS

A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and the Contract closeout. Complete any adjustments and/or alterations that the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual sections for extent of testing required.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when tests will be performed. Submit completion schedule for review within three (3) months after the notice to proceed by Owner or Owner’s Representative has been given. Update this schedule periodically as the project progresses.

3.18 OPERATING INSTRUCTIONS AND OPERATOR TRAINING

A. Provide the services of factory-trained specialists to supervise the operation of all equipment and systems specified and train the Owner’s operating and maintenance personnel for a three (3) day operating/instruction period. Operating instruction time is defined as straight time working hours and not including nights, weekends or travel time to and from the project. Refer to individual sections for additional training and instruction by manufacturer’s trained specialists.

B. Notify the Owner in writing at least three (3) weeks before the operating/instruction period begins. Do not commence until the Owner has issued written acceptance of the starting time and schedule.

C. In addition to the operating/instruction period, organize and conduct a seminar to instruct the Owner's Representatives in the operation and general preventative maintenance of equipment and systems provided at the completion of the project.

D. Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.

E. Make arrangements to give instructions by system and not by building areas.

F. Provide services of qualified personnel, including each sub-trade, each major equipment supplier to attend seminar and instruct on respective equipment or systems. Seminar shall be conducted by the Contractor and may be videotaped and attended by the Architect or Architect's Representative.

G. Submit seminar agenda, schedule and list of representatives to the Owner for review thirty (30) days prior to seminar. Confirm attendance at seminar by written notification to participants.

H. At seminar, submit final copies of record drawings and operating and maintenance manuals to Owner.

I. Submit a written record of the seminar, complete with an attendance list to the Owner.

3.19 OPERATING AND MAINTENANCE MANUALS

A. Provide operating instructions and maintenance manuals for all equipment and materials furnished under this Division.

B. Submit three (3) final copies of operating and maintenance data books for review at least ten (10) weeks before the completion date. Provide 8.5-inch by 11-inch, expanding spine catalog binders bound with heavy red fabric, hot stamp lettering on front and spine identifying project name and Owner's name. Assemble data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item.

C. Index the maintenance manual according to the following system:

1. Tab – 1.0 Fire Protection Systems: Title page identifying project, Owner, Contractor and Engineer with clear plastic protection cover.
2. Tab – 1.1 List of Fire Protection Drawings.
3. Tab – 1.2 Description of Systems: Provide complete descriptions of the operating sequence for each system. Include detailed system description, with individual components described, and description of how components interface with others and to the complete system.
4. Tab – 1.3 Operating Division: Provide information on locations of components, how to energize switches and controls, how components interface with other components, operation of controls including

operational sequence, complete troubleshooting sequence, and failure and safeguards to indicate if equipment goes off-line.

5. Tab – 1.4 Maintenance and Lubrication Division: Provide general maintenance and lubrication schedule for major components and include daily, weekly, monthly, quarterly, semiannual and yearly checks and tasks. Explain how to execute maintenance tasks required for typical equipment such as bearings, drives, motors and filters. Compile this information for equipment separate from shop drawings.
6. Tab – 1.5 List of Equipment Suppliers and Contractors: Provide list of equipment suppliers and contractors, including street addresses, website addresses, fax and toll-free telephone numbers.
7. Tab – Certification (2.0, 2.1, etc.): Include copy of test data on disinfection, chlorination and flushing of systems, analysis of water quality taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certifications, copy of balancing data for water systems, copy of valve identification and pipe color code and inspection approval certificates from Authorities Having Jurisdiction.
8. Tab – Shop Drawings and Maintenance Bulletins (3.0, 3.1, 3.2, etc.): Provide material received in compliance with clause “Submittals and Reviews”.

D. The manual divider and tabs shall be laminated mylar plastic and colored as follows:

Fire Protection Systems	1.0	–	1.5	Orange
Certification	2.0	–	2.4	Green
Shop Drawings & Maintenance	3.0	–	3.17	Yellow

E. Plastic tabs with typewritten card insertions will not be accepted.

F. Maintenance information shall include complete lubrication, cleaning, and servicing data compiled in clearly and easily understandable format. Show model and serial number of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

G. Provide the following equipment maintenance information where applicable:

1. Identifying name and number
2. Locations (where several similar items are used, provide a list)
3. Complete nameplate data
4. Parts list
5. Performance curves and data
6. Wiring diagrams
7. Lubrication charts
8. Manufacturers’ recommended operating and maintenance instructions, with all non-applicable information deleted
9. List of spare parts recommended for normal service requirements
10. Assembly and disassembly instructions with exploded view Drawings, where necessary
11. Trouble shooting diagnostic instructions, where applicable

3.20 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the project site a complete set of Record Drawings. The Record Drawings shall initially consist of a set of blueline prints or AutoCAD files of the Contractor's Coordination Drawings. The prints shall be marked or the AutoCAD files electronically updated to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, and all changes and deviations in the fire protection work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite written instructions from the Architect or Engineer. The updated Coordination Drawings shall be used to produce the final Record Drawings that shall be delivered to the Owner in AutoCAD electronic format media upon project completion.

B. Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two (2) dimensions to permanent structures.

C. The Contractor and subcontractor shall mark all in-progress Record Drawings on the front lower right hand corner with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
(⅜-inch high letters)

To be used for recording Field Deviations and Dimensional Data Only
($^{5}/_{16}$-inch high letters)

D. Upon completion of the work, the Contractor and subcontractors shall certify all Record Drawings on the front lower right hand corner adjacent to the above marking with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
CERTIFIED CORRECT
(⅜-inch high letters)

(Printed Name of General Contractor)
($^{5}/_{16}$-inch high letters)

Date: _____

(Printed Name of Subcontractor)
($^{5}/_{16}$-inch high letters)

Date: _____

E. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Record Drawings to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the Record Drawings. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

3.21 CERTIFICATION

A. Any certifications required by the Specifications, in addition to those required for shop drawings, product data, equipment and other items, are to be so certified in writing by the Owner, a Partner, or a Corporate Officer of the firm required to provide the Certification, or by another person duly authorized to sign binding agreements for and on behalf of the Owner, Partner or Corporation.

3.22 FINAL REVIEW

A. At a time designated by the Owner, the entire system shall be reviewed for compliance with the Contract Drawings and Specifications. Be available at all times during this review.

B. Demonstrate to the Owner and/or the Architect's personnel prior to the Final Review that systems and equipment have been properly balanced and adjusted and are in compliance with the requirements of the Contract Documents. After these demonstration tests are satisfactorily completed, but prior to the Final Review, submit a written certification that: 1) attests to the Contract Document compliance for this project; and 2) certifies that the equipment and materials installed in this project contain no lead, asbestos or PCB. Prior to the final review, the Contractor shall confirm the following items regarding the status of key elements of the work. Negative responses to any of the items indicate that the construction is not substantially complete, and the building is not ready for a final review. The Contractor shall confirm the following in writing:

1. Building has normal electrical power.
2. The emergency or stand-by power system has been started up, commissioned, and is standing by.
3. Building systems have been cleaned.
4. Seismic restraints have been inspected as specified. Any required special inspections have been completed.
5. Building systems have been balanced and copy of balance report submitted to the Architect.
6. Building fire and life safety systems have been tested and accepted by the local authorities. Any required special inspections have been completed.
7. All final wiring connections have been rechecked.
8. All base building lighting systems are completely installed and operating.
9. The domestic cold water system has been installed, flushed, disinfected, tested and operating.
10. The domestic hot water systems are completely installed, flushed, disinfected, tested and operating.

11. The sanitary sewer and storm sewer systems are completely installed, operating, connected to the required city, public or private utilities and pressure tested.
12. There are no deviations or non-compliance with the Contract Documents; otherwise, provide a detailed account of any and all deviations or non-compliance.
13. All items on field review reports have been responded to in writing and are resolved to the satisfaction of the Owner.
14. All outstanding items on submittals and shop drawings have been addressed in writing and are resolved to the satisfaction of the Owner.
15. Schedule the final review only after providing written confirmation of all items above. Provide a minimum of ten (10) days notice.

C. Certificates and Documents required by the Contract shall be presented to the Architect at least two (2) weeks prior to the Final Review.

D. After the Final Review, any changes or corrections noted as necessary for the work to comply with the Contract Documents shall be accomplished without delay in order to secure final acceptance of the work.

3.23 SYSTEM STARTUP

A. Prior to startup of any permanent system, confirm that the area which the system serves is fully closed off from the environment.

B. Operate the entire system properly with all systems balanced and all controls adjusted.

3.24 CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean, subject to the Architect/Engineer's instructions, which shall be promptly carried out.

B. Contractor shall clean all light fixtures and equipment at the completion of the project.

C. All panelboards, wireways, cabinets, enclosures, etc. shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened by this contractor for observation by the Architect/Engineer as required

3.25 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect/Engineer and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Contract Drawings.

B. If the Contractor penetrates any walls or surfaces after they have been waterproofed, he shall restore the waterproof integrity of that surface at his own expense and as directed by the Architect/Engineer

3.26 OPENINGS IN EXTERIOR WALLS

A. Openings in exterior walls and roofs shall be kept properly plugged and caulked at all times, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of the work, openings for which this Contractor is responsible shall be permanently sealed and caulked in a manner approved by the Architect.

3.27 EXAMINATION OF SITE

A. Prior to submitting of bids, the Contractor shall visit the project site and shall familiarize himself with all conditions affecting the proposed installation and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph will in no way relieve the contractor of performing all necessary work shown on the Contract Drawings.

3.28 CONTINUITY OF SERVICE AND SCHEDULING OF WORK

A. Continuity of all services shall be maintained in all areas which will be occupied during the construction period. If any interruption of service becomes necessary, such shall be made only upon consent of the Owner and at a time outside normal working hours (off hours) as the Owner shall designate.

B. Allow time for service interruptions in the overall schedule of the project. The progress of the project shall be neither delayed nor interfered with because of the scheduled service interruptions.

3.29 REMOVAL WORK

A. Particular care shall be taken to avoid creating hazards on the site or causing disruption of service in the adjoining buildings.

B. All existing equipment indicated for removal shall be removed in a neat and workmanlike manner. All existing equipment indicated to be turned over to the Owner shall be presented to the Owner in good condition at a location designated by Owner. All other equipment shall be removed from the premises.

C. Follow state and federal regulations for disposal of any hazardous materials (such as CFC Refrigerant and Glycol).

D. Provide written documentation to the Owner that all hazardous materials have been disposed of properly.

3.30 HAZARDOUS MATERIAL REMOVAL

A. Should this Subcontractor or any of its Sub-Subcontractors encounter any hazardous materials during the performance of its work, this Subcontractor shall stop work immediately and so inform the General Contractor and the Owner of the presence of the hazardous material.

3.31 CERTIFICATES OF APPROVAL

A. Upon completion of all work, furnish, in duplicate, certificates of inspections from the manufacturers stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be in satisfactory operating condition.

3.32 PROJECT CLOSEOUT

A. At the time of project closeout and prior to the final payment, this Contractor shall provide/submit the following for owner to review and sign off:

1. Review with Owner and confirm that all field issues have been resolved.
2. Submit system testing reports, equipment certificates, and operation manuals as per these specifications.
3. Provide the Owner with required training as per these specifications.
4. Provide spare parts, belts, pulleys, filters, etc., as per these specifications and Owner requirements.
5. Turn over all keys, including door access keys and control panel keys to the Owner with proper tags.
6. Submit construction record as-built sets with A/E review stamp.
7. All proposals and change orders are fully executed and submit a certified statement that no change orders will be submitted after project closeout.
8. Submit copies of the Authority's inspection and approval letters.

3.33 EARLY OCCUPANCY

A. Be responsible for completing those systems, which are necessary to allow partial occupancy of the building even if systems in the unoccupied areas are incomplete.

B. Verify and comply with requirements for temporary occupancy with the local Building Department.

END OF SECTION

SECTION 21 00 04
UNIT PRICES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide unit prices for possible revisions and alternates in the work.

B. State and hold firm for the duration of the project all unit prices as described herein.

1.02 DEFINITIONS

A. Unit prices, unless otherwise noted, are to include incidental work normally included in connection with the particular type of work involved and are to include, but not necessarily be limited to, the following:

1. Engineering, including calculations, detailing, coordination, and shop drawings.
2. Material costs, including an allowance for waste, connections, etc.
3. Necessary accessories, e.g., hangers, inserts, clips, bolts, painting, labeling, testing, etc.
4. Fabrication and shop costs.
5. Shop and field labor, including supervision and engineering layout costs.
6. Temporary utilities required, including safety precautions.
7. Costs of standby trades during or beyond normal working hours.
8. Transportation, hoisting, rigging, freight, taxes of any kind, fringe benefits, overhead and profit (excluding Insurance Cost).
9. Tools and equipment.
10. Testing, cleaning, balancing and controlled inspection.

B. Architect/Engineer documents will be used as the basis for calculating changes to contract work.

C. Submit unit prices based upon the specification standards and as noted herein. Unit prices shall apply equally to work when added and also to work when deleted, except where specifically modified below.

D. In addition to your contract proposal, quote prices for the work described below.

PART 2 – PRODUCTS

2.01 PIPING

A. Provide Schedule 40 threaded black steel pipe and hangers.

1.	1" I.D.	$_____/LF
2.	1¼" I.D.	$_____/LF
3.	1½" I.D.	$_____/LF
4.	2" I.D.	$_____/LF

5. 2½" I.D. $_____/LF
6. 3" I.D. $_____/LF

B. Provide Schedule 40 welded black steel pipe and hangers.

1. 2½" I.D. $_____/LF
2. 3" I.D. $_____/LF
3. 4" I.D. $_____/LF
4. 5" I.D. $_____/LF
5. 6" I.D. $_____/LF

C. Provide Schedule 10 black steel pipe and hangers.

1. 2½" I.D. $_____/LF
2. 3" I.D. $_____/LF
3. 4" I.D. $_____/LF
4. 5" I.D. $_____/LF
5. 6" I.D. $_____/LF
6. 8" I.D. $_____/LF
7. 10" I.D. $_____/LF

2.02 VALVES

A. Gate Valves (U.L. and F.M. Listed)

1. 1" $_____
2. 1¼" $_____
3. 1½" $_____
4. 2" $_____
5. 2½" $_____
6. 3" $_____
7. 4" $_____
8. 5" $_____
9. 6" $_____

B. Check Valves (U.L. and F.M. Listed)

1. 1" $_____

	2.	1¼"	$_____
	3.	1½"	$_____
	4.	2"	$_____
	5.	2½"	$_____
	6.	3"	$_____
	7.	4"	$_____
	8.	5"	$_____
	9.	6"	$_____

C. Butterfly Valves (U.L. and F.M. Listed) With Tamper Switch

	1.	1"	$_____
	2.	1¼"	$_____
	3.	1½"	$_____
	4.	2"	$_____
	5.	2½"	$_____
	6.	3"	$_____
	7.	4"	$_____

D. Waterflow Detectors

	1.	1"	$_____
	2.	1¼"	$_____
	3.	1½"	$_____
	4.	2"	$_____
	5.	2½"	$_____
	6.	3"	$_____
	7.	4"	$_____

E. Sprinkler Heads: Install with 10 feet of pipe and necessary elbows and hangers.

	1.	Flush plate type.	$_____
	2.	Recessed type.	$_____
	3.	Flush pendent type.	$_____
	4.	Exposed upgright or pendent type.	$_____
	5.	Sidewall	$_____
	6.	Sidewall extended coverage exposed type.	$_____
	7.	Dry flush plate type.	$_____

8. Dry pendent type. $_____

9. Dry horizontal type. $_____

10. Flush plate, quick response type. $_____

F. Sprinkler Rig: Consisting of valve and tamper switch, check valve, waterflow detector, pressure gauge, inspector test assembly.

1. Assembly Size:

a. 2" $_____

b. 2½" $_____

c. 3" $_____

d. 4" $_____

2.03 WORK REQUIRED FOR EXISTING CONDITIONS

A. Core Drill: Core drill holes in slab. Cost includes layout and equipment costs as well as all required labor. Cost includes firestopping and plugging as required.

1. Holes through 1½" $_____

2. Holes 2" through 3" $_____

3. Holes 4" through 5" $_____

4. Holes 6" and 8" $_____

B. Tie-in to existing pipe.

1. 1" I.D. $_____

2. 1¼" I.D. $_____

3. 1½" I.D. $_____

4. 2" I.D. $_____

5. 2½" I.D. $_____

6. 3" I.D. $_____

7. 4" I.D. $_____

8. 6" I.D. $_____

9. 10" I.D. $_____

END OF SECTION

SECTION 21 05 16
EXPANSION FITTINGS AND LOOPS FOR FIRE PROTECTION PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Expansion loops and flexible expansion loops
2. Expansion compensators
3. Pipe alignment guides and anchors
4. Expansion joints

1.02 RELATED DOCUMENTS

A. Section 21 05 01 – Fire Protection General Provisions

B. Section 21 05 29 – Supports, Hangers, Anchors and Sleeves for Fire Protection

C. Section 21 05 48 – Vibration Isolation and Seismic Restraints for Fire Protection

D. Section 21 10 00 – Piping and Fitting Materials for Water Based Fire Protection Systems

1.03 REFERENCE STANDARDS

A. All Fire Protection design, products, and installation shall comply with the applicable provisions and recommendations of the following jurisdictional codes, authorities and guidelines:

1. New York Building Code
2. International Building Code
3. New York Fire Code
4. International Fire Code
5. National Fire Protection Association Standard 13 “Installation of Sprinkler Systems”
6. National Fire Protection Association Standard 14 “Installation of Standpipe and Hose Systems”
7. National Fire Protection Association Standard 20 “Installation of Stationary Pumps for Fire Protection”
8. National Fire Protection Association Standard 22 “Water Tanks for Private Fire Protection”
9. National Fire Protection Association Standard 24 “Installation of Private Fire Service Mains and Other Appurtenances”
10. National Fire Protection Association Standard 25 “Testing and Maintenance of Water Based Fire Protection Systems”
11. State Fire Marshal Requirements
12. UL – Underwriters Laboratories Inc.
13. Local Codes, Code Amendments and Requirements

1.04 SUBMITTALS

A. Product Data: For each type of expansion fitting indicated.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
2. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
3. Alignment Guide Details: Detail field assembly and anchorage.

C. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Flexible Expansion Loops: MetraFlex

B. Pipe Alignment Guides: Pipe Shields Series E2000 for insulated pipes; B-Line, Grinnell, Hyspan Series 9500 or MetraFlex for uninsulated pipes

2.02 PERFORMANCE REQUIREMENTS

A. Expansion compensator shall be capable of elongating and compressing to absorb 200 percent of maximum piping expansion between anchors.

B. Pipe alignment guides shall be selected for both upward and downward motion.

2.03 FLEXIBLE EXPANSION LOOPS

A. Provide flexible expansion loops of size noted on the Drawings.

B. Flexible loops shall be designed to not impart thrust loads on the anchors. The loop shall consist of two flexible sections of hose and braid, two (2) 90-degree elbows, and a 180-degree return. Loops shall be installed in a neutral, pre-compressed, or pre-extended condition as required for application.

C. Loops installed hanging down shall have a drain plug. Loops installed straight up may be fitted with an automatic air release valve that purges air from the high point of the loop. Loops installed in any position other than hanging down must have the 180-degree return supported.

D. Joints for steel piping:

1. End connections shall be threaded up to 2-inch and flanged for all other sizes.
2. Joints, up to 2-inch: Stainless-steel hoses and single-braid, stainless-steel sheaths with 325 psig at 600 degrees F minimum pressure ratings.
3. Joints, 2.5 to 6-inch: Stainless steel hoses and single-braid, stainless steel sheaths with 145 psig at 600 degrees F minimum pressure ratings.
4. Joints up to 2-inch: Stainless steel hoses and single-braid, stainless steel sheaths with 90 psig at 600 degrees F minimum pressure ratings.
5. Joints for 2.5 to 6-inch: Stainless steel hoses and double-braid, stainless steel sheaths with 200 psig at 600 degrees F minimum pressure ratings.

6. Joints for 8-inch and larger: Stainless steel hoses and double-braid, stainless steel sheaths with 120 psig at 600 degrees F minimum pressure ratings.

E. UL-Listed Seismic Type:

1. All sprinkler and fire standpipe piping passing through or crossing building seismic joints shall contain a flexible expansion loop designed for seismic movement.
2. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be located at, or near, the building seismic joint.
3. A vertical support hanger, located within 4 pipe diameters, shall be installed on each side of the flexible loop. Each hanger to be transversely and longitudinally braced per local codes. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure.
4. Flexible loops shall be capable of movement in the ±X, ±Y, ±Z planes. Movement requirements and location, relative to seismic separation, shall be confirmed by the structural design engineer.
5. Flexible loops may be installed to accommodate thermal expansion, seismic movement, and building settlement.
6. Flexible loop connections to sprinkler piping shall be installed, inspected, and tested in accordance with current NFPA-13 standards.
7. Flexible loops shall consist of two flexible sections of hose and braid, two 90-degree elbows, and 180-degree return. Loops shall include a factory supplied, center support nut located at the bottom of the 180-degree return, and a drain/air release plug.
8. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings.
9. Flexible expansion/seismic loops to be Metraloop® Fireloop™ as manufactured by The MetraFlex Company.

2.04 MISCELLANEOUS MATERIALS

A. Guides shall be steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

B. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex head.

C. Washers: ASTM F844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide at least two (2) guides each side of each expansion loop, compensator or joint. Size guide cylinder to allow the full insulation thickness to be carried through the guide with ample clearance and without restricting the free

movement of the pipe. Size guide cylinder for sufficient length to contain the total movement of the spider. Rigidly anchor pipe guide to building structure.

B. Install expansion fittings according to manufacturer's written instructions in sizes matching pipe size in which they are installed. Align expansion fittings to avoid end-loading and torsional stress.

C. Provide expansion loops, compensators or joints as shown on the Drawings.

D. Provide minimum of three (3) elbow offsets on branch pipe connections into mains and at each riser takeoff to allow piping flexibility and expansion.

E. Install flexible loop within four (4) pipe diameters, both upstream and downstream, from a pipe guide or anchor.

END OF SECTION

SECTION 21 05 17
SLEEVES, SEALS AND ESCUTCHEONS FOR FIRE PROTECTION PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Sleeves
2. Foundation Wall Sleeves
3. Escutcheons.
4. Through-penetration firestopping in fire-rated construction and through-penetration smokestopping in smoke partitions, including methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

1.02 RELATED DOCUMENTS

A. Section 21 05 01 – Fire Protection General Provisions

B. Section 21 07 00 – Fire Protection System Insulation

C. Section 21 10 00 – Piping and Fitting Materials for Water Based Fire Protection Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. NFPA – National Fire Protection Association

B. FM – Factory Mutual

C. UL – Underwriters Laboratories Inc.

D. New York Building Code

E. New York Fire Code

F. International Building Code

G. International Fire Code

1.04 QUALITY ASSURANCE

A. Firestop system installation shall conform to requirements of qualified designs or manufacturer approved modifications, as supported by engineering reports. Field inspections shall be carried out by the firestop manufacturer to verify that the installation is in accordance with the manufacturer requirements.

B. Install firestop materials and systems as required by these Contract Documents and meet and be accepted for use by applicable design building and construction codes.

C. Submit manufacturer's product data, letter of certification, or certified laboratory test report that the material or combination of materials (firestop system) meets the requirements specified in accordance with the applicable referenced standards.

D. The firestop compound shall not contain any solvents or inorganic fibers. The penetration seal material must be unaffected by moisture and must maintain the integrity of the floor or wall assembly for its rated time period when tested in accordance with ASTM E814 (UL1479). The system shall be U.L. Classified for up to and including 3 hours.

E. Firestopping materials shall be asbestos and lead fee and shall not incorporate or not require the use of hazardous solvents.

F. Firestopping sealants must be flexible, allowing for normal pipe movement.

G. All fire stopping materials shall be manufactured by one manufacturer.

H. Installation of firestopping systems shall be performed by a Contractor (or Contractors) trained or approved by the firestop manufacturer.

I. Material used shall be in accordance with the manufacturer’s written installation instructions.

J. Submit a line-by-line statement of compliance or non-compliance with this specification section.

1.05 SUBMITTALS

A. Include on piping shop drawings a layout of masonry and concrete floor and wall sleeve locations for pipes. Include elevations and sleeve sizes.

B. Submit product data on through-penetration firestop. Submittal data for firestopping systems shall include the UL System Numbers listed in the UL Building Materials Directory under which the material was tested in accordance with ASTM E814 (UL 1479) for use in a Through-Penetration Firestop System. Where there is a firestop application that has not been tested by UL, obtain from the manufacturer an engineered judgment that the proposed application of the firestop product is suitable. Submit the engineered judgment to the Authority Having Jurisdiction.

1. Product Data: Manufacturer’s specifications and technical data including detailed specification of construction and fabrication, manufacturer’s installation instructions and details of each proposed assembly identifying intended products and applicable UL system number or UL classified devices.
2. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:

a. Manufacturer or manufacturer's representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

C. Submit Material Safety Data Sheets with product delivered to job site.

D. Submit manufacturer's installation procedures for each type of product.

E. Approved Applicator: Submit document from manufacturer wherein manufacturer recognizes the installer as qualified or submit a list of past projects to demonstrate capability to perform intended work.

F. Upon completion, installer shall provide written certification that materials were installed in accordance with the manufacturer's installation instruction and details.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Sleeves: Pipe Shields, Insul, RK Industries

B. Escutcheon Plates: Beaton & Corbin Manufacturing

C. Firestop: Nelson, Dow, 3M, Hilti

2.02 SLEEVES

A. Construct sleeves for pipes passing through walls (other than foundation walls), floors, partitions, hung or furred ceilings,

B. Wall and floor sleeves

1. Sleeve Materials

Type	Sleeve Materials
1	#18 gauge, galvanized steel
2	Standard weight galvanized steel pipe
3	Cast iron body with flashing clamp and underdeck clamp similar to J.R. Smith, figure 1720.

2. Sleeve Sizes

a. Sleeves shall be of adequate diameter to allow pipe insulation, and fire stopping to fit.
b. Sleeves shall provide 1" minimum clearance around pipes smaller than 4" and 2" minimum clearance around pipes 4" and larger.

3. Sleeve Lengths

Location	Sleeve Length	Material
Floor	All floor sleeves to extend minimum of 2" above finished floor level.	2
Stair Landing	Equal to depth of construction and terminated flush with finished surfaces.	2
Walls and Partitions	Equal to depth of construction and terminated flush with finished surfaces.	1
Floors with membrane waterproofing	All floor sleeves to extend minimum of 2" above finished floor level.	3

2.03 ESCUTCHEONS

A. Install escutcheons at exposed piping through floors, ceilings, walls and partitions in finished areas, within cabinets and millwork, and piping through all fire-rated separations.

B. Provide manufactured wall and ceiling escutcheons and floor plates, with an inside diameter to closely fit around pipe, tube, and insulation of insulated piping and an outside diameter that completely covers opening.

C. Escutcheon Application

Location	
Finished Spaces	Chrome plated brass
Unfinished spaces: including mechanical equipment rooms.	Cast iron

D. Two-piece or hinged escutcheons will not be permitted.

E. Escutcheons shall be installed on both sides of pipe penetrations.

2.04 FIRESTOPPING

A. Fire-Rated Construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, and sound or vibration absorption, and at other construction gaps.

B. Smoke Barrier Construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

C. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free. Mortar systems must be Warnock Hersey approved.

D. Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

E. All firestopping products must be from a single manufacturer.

F. Through-penetration smokestopping at smoke partitions: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded in a non-fire rated smoke barrier.

G. Seal all pipe penetrations through fire-rated construction with factory-built devices or with manufactured fill, void, or cavity materials “Classified” by Underwriters Laboratories Inc. for use as a Through-Penetration Firestop. All firestop devices and systems shall be approved for such use by the Authority Having Jurisdiction. The firesafing system used shall maintain the fire-resistance rating of the building component that is penetrated.

H. All materials shall be non-hardening and non-toxic. The firesafing system used shall accommodate expansion and contraction of the floating plumbing piping systems without damaging the firestop or reducing its effectiveness as a smoke barrier or water seal.

PART 3 – EXECUTION

3.01 SLEEVES

A. Provide sleeves for pipe passing through floors, walls or partitions, hung or furred ceilings, of sufficient diameter to accommodate pipe covering where such is required. Locate sleeves secure in place so that an equal space is around the pipe, after the pipe is installed.

B. For sleeves at penetrations of metal deck, nail, screw or weld to the deck prior to the pouring of the deck concrete. Set sleeves in such a manner so that no concrete fills their interior during the concrete pouring and finishing operations.

C. For exposed pipes, caulk floor sleeves with firestop material watertight and project sleeve approximately 2 inches above the finished floor. Finish sleeves with specified flanges flush with the bottom of slab and also with the finished faces of wall.

D. Provide sleeves with an inside diameter at least ½-inch greater than outside of pipe served, including pipe insulation which must be continuous through sleeve.

E. Where piping penetrates walls (other than foundation walls), partitions, floor slabs, etc., pack space between piping and sleeve with mineral wool (for depth of sleeve), or firestop material.

F. Do not support pipes by resting clamps on sleeves. Clamps shall extend beyond sleeve and be supported outboard of sleeve in an approved manner. In no case shall sleeves be cut or slotted to accommodate pipe clamps.

3.02 ESCUTCHEONS

A. Provide escutcheon plates of the proper size for piping in sleeves passing through floors, walls, soffits, furrings, partitions, hung ceilings, etc., throughout the building where exposed. Exposed escutcheons shall be cast brass chromium plated, bell type, with setscrews of sufficient diameter to include any required pipe insulation. Attach escutcheon to building material, not to pipe. Do not penetrate vapor barriers.

1. Split-casting, deep-pattern type cast-brass type with concealed hinge and set screw with polished chrome-plated and rough brass finish.
2. Split-casting, floor-plate type cast brass with concealed hinge and set screw.

3.03 FIRESTOPPING

A. Where space for future pipes and conduits is required, provide sleeves and fill with lightweight concrete or firestop.

B. Provide firestopping and grouting around pipes penetrating concrete slabs, concrete walls and masonry walls with cement grout in the sleeved opening extending full depth through wall or floor slab. Provide sheet metal cover over the insulation before applying grout. Around pipes through fire rated gypsum board construction, pack the annular space between the wall sleeve and the insulation sheet metal cover with noncombustible approved firestop material and finish with escutcheons on pipe where exposed. Attach escutcheons to wall.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

D. Environmental Requirements:

1. Provide adequate ventilation if using solvent.
2. Provide forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

E. Clean surfaces that will be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

F. Install penetration seal materials in accordance with the UL Fire Resistance Directory or Mortars per Warnock Hersey approval and in accordance with manufacturer's instruction.

G. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

H. Where large openings are created in walls or floors to permit installation of pipes or other items, close unused portions of opening with firestopping material tested for the application. See UL Fire Resistance Directory or Warnock Hersey approvals.

I. Install smokestopping as specified for firestopping.

END OF SECTION

SECTION 21 05 19
METERS AND GAUGES FOR FIRE PROTECTION PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Gauges

1.02 RELATED DOCUMENTS

A. Section 21 05 01 – Fire Protection General Provisions

B. Section 21 11 00 – Fire Protection System Insulation

C. Section 21 10 00 – Piping and Fitting Materials for Water Based Fire Protection Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. NFPA – National Fire Protection Association

B. FM – Factory Mutual

C. UL – Underwriters Laboratories Inc.

D. New York Building Code

E. New York Fire Code

F. International Building Code

G. International Fire Code

H. ASME – American Society of Mechanical Engineers

1. ASME B40.100 – 2013: Pressure Gauges and Gauge Attachments

1.04 QUALITY ASSURANCE

A. Instruments shall be factory-calibrated for the temperature and pressure of the systems in which they are installed.

B. Pressure gauges shall be manufactured in accordance with ASME Standard B40.100.

1.05 SUBMITTALS

A. Submit list indicating use, operating range, total range, and location.

B. Submit manufacturer's data for instrument types, materials, accessories, and installation.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pressure Gauges: Weiss, Trerice, Weksler, Taylor, Ashcroft

2.02 PRESSURE GAUGES

A. Process type in an impact resistant phenolic case, 4.5-inch diameter glycerine-filled phosphor-bronze bourdon tube rated to 600 pounds per square inch. Stainless steel movement, ½-inch brass socket and 1-percent mid-scale accuracy, black figures on white background. Provide brass needle valve and snubber. Weiss Instrument Model LF4UGY1, or equal. Where fluid temperature exceeds 150 degrees F, provide non-liquid filled gauge Weiss Instrument Model NF4UGY1, or equal.

B. Gauges shall have graduation such that at normal working pressure the needle is in the center of the field.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide one pressure gauge per pump. Install piping from pressure gauge to taps before strainers and on suction and discharge of pump. Refer to details on the Drawings.

3.02 SCHEDULE

A. Pressure Gauges:

1. Pumps, Inlet and Outlet
2. Sprinkler Floor Control Valves
3. PRV's, Inlet and Outlet
4. Dry Pipe Valves, Inlet and Outlet
5. Main Water Service
6. Top and Bottom of All Risers
7. Storage Tank Outlet
8. Other locations as indicated on the Drawings

END OF SECTION

SECTION 21 05 23
GENERAL DUTY VALVES FOR WATER BASED FIRE PROTECTION PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. OS&Y Valves
2. Gate Valves
3. Ball Valves
4. Butterfly Valves
5. Check Valves
6. Pressure Relief Valves

1.02 RELATED DOCUMENTS

A. Section 21 10 00 – Piping and Fitting Materials for Water Based Fire Protection Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

1. Standard 13: Installation of Sprinkler Systems
2. Standard 14: Installation of Standpipe and Hose Systems
3. Standard 20: Installation of Stationary Pumps for Fire Protection

H. Owners Insurance Underwriters

1.04 QUALITY ASSURANCE

A. Each valve shall have the manufacturer’s name, size and pressure rating cast or stamped on body.

B. Each valve shall bear UL/FM Global label or marking.

1.05 SUBMITTALS

A. Manufacturer's Specifications and Engineering Data

1. Each valve type
2. Materials or all parts
3. Pressure ratings
4. Schedule of major control valves, check valves and pressure reducing valves
5. Certificates: Manufacturer's certification that valves and accessories meet or exceed specification requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Valves: Stockham, Milwaukee, Kennedy, Nibco, Victaulic, Cla-Val

2.02 VALVES

A. All fire protection valves shall be Underwriters Laboratories label, Factory Mutual approved or allowable per applicable FM Global Property Loss Prevention Data Sheets and to be rated of minimum 175 psi working pressure rating or where line pressure exceeds 175 psi, extra heavy. Shut off valves shall be of the indicating type. Where pressure exceeds 175 pounds per square inch, extra heavy rated valves shall be provided..

B. All fire protection water control valves within the building shall be either wedge gate valves with painted iron wheel handles, shall have gland followers in stuffing boxes, and shall be constructed so that they may be repacked while open and under pressure, or slow-closing quarter-turn gear-operated butterfly valves.

C. All valves shall have the name of the manufacturer and working pressure cast or stamped on body.

D. All valves shall be with threaded, grooved, or flanged ends as required by the piping system in which they are installed.

E. Valves shall be selected for the maximum working pressure they will be exposed to (including churn pressure), or as indicated on the drawings.

F. All fire protection valves shall be provided with tamper switches.

2.03 FLOOR CONTROL, RISER AND ISOLATION VALVES:

A. 175 psig Working Pressure

1. Gate Valves

a. Gate valves up to and including 2 inch Kennedy Figure 66, 175 psig cold water, UL listed, FM approved, bronze body, bronze trim, single disc, outside screw and yoke, screwed bonnet valves with seats of bronze, screwed ends, United #18

b. Gate valves 2½ inch through 12 inch Kennedy Figure 4068, 175 psig cold water, UL listed, FM approved, and approved iron body, outside screw and yoke bolted bonnet valves with double or single disc, Class 125 ANSI B16.1 flanged ends, bronze trim, bronze seats.

2. Butterfly Valves

a. 2½ inch through 8 inch UL listed for specification 1091, FM approved under Approval Standard 1112, ductile iron body conforming to ASTM A536 coated with polyphenylene sulfide blend, ductile iron disc conforming to ASTM A536 with EPDM coating providing bubble tight shut-off, approved weatherproof manual actuator suitable for indoor or outdoor use with two single pole, double throw supervisory switches either pre-wired (WRD) or unwired (UWD) monitoring the open position as required to meet design requirements, grooved ends for installation with grooved mechanical couplings and rated for service up to 175 psi (1,200 kPa) working pressure, equivalent to Victaulic Series 700 or W709, Gruvlok AN7722-3 FD, or Nibco GD4765-4N.

b. UL listed, FM approved, slow-open quarter turn valve with built in tamper switches, 175 psi, threaded ends. Valve shall be provided with tamper switches rated for 0.5 Amps, 28 VDC; equivalent to "No. BB-SCS02" by Milwaukee Valve, No. KG-505W by Nibco.

2.04 CHECK VALVES

A. 175 psig Working Pressure

a. 2½ inch and larger: Iron body, swing check, 175 psi working pressure, bronze mounted, flanged pattern, UL listed, FM approved; equivalent to "Fig. F-908-W" by Nibco.

b. Check Valve – 4 inch and larger: Iron body, swing check, 175 psi working pressure, bronze mounted, flanged pattern, UL listed, FM approved; equivalent to "Fig. F-908-W" by Nibco.

2.05 PILOT OPERATED PRESSURE REDUCING VALVE

A. Size to operate within 20 percent to 80 percent of its maximum flow rate capacity

2.06 PRESSURE RELIEF VALVE

A. Furnish and install where indicated on drawings or downstream of all pressure reducing valves a ¾" cast brass pressure relief valve similar to Potter-Roemer 4059.

2.07 INSTALLATION

A. All valves shall be installed only in the upright vertical or horizontal positions unless specifically otherwise required by the drawings.

B. All valves shall be installed in accessible locations to facilitate easy removal for repair or replacement.

C. All grooved end valves shall be of the same manufacturer as the grooved couplings and fittings.

PART 3 – EXECUTION

3.01 VALVES

A. Provide full line size check valves with automatic ball drip on the boss located on the bottom and inlet side of each check valve serving fire department connections.

B. Install check valve and water flow indicators with eighteen-inch clearance from obstructions so that they can be removed and serviced.

C. Pressure gauges shall be provided at each side of the main check valve and at each control valve for each floor.

END OF SECTION

SECTION 21 05 29
HANGERS AND SUPPORTS FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Hangers
2. Supports

1.02 RELATED DOCUMENTS

A. Section 21 10 00 – Piping and Fitting Materials for Water Based Fire Protection Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

1. Standard 13: Installation of Sprinkler Systems
2. Standard 14: Installation of Standpipe and Hose Systems
3. Standard 20: Installation of Stationary Pumps for Fire Protection

H. Owners Insurance Underwriters

1.04 QUALITY ASSURANCE

A. Each hanger shall be UL/FM Global approved.

1.05 SUBMITTALS

A. Manufacturer’s literature, catalog data and illustrations

B. Shop drawings indicating:

1. Dimensions

2. Construction details of hangers, inserts, anchors and guides
3. Materials or all parts
4. Maximum load
5. Locations
6. Recommended installation procedures.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Hangers: Carpenter & Patterson, Grinnell Company Inc., I.R. Rauch's & Sons

2.02 HANGERS

A. All piping shall be securely supported from the building structure by means of Underwriters Laboratories and Factory Mutual approved iron hangers, supports and pipe inserts and installed in accordance with Underwriters approved methods.

B. Supports for vertical piping shall be heavy black iron extension clamps with bolts, each end resting on the building structure or hung from the slab in an approved manner.

C. Provide all auxiliary steel required for pipe supports.

D. Piping shall be hung from structural slab by means of malleable iron concrete inserts set informs before concrete is poured. Drilled type concrete inserts may be provided. Power driven studs will not be accepted unless accepted by projects structural engineer.

E. Piping shall not be hung from ductwork, or the work of other trades.

F. No pipes or other apparatus shall be installed so as to interfere in any way with the full swing of doors, building access doors, and access doors in ductwork. The arrangement, positions, and connections of pipes, drains, valves, etc., shown on the Drawings shall be taken as a close approximation and while they shall be followed as closely as possible, the right is reserved by the Project Representative to change the locations to accommodate any conditions which may arise during the progress of the work without additional compensation to this Contractor for such changes, provided that the changes are requested prior to the installation of this Contractor's work.

G. Piping typically shall be installed concealed in or above building construction; i.e.; hung ceilings, and shall be so arranged that relocation of lighting fixtures, or plumbing and mechanical systems, will not cause any interference.

H. All screwed pipe throughout the job shall be reamed smooth before being installed. Pipe shall not be split, bent, flattened or otherwise injured either before or during the installation. The Architect reserves the right to reject any and all work not in accordance with the review Shop Drawings.

I. Provide in accordance with referenced standards. Do not mix piping material and hanger material of dissimilar metals. All beam clamps shall be fitted with steel retainer straps. Hanger rods of less than 3/8-inch diameter are not permitted. All

horizontal piping shall be supported by means of UL approved clevis type hangers with proper size suspension rods and locknuts, spaced as required.

J. All bracket, clamp and rod sizes indicated in this specification are minimum sizes only. All structural hanging materials shall have a built-in safety factor of 5.

K. Provide rolled-steel auxiliary pipe supports as required.

L. Hanger rods are to be cadmium plated or galvanized.

M. Anchor points shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions from the anchored points.

N. Guide points shall be located and constructed wherever required or shown on drawings and at each side of an expansion joint or loop, to permit free axial movement only in a piping system.

O. All hangers shall be U.L. listed and FM approved.

P. Pipe Hanger Schedule:

	Carpenter & Patterson	**Grinnell**	**I. R. Rauch's & Sons**
C-Clamp with Retaining Clip and locknut(pipe sizes 2" & smaller	47 with 22	86 with 89	47 with 22
Beam Clamp	293	228	82
Multi-J Hook	---	---	228
J Hook	---	---	221
Clevis Hanger	100	260	100
Clevis Hanger w/Saddle	100SH	---	100SH
180° Shield	265P	168	265P
Single Rod Roll Hanger	140	181	140
Double Rod Roll Hanger	142	171	142
Trapeze	---	46	1600-1700
U-bolt Adjustable Pipe	283	137C	283
Stanchion Saddle	247	259	247
Welded Steel Bracket	84 or 139	199 or 195	84 or 139
Riser clamp	126	261	126
Welded Beam Attachment	113A	66	---

	Carpenter & Patterson	**Grinnell**	**I. R. Rauch's & Sons**
Welded Beam Attachment w/bold & nut	113B	66	113A
Concrete Insert	108	282	180 or 181
Phillips Inserts	513	Phillips Insert	1000

Q. Hanger Rod Schedule:

Pipe Size	**Rod Diameter**
4" and smaller	3/8"
5”, 6”, & 8”	1/2"
10” & above	5/8"

2.03 FOUNDATIONS

A. All equipment, piping, etc., shall be mounted on approved foundations, all as specified herein, or as shown on the drawings.

B. All floor-mounted equipment shall be erected on 12" high concrete pads, provided under a separate section of the specifications, over the complete floor area of the equipment, unless specified to the contrary herein. Hereinafter, wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall in turn be mounted upon aforementioned pads unless specified to the contrary herein.

C. All floor-mounted equipment shall be erected on 12" high concrete pads, over the complete floor area of the equipment, unless specified to the contrary herein. Hereinafter, wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall in turn be mounted upon aforementioned pads unless specified to the contrary herein.

D. All concrete foundations and supports (and required reinforcing thereof) will be furnished and installed under this Section of the Specification. Furnish templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of equipment. Submit shop drawings showing the complete details of all foundation bases including necessary concrete and steel work, vibration isolation devices, etc.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All piping shall be supported only from building structural steel or galvanized steel inserts imbedded in poured concrete. Where piping revisions are required after slabs are poured, pipes 3" and smaller may be supported at intermediate points by "Phillips" or other 3/4" expansion bolts and shields, provided main supports are not less than 20 feet on centers. All inserts, expansion bolts and shields in post-tensioned concrete slabs shall be submitted to Structural Engineer for approval prior to commencement of work. Intermediate supports for piping 4" and larger shall be attached to concrete beams or columns by means of 4" x 4" x 3/8" (horizontal) and supporting rod at 90° from anchor bolt. It is the intent that inserts are only permitted in poured concrete construction.

B. Hanger Locations for Horizontal Piping

1. Steel Piping 1¼" and Smaller: Every 12 feet.
2. Steel Piping (Schedule 40 and larger) 1½" and Larger: Every 15 feet.
3. Steel piping (less than schedule 40) 11/2” and larger: Every 12 feet.

C. Support Locations for Vertical Piping

1. Threaded & Mechanical Joint Piping: At every floor, but in no case greater than 20-foot intervals.

D. All beam attachments shall be installed on clean, smooth, and non-fireproofed sections of the beam.

E. All fire protection piping shall be hung individually from the structure.

F. All hangers, anchors, rods and supports shall be painted. Refer to Section 21 05 95.

G. Submit pipe hanger, insert and support details for concrete floor construction to the Project Representative for review and approval. Piping shall be hung from structural slab by means of UL Listed or FM Approved or concrete inserts set in place before concrete is poured. Drilled type concrete inserts may be provided as approved by structural engineer. Power driven studs shall not be accepted unless accepted by the Project

H. Provide concrete bases for floor mounted fire pump, jockey pump, floor set pump controllers, pre-action, dry pipe or deluge valve cabinets.

I. Set concrete base height dimensions of sufficient height to assure current carrying parts of controllers and motors are not be less than 12 inches above finished floor level, to accommodate piping connections to pumps without offsets or stresses at pipe connections, and not less than 4 inches high.

J. Determine size of concrete base dimensions from equipment manufacturer dimension Drawings and supply dimensions to concrete pad installer in ample time for installation.

K. Chamfer edges, trowel finish, make level, and securely bond to floor by roughening slab and coating with cement grout, doweling or bolting as required for permanent bond to floor.

L. Set anchor bolts in sleeves before pouring.

M. Fill equipment bases with grout, after fire pump alignment procedures have been successfully performed.

END OF SECTION

SECTION 21 05 48
VIBRATION AND SEISMIC CONTROLS FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Provide engineered seismic restraint systems for suspended Fire Protection piping equipment compliant with the currently adopted version of the International Building Code (IBC) with local building code amendments and NFPA-13.
2. At seismic restraint installations, provide vertical support systems engineered to accommodate dead load plus seismic force restrictions.

1.02 RELATED DOCUMENTS

A. Section 21 10 00 – Piping and Fitting Materials for Water Based Fire Protection Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

1. Standard 13: Installation of Sprinkler Systems
2. Standard 14: Installation of Standpipe and Hose Systems
3. Standard 20: Installation of Stationary Pumps for Fire Protection

H. Owners Insurance Underwriters

1.04 QUALITY ASSURANCE

A. Publications, codes and standards listed below form a part of this specification to the extent referenced.

B. Applications, Design and Inspection Manual – Engineered Seismic Bracing of Suspended Utilities, 2006 International Building Code Edition.

C. International Seismic Application Technology (ISAT) - Vol. 2 – HVAC Duct, Mechanical Piping, Plumbing, Process Piping and Equipment

D. International Building Code (IBC):

1. Chapter 16 – Structural Design.
2. Chapter 17 – Structural Tests and Special Inspections

E. ASCE 7-05, Chapter 13, Minimum Design Loads for Buildings and Other Structures, American Society of Civil Engineers (ASCE).

F. ACI 318, Building Code Requirements for Structural Concrete, American Concrete Institute (ACI).

1.05 WORK INCLUDED

A. Provide engineered seismic restraint systems for suspended Fire Protection piping equipment compliant with the currently adopted version of the International Building Code (IBC) with local building code amendments and NFPA-13.

B. At seismic restraint installations, provide vertical support systems engineered to accommodate dead load plus seismic force restrictions.

1.06 SUBMITTALS

A. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, due to seismic forces required to select seismic restraints.
3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.

B. Contractor to convey to ISAT each overhead deck condition to which seismic attachments will be made. Information to include type and density of concrete, concrete thickness, size and gage of metal deck and any point load limitations or restrictions.

C. Submit seismic restraint layouts stamped by a registered design professional licensed to practice in the State where project is located. Seismic restraint layouts to show:

1. All vertical support and seismic brace locations.
2. All anchorage connections to structure. Anchor brand, type, quantity and size.

3. Vertical support and brace reaction point load at all connections to structure. For review by engineer of record in checking suitability of the building structure to accommodate imposed loads.
4. Plan set sheets showing appropriate installation details reflecting actual job site conditions.

D. Include cover sheet with Seismic Restraint Bracing Legend delineating:

1. Maximum Allowable Size or Utility Weight (Lbs/Lf).
2. Minimum Vertical Support Rod Diameter.
3. Support Rod Total Vertical Load.
4. Maximum Allowable Transverse Brace Spacing.
5. Transverse Brace Reaction
6. Maximum Allowable Longitudinal Brace Spacing.
7. Longitudinal Brace Reaction
8. Minimum Required Seismic Restraint Brace Arm Assembly.
9. Minimum Required Seismic Restraint Anchorage to Overhead Structure.
10. Installation Detail Drawing References.

1.07 COMPONENT IMPORTANCE FACTOR

A. In order to identify systems requiring seismic restraint and to define those from which restraints may be excluded, utility components are assigned an ASCE 7 Importance Factor (Ip) on the basis of the following:

Ip = 1.5 Fire Protection component which is required to function after a seismic event including fire protection sprinkler systems

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: C.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.

a. Component Importance Factor: 1.5.
b. Component Response Modification Factor: 1.5.
c. Component Amplification Factor: 1.0.

B. Design Spectral Response Acceleration at Short Periods (0.2 Second):.

C. Design Spectral Response Acceleration at 1.0-Second Period:

D. Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES].

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they are subjected.

2.02 ACCEPTABLE MANUFACTURERS

A. Seismic restraint hardware and engineering by International Seismic Application Technology (ISAT) or approved equal.

B. Vertical support and seismic restraint anchorages to utilize ISAT Blue Banger Hanger Cast-In Place Dec Inserts unless noted otherwise. Post installed anchors are an acceptable alternate provided the anchors are those pre-engineered within the ISAT Applications, Design and Inspection Manual.

C. Vertical support and seismic restraint connections to structural steel are to utilize ISAT BC-4 Beam Clamp connections unless noted otherwise. Welded or bolted connections are an acceptable alternate provided the details employed are those pre-engineered within the ISAT Applications, Design and Inspection Manual.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Vertical support and seismic restraint anchorages to be per the ISAT Applications, Design and Inspection Manual.

B. For conditions not covered within the ISAT Applications, Design and Inspection Manual, the required engineering is to be performed by ISAT.

C. ISAT shall provide field installation training prior to commencement of install.

D. Field relocation of any seismic installation points away from that shown on the ISAT furnished shop drawing layouts shall be coordinated with ISAT Technical Service.

E. Consult ISAT Technical Service when field conditions prohibit compliance with the supplied installation details.

F. In order to satisfy ASCE 7 minimum yield strength requirements, the allowable brace spacing for non-ductile systems (eg. Plastic) shall be no more than half that for ductile systems).

G. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
3. Brace a change of direction longer than 12 feet.

3.02 EQUIPMENT CONNECTIONS

A. Where seismic bracing is allowed to be omitted due to size or proximity to overhead deck, all terminations to fixed equipment, panels, etc. or to other portions of the system requiring seismic restraint are to utilize flexible connectors.

B. Where seismic bracing is allowed by code to be omitted due to size or proximity to overhead deck, the inspector of record, or others, shall be responsible for assuring that damaging impact or vertical support failure cannot occur.

Assessment as to conformance with this requirement is outside ISAT's scope of responsibility.

3.03 SPECIAL INSPECTION

A. Special Inspection Requirements

All Designated Seismic Systems are subject to Special Inspection per IBC Chapter 17. ISAT will provide a special inspection plan to the contractor for submittal to the owner and design team for use by the project's special inspectors. The plan will include the following:

1. A list of all components of the seismic system that require inspection of testing.
2. The required frequency of testing and inspection.
3. Type and nature of testing required.

B. Special inspection for mechanical and electrical components shall be provided as follows:

1. For all Designated Seismic Systems within seismic design categories D, E or F.
2. Periodic special inspections during the anchorage of electrical equipment for emergency or standby power systems in structures assigned to Seismic Design Categories E or F.
3. Periodic special inspection during the installation of anchorages of all other electrical equipment in Seismic Design Categories E or F.
4. Periodic special inspection during the installation for flammable, combustible or highly toxic piping systems and their associated mechanical units in Seismic Design Categories C, D, E or F.
5. Periodic special inspection during the installation of vibration isolation systems where the construction documents indicate a maximum clearance (air gap) between the equipment support frame and restraint less than or equal to ¼ inch.

C. Install identification tags at all seismic brace locations. Tags to include the following information:

1. Specific seismic forces (g-force) the location was designed to resist.
2. Maximum brace reaction at connection to structure.
3. For single hung items, the maximum pipe/conduit size the brace location was designed to accommodate.
4. For trapeze supported items, the maximum weight (lbs/lf) the brace location was designed to accommodate.
5. For suspended equipment, the maximum unit operating weight (lbs) the brace location was designed to accommodate.
6. Location identifier cross matched to that on plain set layout.

D. Upon completion of construction a Quality Assurance Representative of ISAT shall review the installation of the seismic-force-resisting system and provide documentation indicating general conformance to seismic restraint layout drawing.

END OF SECTION

SECTION 21 05 53
IDENTIFICATION FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Equipment identification
2. Piping identification
3. Signage

1.02 RELATED DOCUMENTS

A. Section 21 05 01 – Fire Protection General Provisions

B. Section 21 05 80 – Access Doors in General Construction

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. NFPA – National Fire Protection Association

B. FM – Factory Mutual

C. UL – Underwriters Laboratories Inc.

D. New York Building Code

E. New York Fire Code

F. International Building Code

G. International Fire Code

H. ASME – American Society of Mechanical Engineers

1. ASME A13.1 – Scheme for the Identification of Piping Systems

I. ASTM – American Society for Testing and Materials

1. ASTM D709 – Standard Specification for Laminated Thermosetting Materials

J. APWA – American Public Works Association

1. Recommended Guidelines for Underground Utilities

1.04 QUALITY ASSURANCE

A. Above ground piping identification shall comply with NFPA requirements.

B. Underground piping identification shall comply with APWA Recommended Guidelines for Underground Utilities.

1.05 SUBMITTALS

A. Submit the following:

1. Valve identification chart
2. Lists of pipe and equipment to be labeled
3. Color chart

B. Product Data: Manufacturer's latest published data for materials, equipment and installation, including samples of valve tags, equipment identification and piping identification.

C. Maintenance Manuals: Provide valve tag schedules for inclusion in maintenance manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Identification & Sinage: Seton; Stranco; Kolbi

2.02 VALVE IDENTIFICATION

A. All tagged components shall be in accordance with NFPA.

B. Tag valves with identifying number and system. Number valves by floor level.

C. For valves, etc., use metal (brass, stainless steel or aluminum) tags, 3" minimum in diameter, with 1½" white painted letters with a red background. Attach tags with chain of same material.

D. Prepare lists of all tagged valves showing location, floor level, tag number and use. Prepare separate lists for each system. Mount lists under a sheet of clear acrylic in Equipment Room. Include copies in each maintenance manual.

2.03 PIPE IDENTIFICATION

A. All piping shall be identified by stenciled lettering, or self adhesive pipe markers which legend conforms to OSHA/ANSI standards including but not limited to the identification of flow direction, pressure, supply/return, pump discharge, sprinkler, fire standpipe, dry sprinkler, etc.

B. There shall be at least one lettering identification for each pipe in each space and at all valve locations.

C. For painted identification use color sharply contrasting with background. If necessary, paint a strip background of black or white to obtain contrast.

D. Vertical piping shall be labeled at each floor. Horizontal piping shall be labeled every 10', both sides of partitions, before and after turns, and close to valves and flanges.

E. Pipe markers shall have 1.25-inch high letters and integral directional flow arrows. Smaller letters may be used only when space does not permit 1.25-inch high lettering.

F. For piping up to 5-inch diameter, use pre-formed snap-on markers.

G. For piping 6-inch diameter and up, use pre-formed strap-on markers with nylon straps.

H. Material: Semi-rigid colored vinyl; 15 gauge up to 1-inch pipe, 30 gauge for all other pipe sizes.

I. Seton “Setmark” or equal.

J. Pressure-sensitive tapes are unacceptable.

K. Exterior Underground Pipe Markers:

1. Material shall be detectable tape, nominal 5-mil thick, minimum 3 inches wide with aluminum backing.
2. Tape color, size and depth to be in accordance with APWA standards with black lettering and appropriate warning message.

2.04 EQUIPMENT IDENTIFICATION

A. Fire Protection equipment shall be identified by means of nameplates permanently screw-fastened to the equipment. Nameplates shall be black surface, white core laminated bakelite with engraved letters. Plates shall be a minimum of 3-inch long by 1-inch wide with white letters ⅜-inch high.

2.05 SIGNAGE

A. Provide engraving stock melamine plastic laminate, complying with ASTM D709, in sizes and thicknesses indicated, engraved with engraver’s standard letter style of sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: $^{1}/_{16}$-inch for signs up to 20 square inches or 8-inch length; ⅛-inch for larger signs.
2. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

2.06 PAINTING

A. Exposed black steel piping, pipe covering, equipment and support piping and enclosures shall be given two coats of paint.

B. All pipe hangers, anchors and supports shall be given a zinc chromate primer before installation.

C. All sprinkler and standpipe piping is to be painted red up to sprinkler control vale assemblies or sprinkler alarm check valves.

END OF SECTION

SECTION 21 05 80
ACCESS DOORS IN GENERAL CONSTRUCTION FOR FIRE PROTECTION

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Furnishing access doors for installation in general construction and color-coded identification dots.

1.02 RELATED DOCUMENTS

A. Section 21 05 01 – Fire Protection General Provisions

B. Section 21 05 53 – Systems Identification for Fire Protection

1.03 REFERENCE STANDARDS

A. ASME – American Society of Mechanical Engineers

1. ASME A13.1: Scheme for the Identification of Piping Systems

B. ASTM – American Society for Testing and Materials

1. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
2. ASTM A1008: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy

C. NAAMM – National Association of Architectural Metal Manufacturers

1. AMP 500-06 – Metal Finishes Manual for Architectural and Metal Products

D. UL – Underwriters Laboratories Inc.

1. UL Fire Resistance – Fire Resistance Directory set

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain doors for the entire project from a single manufacturer.

B. Fire-Resistive Rating: Wherever access doors are required in construction where a fire-resistive classification is indicated, on the Architectural documents, provide access door assembly with panel door, frame, hinge and latch from manufacturer listed in Underwriters Laboratories Inc.'s "Building Materials Directory" for required rating.

1. Provide UL Label on each fire-rated access door.

C. Furnish inserts and anchoring devices that must be built into other work for installation of access doors.

1.05 SUBMITTALS

A. Shop Drawings: Submit access door locations superimposed on the fire protection piping layout shop drawings. Submit manufacturer's data on access doors including size and type.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Access Doors: Milcor Inc., Karp Associates, Inc., J.L. Industries, Acudor, Williams Brothers

B. Color-Coded Identification Buttons: Brady/Seton, Stranco

2.02 ACCESS DOOR CONSTRUCTION

A. Provide recessed type as required to accept matching ceiling tile or drywall, etc.

B. Provide UL-rated doors for fire-rated construction.

C. Provide flush type steel framed panel with concealed continuous piano hinges for masonry or concrete construction. Provide textured frame for drywall construction.

D. Provide cam type locking device. Provide cylinder lock type access doors located in public corridors and washrooms complete with master keys.

E. Provide insulated doors in insulated or acoustically rated construction.

F. Furnish access doors of proper size for access to concealed equipment. Unless otherwise indicated, minimum size to be 12-inch by 12-inch for hand access and minimum 18-inch by 18-inch for valve and actuator access and 24-inch by 24-inch for equipment access. The following schedule is based on Karp Associates Inc.:

1. Rated Construction: Fire-rated access door UL "B" Label Model KRP
2. Non-Rated Dry Wall Construction: Model KDW
3. Non-Rated Masonry, Concrete: Model DSC 214-M
4. Non-Rated Ceramic Tile, Stainless Steel, Satin Finish: Model DSC 214-M
5. Non-Rated Plaster Wall: Model DSC 214-PL
6. Non-Rated Plaster Ceilings: Model DSC 210-PL

G. Provide color-coded dots on access doors and accessible ceiling tiles to indicate type of service.

PART 3 – EXECUTION

3.01 GENERAL

A. Coordinate location of access doors in hung ceilings, furred spaces, walls, etc., to provide access to concealed work items requiring maintenance and/or adjustment. Obtain approval of the Architect for the locations of such access doors.

B. Locate and group equipment requiring access doors. Coordinate location of equipment with other trades to minimize number of access doors in one area.

C. Provide access doors for maintenance or adjustment purposes for fire protection system components, including but not limited to the following:

1. Valves
2. Flow switches
3. Concealed equipment

D. Access doors shall be marked by small color markings at corner of tile or door in accordance with the following color assignments:

1. Fire Protection - Red

END OF SECTION

SECTION 21 08 00
COMMISSIONING OF FIRE SUPPRESSION

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Work under this Contract shall conform to the requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers commissioning of the complete Fire Protection Systems for the project.
2. Furnish labor and material to accomplish the complete commissioning of the Fire Protection Systems as specified herein.
3. Start-up and testing of the Fire Protection System equipment.
4. Testing and adjusting piping and central systems.
5. Cooperation with the Commissioning Authority.
6. Providing qualified personnel for participation in commissioning tests.
7. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
8. Providing Operation and Maintenance Manuals, and as-built drawings to the Commissioning Authority for verification.
9. Providing training and demonstrations for the Fire Protection Systems.

B. Commissioning work shall be a team effort to ensure that all fire protection equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance parameters for fine-tuning of control sequences and operational procedures. Commissioning shall coordinate system documentation, equipment start-up, control system calibration, testing, and verification and performance testing.

C. The commissioning team shall be made up of representatives from the Owner, design professionals, major equipment suppliers, and construction trades. The trades represented on the commissioning team shall include, but not be limited to, piping and fitting, Building Management System (BMS) (Division 23), fire pump manufacturer, fire protection and electrical. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the commissioning team. Responsibility for various steps of the commissioning process shall be divided among the members of the commissioning team, as described in this Section.

D. The Commissioning Authority, retained by the Owner, shall have responsibility for coordinating and directing each step of the commissioning process.

E. Fire protection system installation, start up, testing, preparation of O&M manuals, and operator training are the responsibility of the Division 21 Fire Protection Contractors, with coordination, observation, verification and commissioning the responsibility of the Commissioning Authority. The commissioning process does not relieve Division 21 (Fire Protection) from the obligations to complete all portions of the work in a satisfactory and fully operational manner.

F. Definitions

1. Commissioning: The process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained to perform in conformity with the design intent. For this project, the commissioning includes construction, start up, acceptance, and training.
2. Commissioning Authority: The designated person, company, or agent, retained by the Owner, who implements the overall commissioning process.
3. Commissioning Plan: A document defining the commissioning process, which is developed by the Commissioning Authority.
4. Commissioning Report: The document that records the results of the commissioning process, including the as-built performance of the fire protection system and unresolved issues, and documents all sign-offs.
5. Commissioning Specification: The Contract Document that details the objective, scope, and implementation of the construction and acceptance phases of the commissioning process as developed in the design-phase Commissioning Plan.
6. Commissioning Team: Those people responsible for working together in carrying out the commissioning process.
7. Design Intent: A detailed explanation of the ideas, concepts, and criteria that are defined by the Owner to be important. This typically is an expansion of the information provided in the Owner's Program.
8. Design Intent Document: A detailed written document, evolving throughout the commissioning process, clearly defining items and criteria of the design intent.
9. Functional Performance Testing (FPT): The process of determining the ability of the fire protection system to deliver services in accordance with the final design intent.
10. Construction Documents: Design plans and specifications. Also referred to as Contract Documents.
11. Design Professional: The Owner's Architectural, Engineering and Other Consultants who prepared the Construction Documents.
12. TAB: Testing and Adjusting work.
13. Verification: That full range of checks and tests carried out to determine if all components, systems, sub-systems, and interfaces between systems operate in accordance with the Contract Documents. In this context, "operate" includes all modes and sequences of control operation, interlocks and conditional control responses, and specified responses to abnormal conditions.

G. Purpose: The commissioning is a process and its purpose is to:

1. Clearly document the design intent.
2. Verify that the systems installation and performance is in accordance with the plans, specifications and design intent.
3. Train the Owner's operators so that they fully understand the design intent and the operation and maintenance requirements of the equipment.

H. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems, and sub-systems. The following equipment and systems shall be evaluated:

1. Fire standpipe systems
2. Fire pumps
3. Pump controllers
4. Starters furnished by Division 21 (Fire Protection)
5. Coordination with the BMS (Division 23)

I. Timely and accurate documentation is essential for the commissioning process to be effective. Documentation required as part of the commissioning process shall include but not be limited to:

1. Progress and status reports, including deficiencies noted
2. Minutes from all meetings
3. Pre-start, and start-up procedures
4. Training agenda and materials
5. As-built records
6. Commissioning report
7. Operational and Maintenance (O&M) manuals

J. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to the Contract Documents. All tests shall be witnessed by the Commissioning Authority. The following testing is required as part of the commissioning process:

1. Verification tests are comprised of a full range of checks and tests to determine that all components, equipment, systems, and interfaces between systems operate in accordance with the Contract Documents. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.
2. Functional performance testing shall determine if the fire protection system is providing the required services in accordance with the finalized design intent.

K. Comprehensive training of O&M personnel shall be performed by the Fire Protection Contractor, and where appropriate by other sub-contractors, and vendors prior to turnover of building to the Owner. The training shall include classroom instruction, along with hands-on instruction on the installed equipment and systems. All training sessions shall be videotaped or recorded on alternative audiovisual media.

1.02 RELATED DOCUMENTS

A. Division 1 Specifications

B. Section 21 05 01 – Fire Protection General Provisions

C. Section 21 05 48 – Vibration Isolation and Seismic Restraints for Fire Protection

D. Section 21 05 50 – Access Doors in General Construction for Fire Protection

E. Section 21 05 53 – Systems Identification for Fire Protection

F. Section 21 13 19 – Fire Protection Systems

G. Division 22 – Plumbing Specifications

H. Division 23 – Mechanical Specifications

I. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

The following references are a guideline to the commissioning process and shall be applied as appropriate:

A. AABC – Associated Air Balance Council

1. ACG Commissioning Guideline– For Building Owners, Design Professionals and Commissioning Service Providers

B. ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE Guideline 1.1: HVAC&R Technical Requirements for the Commissioning Process
2. ASHRAE Guideline 4: Preparation of Operating and Maintenance Documentation for Building Systems
3. The 2007 ASHRAE Handbook – HVAC Applications

1.04 QUALITY ASSURANCE

Commissioning Authority shall meet the following qualifications:

A. Commissioning Authority shall have a minimum of five (5) years of demonstrated experience in the commissioning of Fire Protection Systems similar in size and complexity to this project.

B. Commissioning Authority shall hold a Certified Commissioning Professional (CCP) designation from the Building Commissioning Association.

1.05 SUBMITTALS

A. As-built records

B. Pre-test and Final Test Report Forms (forms format only) for each system and piece of equipment

C. Pre-test and Final Test Report Forms for each system and piece of equipment

D. Verification and functional performance testing procedures

E. Test and Balance report and verification datasheets

F. Commissioning Report

G. Operational and Maintenance (O&M) manuals

1.06 ROLES AND RESPONSIBILITIES

A. Contracting Officer is the Building Owner.

1. Contracting Officer will advise Commissioning Authority regarding changes in building occupancy and/or usage.
2. Assign maintenance personnel and schedule them to participate in meetings, training session as follows:

   a. Construction-Phase coordination meeting
   b. Initial Owner training session at initial placement of major equipment
   c. Maintenance orientation and inspection
   d. Piping test and flushing verification meetings
   e. Procedures meeting for Testing and Adjusting
   f. Owner's training session
   g. Verification demonstrations
   h. Final review at acceptance meeting

3. Provide qualified personnel for video taping and editing of training sessions.
4. Video tape construction process, hidden shafts, etc.
5. Provide any utilities required for the commissioning process.
6. Provide detailed program clearly stating the Owner's objectives, parameters, budgets, etc. for this facility.

B. Commissioning Authority

1. Develop the commissioning requirements and all related testing, verification and quality control sections.
2. Prepare the commissioning program required as part of the Commissioning Specification. Include lists of all contractors for commissioning events by name, firm, and trade specialty.
3. Develop detailed pre-test and final test reports forms, to be used by the Commissioning Authority for data recording purposes throughout the testing process. The Commissioning Authority shall specifically develop these forms for each system and piece of equipment installed on the project. All forms to be submitted for approval a minimum of one hundred and twenty (120) days prior to initial testing.
4. Execute the commissioning program, through organization of all tests, meetings, demonstrations, training events and performance verifications described in the Contract Documents and the approved commissioning program. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning event. The Commissioning Authority shall act as chairman at all commissioning events and assure the execution of all agenda items. The Commissioning Authority shall prepare minutes of every commissioning event and send copies to all those in attendance and the Owner within five (5) workdays of the event.
5. Review the Construction Documents which define the scope of the commissioning process and the final performance of the system. This includes verification that appropriate commissioning guidelines have been followed, and to document the performance of each piece of equipment and each system.

6. Review all approved submittals for coordination with the commissioning process and the performance testing of the Fire Protection Systems.
7. Schedule regular Construction-Phase coordination meetings to include Owner and Contractor and Design Professional. These meetings shall be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for fire protection system orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, test and adjust (TAB) work and verification and functional performance testing.
8. Schedule Owner training sessions so that they will be held at an appropriate timeframe relative to the turnover of the systems to the Owner. These sessions shall be attended by the Owner's O&M personnel, the Contractor, the Design Professional, and the Commissioning Authority. The Design Professional shall conduct this session giving an overview of the system, the system design goals and the reasoning behind the selection of the equipment.
9. Conduct and record the results of periodic inspections, undertaken by the Commissioning Authority, of work in progress to ensure that all systems are installed according to specifications. The Commissioning Authority shall note in writing any deficiencies discovered. Once the deficiencies have been corrected, as reported by the Contractor, the Commissioning Authority shall re-inspect the work and report that the corrections have been made.
10. Assist the Contractor in recommending solutions to minor deficiencies.
11. Conduct the system orientation and inspection following the initial training session. Any subsequent system orientation and inspection shall be conducted by the Contractor. The emphasis of this system orientation and inspection shall be an observation of the equipment location with respect to accessibility. Prepare minutes of this meeting, with separate summary of deficiency findings by the Owner and Commissioning Authority. Distribute to attendees and the Owner.
12. Adequate accessibility for maintenance and component replacement or repair is the Contractor's responsibility and shall be checked by the Commissioning Authority.
13. Receive and review the Operation and Maintenance (O&M) manuals as submitted by the Contractor (ensuring that they follow the specified outline and format), and as reviewed and approved by the Design Professional. Insert systems description as provided by the Design Professional.
14. Witness equipment and system start-up and testing. Ensure the results are documented (including a summary of deficiencies), and incorporated in the O&M manuals. The Commissioning Authority shall record all test results on pre-test and final test forms for each piece of equipment.
15. Prior to initiating the TAB work, meet with the Owner, Contractor, Design Professional, and TAB Contractor. The TAB Contractor shall outline TAB procedures and get concurrence from the Design Professional and Commissioning Authority. Ensure that the TAB Contractor has all forms required for the job database and understands their importance and use.
16. Schedule the O&M training sessions. All training sessions shall be on-site, except where otherwise specified. These training sessions are to be attended by the Owner, Commissioning Authority, Design Professional, Contractors and equipment suppliers as necessary. The format shall follow the outline in the O&M manuals. This system orientation and inspection should include hands-on training. The

Commissioning Authority shall be solely responsible for recording all demonstration and training sessions on videotape, or alternative approved media, and furnish two (2) copies of the recording media to the Owner. Each session shall clearly reflect the content of each training session. Video tapes or other approved media and enclosures shall be neatly labeled.

17. Submit detailed verification test procedures and datasheets to the Design Professional for review.
18. Submit detailed FPT procedures to the Design Professional for review and acceptance.
19. Upon receipt of notification from the Design Professional that the systems have been completed and are operational, the Commissioning Authority shall proceed to verify the TAB report and operation of the control systems in accordance with the Commissioning Specification.
20. Conduct verification tests.
21. Record verification test data, and submit to the Design Professional for review and acceptance.
22. Provide detailed checklists datasheets to document verification tests.
23. Provide and install calibrated test instrumentation to monitor and record data as necessary.
24. Certify that the systems are ready for functional performance testing.
25. Observe and record functional performance tests.
26. Submit Functional Performance Test report to the Design Professional for review.
27. Re-test if performance deficiencies are found, corrected and additional testing is requested.
28. Review as-built drawings for accuracy with respect to installed systems. Review revisions to achieve accuracy.
29. Ensure that the O&M manuals and all other as-built records have been updated to include all modifications made during the Construction Phase.
30. Observe and record repeated functional performance tests to accommodate seasonal tests and/or correct any performance deficiencies. Revise and re-submit the commissioning report.
31. Prepare the final commissioning report.
32. Assemble the final project documentation, which shall include the commissioning report and all as-built records. Submit this documentation to the Design Professional for review and acceptance.
33. The Commissioning Authority shall verify that all O&M manuals, “as-built” documentation, and training manuals and training sessions are complete in every aspect and in accordance with the project specifications. The Commissioning Authority shall supplement the above documentation, as required, to make them complete.

C. Architect

1. Provide support to the Design Professional who must provide a service as a part of the commissioning process. This shall include providing adequate space for equipment installation and maintenance.
2. Conduct periodic inspections of work in progress to ensure that all systems and equipment are installed according to specifications.
3. Provide data on structure, building materials, interior finishes, and furnishings for their effect on fire protection systems.

D. Fire Protection Design Professional

1. Provide documentation of initial design concepts and Design Intent on the Owner's program.
2. Provide system design parameters and obtain approval of Owner.
3. Prepare Construction Documents incorporating the Commissioning Specification requirements and description of the system.
4. The Design Professional retains responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design.
5. Participate in O&M personnel orientation and inspection at the final construction stage.
6. Attend initial meeting with TAB representative as scheduled by the Commissioning Authority.
7. Review verification and functional performance testing procedures submitted by the Commissioning Authority, for conformance with the Construction Documents.
8. Review TAB report and verification datasheets for system conformance to the Contract Documents. Issue to the Commissioning Authority a report noting deficiencies requiring correction.
9. Review Functional Performance Testing report for deficiencies in meeting the finalized design intent.
10. Review as-built records as required by the Contract Documents and turn them over to the Commissioning Authority for inclusion in final project documentation.
11. Review and comment on the final commissioning report.

E. Electrical Design Professional

1. Provide documentation for electrical services to be provided for specific fire protection equipment requirements.
2. Provide electrical system information confirming compatibility with electrical service requirements specified by the fire protection design professional for all fire protection equipment and systems. Provide information necessary for the basis of design.
3. Prepare the Contract Documents that coordinate interfaces between life safety systems, BMS, and fire protection systems including commissioning specifications.
4. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority.
5. Participate in the start-up of fire protection equipment and systems.
6. Participate in the fire protection training sessions as required.
7. Participate in review of shop drawings for fire protection equipment.
8. Prepare electrical ladder wiring diagrams indicating power source connections to fire protection equipment and systems and interrelationships between life safety systems and fire protection systems and equipment, including a review of the automatic control and/or Building Management System.
9. Prepare as-built electrical service record drawings as required by the Contract Documents.
10. Verify that any space requirements for electrical equipment are in accordance with relevant code requirements.
11. Participate in O&M personnel orientation and inspection sessions.

F. General Contractor

1. Include cost for commissioning requirements in the contract price.
2. Coordinate construction progress with the commissioning schedule to assure that the building envelope and systems that affect proper operation and control of fire protection equipment and systems being tested are completed prior to testing.
3. Include commissioning requirements in the Fire Protection, Electrical, and Division 23 (BMS) controls contracts, as well as all other sub-contractors, to ensure cooperation of all parties in the fire protection commissioning program.
4. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the fire protection commissioning program as described in the Contract Documents.
5. Issue a statement that TAB work has been completed, and submit the final TAB reports for review.
6. Issue a statement that fire suppression system controls have been tested and calibrated.
7. Remedy deficiencies identified in verification tests.
8. Evaluate any performance deficiencies identified in the Functional Performance Testing report for non-performance with the Contract Documents.
9. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.

G. Fire Protection Contractor

1. Include cost of commissioning requirements in the contract price.
2. Include requirements for submittal data, O&M data, and training in each purchase order or sub-contract written.
3. Ensure cooperation and participation of specialty sub-contractors such as testing and adjusting (TAB).
4. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
5. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority.
6. Assist the Commissioning Authority in all verification and functional performance tests.
7. Prepare preliminary schedule for fire protection system orientations and inspections, O&M manual submissions, training sessions, pipe system testing, flushing and cleaning, equipment start-up, TAB and task completion for use by the Commissioning Authority. Update schedule as appropriate throughout the construction period.
8. Attend initial training session.
9. Conduct fire protection system orientation and inspection at the equipment placement completion stage.
10. Update drawings to the record condition to date, and review with the Commissioning Authority.
11. Gather O&M data on all equipment, and assemble in binders as required by the Commissioning Specification and Section 21 05 01 – Fire Protection General Provisions. Submit to Commissioning Authority prior to the completion of construction.
12. Coordinate with the Commissioning Authority to provide sufficient advanced notice so that the witnessing of equipment and system start-up and testing can begin.

13. Notify the Commissioning Authority a minimum of two weeks in advance of the time for start of the TAB work. Attend the initial TAB meeting for review of the official TAB procedures.
14. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the Commissioning Authority.
15. Provide written notification to the General Contractor and Commissioning Authority that the following work has been completed in accordance with the Contract Documents, and that the equipment, systems, and sub-system(s) are operating as required:

    a. Fire protection equipment including all pumps, alarm devices, and all other equipment furnished under this Division.
    b. Fire standpipe system and equipment, sprinkler systems and equipment.
    c. Fire stopping in the fire-rated construction, including caulking, gasketing and sealing of smoke barriers.

16. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.
17. Provide a complete set of as-built records to the Commissioning Authority.

H. Test, and Adjust (TAB) Contractor

1. Include cost for commissioning requirements in the contract price.
2. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
3. Submit the TAB procedures to the Commissioning Authority and Design Professional for review and acceptance.
4. Attend the TAB review meeting scheduled by the Commissioning Authority. Be prepared to discuss the procedures that shall be followed in testing and adjusting the fire protection system.
5. Participate in training sessions as scheduled by the Commissioning Authority.
6. At the completion of the TAB work, and the submittal of the final TAB report, notify the Fire Protection Contractor and the General Contractor.
7. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB where required by the Commissioning Authority for verification or diagnostic purposes.
8. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.

I. Equipment Suppliers and Miscellaneous Contractors

1. Include cost for commissioning requirements in the contract price.
2. Provide submittals, and appropriate O&M manual section(s).
3. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
4. Participate in training sessions as scheduled by the Commissioning Authority.
5. Demonstrate performance of equipment as applicable.

J. Electrical Contractor

1. Include costs for commissioning requirements in the contract price.
2. Ensure participation in testing of fire pumps and miscellaneous fire protection equipment.
3. Ensure coordination, installation, and operation interfaces between life safety and fire protection systems.

1.07 DOCUMENTATION

The Commissioning Authority shall oversee and maintain the development of commissioning documentation. The commissioning documentation shall be kept in three-ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The commissioning documentation shall include, but not be limited to, the following:

A. Approved TAB report for the systems being commissioned.

B. All accepted shop drawings and hydraulic calculations of fire protection equipment. Shop drawings shall be full size sheets folded as required to fit in binders.

C. All pre-functional performance test checklists, signed by indicating personnel, organized by system and sub-system.

D. All verification and functional performance test checklists/results, signed by indicated personnel, organized by system and sub-system.

E. Three copies of the operation and maintenance (O&M) manual(s) specified in other sections of these specifications shall be included with the commissioning documentation. The manuals shall be incorporated in the commissioning documentation prior to commencement of O&M training required in this and other sections of the specification. Preparation of O&M manuals shall be as specified in Section 21 05 01 – Fire Protection General Provisions, Paragraph 3.17 O&M Manuals.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Authority for approval.

B. The Owner shall furnish necessary utilities for the commissioning process.

2.02 TEST EQUIPMENT – PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as

needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

PART 3 – EXECUTION

3.01 GENERAL

A. A pre-construction meeting of all commissioning team members shall be held at a time and place designated by the Owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. The Contractor shall complete all phases of work so the systems can be started, tested, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, wire, controls, etc. per the Contract Documents and related directives, clarifications, and change orders.

C. A Commissioning Plan shall be developed by the Commissioning Authority. The Contractor shall assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority shall notify the Contracting Officer.

D. Acceptance procedures are normally intended to begin prior to completion of a system and/or sub-systems, and shall be coordinated with the Division 21 Fire Protection Contractor. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems as per the schedule.

E. The Commissioning Authority shall develop a detailed schedule for acceptance procedures and training. The Commissioning Authority shall work in a cooperative manner with the Contractor to assure that the commissioning process does not interfere with the completion of work in accordance with the overall schedule.

3.02 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Contractor shall provide skilled technicians to start up and debug all systems within Division 21 (Fire Protection). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program. Work schedules, time required for testing, etc. shall be requested by the Commissioning Authority and coordinated by the Contractor. Contractor shall ensure that the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Authority time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained.

C. The Commissioning Authority reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and a willingness to work with the Commissioning Authority. Contractor shall provide adequate documentation and tools to start up and test the equipment, systems, and/or sub-systems.

3.03 DEFICIENCY RESOLUTION

A. In some systems, improper adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Contracting Officer, with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Contracting Officer shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority shall notify the Contracting Officer, indicating the nature of the problem, expected steps to be taken, and suggested deadline(s) for completion of activities. If the deadline(s) pass without resolution of the problem, the Contracting Officer reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner shall be the Contractor's responsibility.

3.04 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor(s), suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their contractual obligations.

3.05 ACCEPTANCE PROCEDURES

A. Verification Tests

1. Scope

a. Operating tests and checks to verify that all components, equipment, systems, sub-systems, and interfaces between systems operate in accordance with the Contract Documents. These tests are to include all operating modes, interlocks, specified control responses, specific responses to abnormal or emergency conditions and verifications of the proper response of the Building Automation System controllers and sensors.
b. Verify the validity of the TAB report.

2. Participants

The Commissioning Authority shall be responsible for preparing the scope of these tests. The Commissioning Authority shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Following is a list of tasks and supporting information that shall be required:

a. Fire Protection Contractor – Provide the services of technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cutsheets of all installed equipment.
b. Electrical Contractor – Provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

3. Documentation and Reporting Requirements

a. Provide checklists for each component, piece of equipment, system, and sub-system, including all interfaces, interlocks, etc. Each item to be tested shall have a different entry line with space provided for comments. Separate checklists shall be prepared for each mode of operation. Provide space to indicate whether the mode under test responded as required or not. Also, provide space for all necessary parties to sign off on each checklist.
b. Datasheets used in verification of the proper operation of the control system shall include each controller to be verified, and its location. For each controller, provide space for recording the readout of the controller, the reading at the controller's sensor(s), and any comments. Also, provide space for all necessary parties to sign off on each checklist.
c. All test procedures and datasheets shall be submitted to the design professional for review and acceptance.

4. Instrumentation

a. The Commissioning Authority shall furnish all measurement instrumentation for the verification tests. All instruments will have calibrated within the six-month period prior to these tests.

5. Procedures

a. The Commissioning Authority shall direct and witness the verification operating tests and checks for all equipment and systems.

(1) Set the system equipment (i.e. pumps, controllers) into the operating mode to be tested, i.e. normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.

(2) The Commissioning Authority shall inspect and verify the position of each device and interlock identified on the checklist. Each item shall be signed off as acceptable (yes), or failed (no).
(3) This test shall be repeated for each operating cycle that applies to the fire protection system being tested.
(4) Operating checks shall include all safety cutouts, alarms and interlocks with life-safety systems during all modes of operation of the fire protection system.
(5) If during a test an operating deficiency is observed, appropriate comments shall be added to the checklist datasheet.
(6) Verification of the interface of the Building Management System and the TAB criteria shall be included.
(7) Verification of the proper responses of Building Management System controllers and sensors shall be included.

b. The Commissioning Authority shall direct and witness the field verification of the final TAB report.

(1) The Commissioning Authority shall select, at random, 10 percent of the report data for verifications.
(2) The TAB Contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB Contractor must use the same instruments (by model and serial number) that were used when the original data were collected.
(3) Failure of an item is defined as:

(a) For all readings, a deviation of more than 10 percent.

(4) A failure of more than 10 percent of the selected items shall result in the rejections of the final TAB report.

c. If the deficiencies are identified during verification, the General Contractor must be notified, and action taken to remedy the deficiency. The final tabulated checklist datasheets shall be reviewed by the Design Professional and the Commissioning Authority, to determine if verification is complete, and the operating system is functioning in accordance with the Contract Documents.

B. Functional Performance Testing

1. Scope

a. Functional performance tests shall determine if the fire protection system is providing the required flows and pressure in accordance with the final design intent. Following is a test example:

(1) Determine the ability of the fire pumps to deliver the required volume and pressure to the distribution system.

2. Submittals

a. Detailed procedures for each series of tests shall be submitted to the Commissioning Authority for review and acceptance. The procedures shall include samples of the datasheets that will be part of the reports.

3. Participants

a. Participants in the functional performance tests shall be the same as those listed in the verification tests.

4. Instrumentation

a. In addition to the instrumentation requirements detailed under verification, the Commissioning Authority may need to provide data acquisition equipment to record data for the complete range of testing.

5. Procedures

a. The Commissioning Authority shall supervise and direct all functional performance tests.
b. For each test, the Commissioning Authority shall install the measuring instruments and logging devices to record test data for the required test period. The instrumentation shall monitor and record all operating conditions to allow for complete evaluation of the test results.
c. Measurement will be required to allow for calculation of total capacity of the system for each mode of operation under test.

6. Documentation and Reporting Requirements

a. All measured data, datasheets, and a comprehensive summary, describing the operation of the fire protection system at the time of testing, shall be submitted to the Commissioning Authority.
b. A preliminary Functional Performance Test report shall be prepared by the Commissioning Authority and submitted to the Design Professional for review. Any identified deficiencies need to be evaluated by the Design Professional and Construction Manager to determine if they are part of the Contractor's contractual obligations. Construction deficiencies shall be corrected by the responsible Contractor(s) and the specific functional performance test repeated.
c. If it is determined that the fire protection system is constructed in accordance with the Contract Documents, and the performance deficiencies are not part of the Contract Documents, the Contracting Officer must decide whether any required modifications needed to bring the performance of the fire protection system up to the finalized design intent shall be implemented, or if the test shall be accepted as submitted. If

corrective work is performed, the Contracting Officer shall determine if a portion or all required functional performance tests should be repeated, and a revised report submitted.

3.06 OPERATING AND MAINTENANCE MANUAL

A. The operating and maintenance manual shall consist of binders (as described in Section 21 05 01 – Fire Protection General Provisions for Fire Protection, Paragraph 3.17 O&M Manuals) with 8.5-inch by 11-inch sheets.

3.07 OPERATING AND MAINTENANCE TRAINING

A. The Fire Protection Contractor, and appropriate sub-contractors, shall provide comprehensive operating and maintenance instruction on building systems in accordance with the Contract Documents prior to delivery. The instruction shall include classroom instruction delivered by competent instructors based upon the contents of the operating manual.

B. Each classroom training period shall be followed by an inspection, explanation and demonstration of the system concerned by the instructors. All specified equipment shall be started up and shut down, with the exception of sprinkler system.

C. The Contractor shall be responsible for organizing, arranging, and delivering in a manner and on a schedule agreeable to the Contracting Officer.

D. The Contractor shall provide, at or before substantial completion, a proposed agenda and schedule of the above training for approval by the Commissioning Authority and the Contracting Officer.

E. Each classroom training session and demonstration shall be recorded on videotape or alternative acceptable media and submitted to the Contracting Officer.

F. The Fire Protection Contractor shall provide a letter of certification to the Project Representative stating that project site training session(s) of at least two (2) hours duration were conducted for this project for the Sub-contractor’s supervisory and installing personnel.

END OF SECTION

SECTION 21 10 00
PIPING AND FITTING MATERIALS FOR WATER BASED FIRE PROTECTION SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Pipes

B. Fittings

C. Joints

1.02 RELATED DOCUMENTS

A. Section 21 00 01 – Fire Protection General Provisions

B. Section 21 12 00 – Standpipe and Hose Systems

C. Section 21 13 13 – Wet Pipe Sprinkler Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

1. Standard 13: Installation of Sprinkler Systems
2. Standard 14: Installation of Standpipe and Hose Systems
3. Standard 20: Installation of Stationary Pumps for Fire Protection

H. Owners Insurance Underwriters

1.04 QUALITY ASSURANCE

A. Each pipe length shall have the manufacturer’s name and size cast, stamped or rolled on.

B. Each fitting shall have the manufacturer’s name and size cast, stamped or rolled on.

C. All piping, fittings and joints are to be UL listed and FM Approved.

1.05 SUBMITTALS

A. Prior to purchase, submit a list of all proposed piping materials including system/material (use Schedule)

B. Submit complete back up material where manufacturing specification standards of proposed materials differ from those specified.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal to that specified, shall have same quality, finish, material construction, etc., as those specified under base Specification.

B. Acceptable Manufacturers:

1. Piping: Wheatland Tube Co., Berger Pipe Co., Allied Tube and Conduit Corp.
2. Fittings: Victaulic, Stockham, Nibco, Flagg
3. Mechanical Couplings: Victaulic, Gustin-Bacon

2.02 PIPING AND FITTING MATERIALS

A. General Characteristics for Threaded Pipe and Fittings: Field Pipe Threading: Comply with ASME B1.20.1 “Pipe Threads, General Purpose (inch)”.

B. General Characteristics for Welded Pipe and Fittings: Welding: Shop Welded and in compliance with AWS B2.1 “Specifications for Qualifications of Welding Procedures and Welders for Piping and Tubing”.

C. Automatic Fire Sprinkler Systems and Standpipe Systems Black Steel Piping:

1. Above Grade Piping Systems Pipe Sizes 2 inch and Smaller: Piping: ASTM A53, or A53 M, Standard weight black steel pipe, Schedule 40, welded or seamless, with manufacturer’s name rolled into each length.
2. Above Grade Piping Systems Pipe Sizes 2½ inches and Larger: Piping: ASTM A135 or A53 B, Standard weight black steel pipe, Schedule 10, welded or seamless, with manufacturer’s name rolled into each length.
3. Fittings:

a. Pipe Sizes 2 inch and Smaller:

(1) Class 125 cast iron threaded fittings for working pressures under 175 pounds per square inch, conforming to ANSI B16.4.
(2) Class 150 malleable iron threaded fittings for working pressures under 300 pounds per square inch, conforming to ANSI B16.3.
(3) Class 250 cast iron threaded fittings for working pressures

up to 400 pounds per square inch, ANSI B16.4

b. Pipe Sizes 2½ inch and Larger: ASTM B16.9, B16.25 welded fittings, cast iron flanges, and vee-butt welded joints.

c. Pipe Sizes 1½ inch and Larger:

(1) Various Victaulic “Firelock” fittings/couplings may be acceptable, however mechanical T-style fittings 920, 921 and Hooker-style fittings, etc. will not be permitted. Contractor to submit list of fittings he intends to use and in which systems.

4. Grooveless clamp or saddle fittings are not acceptable.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All piping, fittings, and other materials shall be installed according to the Local Authority rules and an inspection certificate furnished.

B. Make all joints smooth and unobstructed inside. Ream all cut pipe ends to remove burrs. Remove all obstructions prior to fabrication.

C. Install a union or flanges at equipment connections and elsewhere as indicated.

D. Make welded joints on pipe runs with continuous welds, without backing rings, and with pipe ends beveled before fabrication. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no metal shall project within the pipe.

E. All screwed pipe throughout the job shall be reamed smooth before being installed. Use full pipe lengths; random lengths joined by couplings will not be accepted.

F. Pipe shall not be split, bent, flattened or otherwise damaged either before or during the installation.

G. All welded elbows shall be long radius type.

H. The Fire Protection Subcontractor utilizing a grooved piping system shall provide a letter of certification to the Project Representative stating that a project site training session of at least two (2) hours duration was conducted for this Project by the grooved fitting manufacturer for the Subcontractor’s supervisory and installing personnel.

I.

3.02 TESTING

A. General:

1. All inspections, examinations, and tests required by the authorities and/or agencies specified hereinbefore shall be arranged and paid for by this Fire Protection Subcontractor, as necessary to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be in quadruplicate and shall be delivered to the Architect for distribution. Note: All hydrostatic tests shall be performed as required by the reference standards cited hereinbefore and the Authority Having Jurisdiction.
2. Provide acceptance test consisting of hydrostatic tests of the fire protection piping system in accordance with NFPA Pamphlet No. 13 and No. 14, but at not less than 200 pounds pressure for two (2) hours, or at 50 pounds per square inch in excess of the maximum static pressure when the maximum static pressure is in excess of 150 pounds per square inch.

END OF SECTION

SECTION 21 11 19
FIRE DEPARTMENT CONNECTIONS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Exposed-Type Fire-Department Connections

1.02 RELATED DOCUMENTS

A. Section 21 00 01 – Fire Protection General Provisions

B. Section 21 12 00 – Standpipe and Hose Systems

C. Section 21 13 13 – Wet Pipe Sprinkler Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

H. Owners Insurance Underwriters

I. Local Fire Department

1.04 SUBMITTALS

A. Product data for each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All

items submitted as being equal to that specified, shall have same quality, finish, material construction, etc., as those specified under base Specification.

B. Acceptable Manufacturers:

1. Fire Department Connections: Potter-Roemer, Elkhart Brass & Croker

2.02 EXPOSED-TYPE FIRE DEPARTMENT CONNECTIONS

A. Standard: UL 405.

B. Type: Exposed, projecting, for wall mounting.

C. Pressure Rating: 175 psig minimum.

D. Body Material: Corrosion-resistant metal.

E. Inlets: Brass with threads conforming to local Fire Department requirements and sizes. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

F. Caps: Brass, lugged type, with gasket and chain painted red for standpipe, green for sprinkler and yellow for combined sprinkler/standpipe.

G. Escutcheon Plate: Round, brass, wall type.

H. Outlet: Back, with pipe threads.

I. Number of Inlets: Three.

J. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE”.

K. Finish: Polished chrome plated.

L. Outlet Size: NPS 4.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install yard-type fire-department connections in concrete slab support. Comply with requirements for concrete in Section 03 30 00 “Cast-in-Place Concrete.”

B. Install automatic (ball-drip) drain valve at each check valve for fire department connection.

END OF SECTION

SECTION 21 12 00
STANDPIPE AND HOSE SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Angle Hose Valves

B. Fire Hose and Nozzles

C. Accessories for Valves and Hoses

D. Cabinets

E. Roof Manifold

1.02 RELATED DOCUMENTS

A. Section 21 05 23 – General Duty Valves for Water Based Fire Protection Piping

B. Section 21 11 19 – Fire-Department Connections

C. Section 21 13 13 – Wet Pipe Sprinkler Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

H. Owners Insurance Underwriters

I. Local Fire Department

1.04 SUBMITTALS

A. Product data for each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics,

furnished specialties and accessories.

B. Shop Drawings for fire protection standpipes.

1. Include plans, elevations, sections and attachment details.

1.05 DEFINITIONS

A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig, but not higher than 250 psig.

B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal to that specified, shall have same quality, finish, material construction, etc., as those specified under base Specification.

B. Acceptable Manufacturers:

1. Valves and Accessories: Potter-Roemer, Elkhart Brass & Croker.
2. Fire Hose: Potter-Roemer, Elkhart Brass & Croker.
3. Cabinets: Potter-Roemer, Elkhart Brass & Croker.

2.02 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

2.03 2½" ADJUSTABLE-VALVE HOSE CONNECTIONS

A. Standard: UL 688 hose valve for connecting fire hose.

B. Pressure Rating: 300 psig minimum.

C. Material: Brass or Bronze

D. Inlet: Female Pipe Threads

E. Outlet: Male hose threads with lugged cap, gasket and chain. Include hose valve threads matching local fire-department threads.

F. Pattern: Angle

G. Finish: Polished Chrome Plated

H. Similar to Potter Roemer 4065

2.04 ROOF MANIFOLD

A. Roof manifold shall be Potter Roemer series 5890 with three way 2 ½" outlets, cast brass angle inlet body

B. Roof manifold shall be rated for the maximum pressure it could be exposed to.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Threads shall be full and clean cut. All threaded pipe shall be reamed or filed to original bore of pipe and all burrs shall be removed. Care shall be taken that the pipe does not extend into the fitting obstructing the waterway. Teflon tape shall be applied to the threads of the pipe and not to the fittings.

B. A one-piece reducing fitting shall be used wherever a change is made in the size. The use of bushings or reducing flanges will not be permitted.

C. Unions shall be provided at connections to each piece of equipment for easy dismantling.

D. All control valves, pressure reducing valves, check valves, water flow switches, pressure switches, etc., shall be easily accessible for maintenance and removal.

E. Only shoulder nipples shall be used. Close nipples will not be acceptable.

3.02 TESTS

A. During the progress of the work, test the fire standpipe systems piping. Such tests shall be made in the presence of the Owner's representative, and all other authorities having jurisdiction.

B. The piping shall be tested in accordance with local requirements and NFPA Code requirements, but in no case shall the system be tested at less than 200 psig hydrostatic pressure for two (2) hours.

C. Defects disclosed by the tests shall be repaired or replaced with new work. Tests shall be repeated as directed, until all work is proven satisfactory.

D. Take due precautions to prevent damage to the building and its contents as a result of such tests. Repair any damage caused.

E. During construction, properly cap all lines and equipment nozzles so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed to remove grit, dirt, sand, etc., from the piping for as long a time as is required to thoroughly clean the system.

END OF SECTION

SECTION 21 13 13
WET PIPE SPRINKLER SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Sprinkler Heads

B. Water Flow Switch

C. Tamper Switch

D. Floor Control Valve

E. Pressure Relief Valve

F. Inspectors Test Connection

1.02 RELATED DOCUMENTS

A. Section 21 05 23 – General Duty Valves for Water Based Fire Protection Piping

B. Section 21 11 19 – Fire-Department Connections

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

H. Owners Insurance Underwriters

I. Westchester Fire Department

1.04 SUBMITTALS

A. Product data for each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics,

furnished specialties and accessories.

B. Shop Drawings for wet pipe sprinkler systems.

1. Include dimensioned plans, elevations, sections and attachment details.
2. Identification chart and tags for valves and alarm devices.
3. Hydraulic calculations

PART 2 – PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation and testing shall comply with the following:

1. NFPA-13

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

a. Building Service Areas: Ordinary Hazard, Group 1
b. Electrical Equipment Rooms: Ordinary Hazard, Group 1
c. General Storage Areas: Ordinary Hazard, Group 1
d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1
e. Office and Public Areas: [Light Hazard] <Insert classification>.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft..
b. Storage Areas: 130 sq. ft..
c. Mechanical Equipment Rooms: 130 sq. ft..
d. Electrical Equipment Rooms: 130 sq. ft..
e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.02 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal to that specified, shall have same quality, finish, material construction, etc., as those specified under base Specification.

B. Acceptable Manufacturers:

1. Sprinklers: Tyco, Reliable & Viking
2. Water Flow Switches: Tyco, Potter Roemer, Potter Electric, Reliable, & Viking
3. Tamper Switch: Tyco, Potter Roemer, Potter Electric Reliable & Viking
4. Sprinkler Control Valve Assembly Cabinet: Croker, Potter Roemer & Elkhart Brass

2.03 SPRINKLER HEADS

A. General:

1. Fire sprinklers shall be of one manufacturer throughout building. No mixing of sprinkler brands shall be permitted, unless otherwise noted for window protection sprinkler heads.
2. Sprinklers shall be UL listed or FM Global approved.
3. Pressure Rating for Automatic Sprinklers: 175 psig
4. Sprinklers shall be of all brass frame construction with a coated metal-to-metal seating mechanism.
5. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited, including O-Rings.
6. Sprinklers shall have a quick response frangible bulb type fusible element with a temperature rating of 155 or 200 degrees F or shall have a fast response metal type fusible element with a temperature rating of 165 to 212 degrees F.
7. Sprinklers to be installed in areas with no ceilings shall be of a brass finish and shall be of adequate temperature for the hazard.
8. Exposed sprinklers subject to corrosive atmospheres shall have a factory applied corrosion resistant coating.
9. Provide approved sprinkler head wire guards for sprinkler heads located 7 feet 6 inches or lower above finished floor level.
10. Provide sprinkler heads with minimum ½ inch discharge orifice.
11. Provide proper wrenches to service specified sprinkler heads.

B. Quick Response Standard Coverage Sprinklers

1. Pendant, upright, horizontal sidewall, and semi-recessed: Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Sprinklers shall have a quick response frangible bulb type fusible element. Sprinklers to be installed in areas with no ceilings shall be of a brass finish and shall be of adequate temperature for the hazard semi-recessed heads shall have chrome plated recessed escutcheon.
2. Concealed: Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Quick response

concealed pendent sprinkler orifice shall be standard nominal ½" with a K factor of 5.5. Quick response concealed pendent sprinklers shall be listed for installation in an ordinary hazard occupancy if installed in an ordinary hazard occupancy. Concealed pendent sprinkler shall have a cover that is a push-on, thread-off assembly.

C. Quick Response Extended Coverage Sprinklers

1. Pendant: Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism. Extended coverage pendent sprinklers shall have a quick response frangible bulb type fusible element. Extended coverage quick response pendent sprinkler shall be installed in conformance with the manufacturer's listing and installation guidelines. Extended coverage quick response pendent sprinklers shall be UL listed for light hazard or ordinary hazard occupancies depending on where they will be installed Extended coverage quick response pendent sprinklers shall have nominal orifices of ½" and 17/32" with K factors of 5.5 and 8.0, respectively.
2. Concealed: Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Quick response extended coverage concealed pendent sprinkler orifice shall be standard nominal ½" with a K factor of 5.5. Quick response extended coverage concealed pendent sprinklers shall be listed for extended coverage application. Concealed pendent sprinkler shall have a cover that is a push-on, thread-off assembly.
3. Sidewall: Sprinklers shall be of all brass frame construction with a coated metal to metal seating mechanism. Sprinklers utilizing non-metal parts in the sealing portion of the sprinkler are strictly prohibited. Sidewall sprinklers shall have a quick response frangible bulb type fusible element. Quick response extended coverage horizontal sidewall sprinkler shall be installed in conformance with the manufacturer's installation guidelines. For concealed sidewall extended coverage type sprinklers shall have a cover that is a push-on, thread-off assembly

D. Dry Pendant Sprinkler:

1. Quick response dry pendent barrel shall be of steel construction with an electro-deposited epoxy base coating. Quick response dry pendent sprinklers shall have a 3 mm frangible bulb type fusible element. Quick response dry pendent sprinklers shall have a 1-inch NPT, a standard orifice, and a nominal K Factor of 5.6. The installation of quick response dry pendent sprinklers shall be in conformance with the manufacturer's installation guidelines. Quick response dry pendent sprinklers shall be UL listed. Quick response dry pendent sprinklers shall be listed for installation in an Ordinary Hazard occupancy if installed in an Ordinary Hazard occupancy.

2.04 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

1. Standard: UL 346.
2. Water-Flow Detector: Electrically supervised.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
4. Type: Paddle operated.
5. Pressure Rating: 250 psig.
6. Design Installation: Horizontal or vertical.

C. Pressure Switches:

1. Standard: UL 346.
2. Type: Electrically supervised water-flow switch with retard feature.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

1. Standard: UL 346.
2. Type: Electrically supervised.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Design: Signals that controlled valve is in other than fully open position.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

PART 3 – EXECUTION

3.01 GENERAL

A. Information included in this specification and of various agency requirements are given as a guide only. The contract documents do not relieve Contractor's responsibility to provide all work and equipment necessary to complete the installation in accordance with all requirements.

3.02 INSTALLATION

A. No pipes or other apparatus shall be installed so as to interfere in any way with the full swing of the doors or path of egress. The arrangement, positions and connections of pipes, drains, valves, etc., shown on the drawings, shall be taken as a close approximation and while they shall be followed as closely as possible, the right is reserved by the architect to change the locations to accommodate any conditions which may arise during the progress of the work without additional compensation to this contractor for such changes, provided that the changes are requested prior to the installation of this work.

B. All piping shall drain back to the risers or be provided with drain valves. Special precautions must be taken to avoid electrical work and ventilation ducts, and no piping shall pass below lighting fixtures in luminous ceilings or under skylights.

C. All piping shall be unexposed except in no-ceiling areas. Where required, heads shall be located below ducts. Diffusers and lighting fixtures take preference in room layout.

D. In areas with restricted head room, heads and piping shall be tight to ceilings and provided with guards.

E. No heads shall be nearer than 6 inches to a ceiling support, and where 12" x 12", 24" x 24" or 24" x 48" ceiling panels are used, the heads shall be located in the center of the panel.

F. Install sprinkler heads in all areas on a true axis line in both directions with a maximum deviation from the axis line of ½" plus or minus. In acoustical tile ceilings, sprinkler heads shall be located on center of tile. At the completion of the installation, remove and reinstall any heads found to exceed the above mentioned tolerances.

G. Where sprinklers are installed in areas without hung ceiling, install sprinklers both above and below all ductwork, catwalks or other obstructions 48” and larger in width or where the total aggregate of multiple ducts or obstructions exceeds 48” in width or length.

3.03 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 DRAINS AND TESTS

A. Provide drains at base of riser, valved sections inside building, and at other locations indicated or requiring same for complete drainage of systems. Siamese drains shall be automatic ball drips. Other drains shall be valves and/or plugs as indicated and/or required. Pipe drains to locations as required.

B. During the progress of the work, test the sprinkler systems piping. Such tests shall be made in the presence of the Owner's representative, and all other authorities having jurisdiction.

C. Test pipes shall be valved and piped to discharge through proper orifice at approved locations.

D. The piping shall be tested in accordance with local requirements and NFPA Code requirements, but in no case shall the system be tested at less than 200 psig hydrostatic pressure for two (2) hours.

E. Defects disclosed by the tests shall be repaired or replaced with new work. Tests shall be repeated as directed, until all work is proven satisfactory.

F. Take due precautions to prevent damage to the building and its contents as a result of such tests. Repair any damage caused.

G. During construction, properly cap all lines and equipment nozzles so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed to remove grit, dirt, sand, etc., from the piping for as long a time as is required to thoroughly clean the system.

END OF SECTION

SECTION 21 31 13
ELECTRIC DRIVEN CENTRIFUGAL FIRE PUMPS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Automatic Fire Pump

B. Automatic Fire Pump Motor Controller

C. Jockey Pump and Controller

1.02 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. FM – Factory Mutual

B. UL – Underwriters Laboratories Inc.

C. New York Building Code

D. New York Fire Code

E. International Building Code

F. International Fire Code

G. NFPA – National Fire Protection Association

H. Owners Insurance Underwriters

I. Westchester Fire Department

1.03 SUBMITTALS

A. Product Data:

1. For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop drawings for fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Operating Instructions: Written operating instructions including start-up and shutdown.

D. Maintenance Data`

1. Written instructions on items requiring periodic maintenance.
2. Parts List.

E. Factory Tests and Certificates

1. Pumps hydraulically tested for pressure/flow performances.
2. Provide certified test data.

F. Responsibility of Manufacturer

1. The manufacturer shall be responsible for the complete pumping system and shall guarantee pumps, motors, control and all components of the pumping system.

PART 2 – PRODUCTS

2.01 GENERAL

A. All pumps shall be as scheduled on the drawings.

B. Pumping systems shall be complete with all necessary controls, starters and alarms.

C. All pumps shall be U.L. listed and FM approved.

2.02 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal to that specified, shall have same quality, finish, material construction, etc., as those specified under base Specification.

B. Acceptable Manufacturers:

1. Fire Pump: Peerless Pump Company, Paterson Pump & Aurora Pump Company
2. Jockey Pump: Grundfos, Goulds, MTH Pumps
3. Controllers: Firetrol & Joslyn Clark

2.03 AUTOMATIC FIRE PUMP

A. The manufacturer of the fire pump shall have a quality management system in place and shall be ISO 9001 Certified. The pump(s) shall be listed by Underwriters Laboratories (UL) and approved by Factory Mutual FM. The unit shall meet all the requirements outlined in NFPA-20

B. Pump shall be designed to deliver flow rate required to meet design flow conditions when operating against at TDH as shown indicated in schedule on drawings. The pump shall also deliver not less than 150 percent of rated capacity at a pressure not

less than 65 percent of rated pressure. Motor and pump speed shall not exceed 3600 rpm. Unit pressure shut-off head shall not exceed 140 percent of rated pressure.

C. Horizontal Split Case:

1. The pump(s) shall be horizontal, split case, cast iron, bronze fitted, centrifugal fire pump and shall be mounted on a fabricated steel base, complete with coupling, coupling guard, and directly connected to the Motor. The pump shall be (clockwise rotation/counterclockwise) as viewed from the driver end. The pump discharge flange shall be rated for 125 lb. – 200 psi W.P.. The pump casting shall be smooth, free of scale, lumps, cracks, sand holes and defects of any nature which may make it unfit for the use for which it is intended
2. The bolting of pressure-holding castings shall be such that the maximum stress on any bolt will not exceed one-fourth the elastic limit of the material as computed by using the stress area and on the basis of the water pressure equivalent to the shutoff pressure effective over the area out of the centerline of the bolts.
3. The pump bearings shall have an L-10 rating of not less than 5,000 hours based on load ratings and fatigue life.
4. The shaft shall be sealed with a stuffing box and packing with external water-seal piping. The stuffing box glands shall exert uniform pressure on the packing.
5. Bearing housing supports, and suction and discharge flanges shall be integrally cast with the lower half of the casing. Removal of the upper half of the casing must allow the rotating element to be removed without disconnecting the suction and discharge flanges. Replaceable shaft sleeves shall be furnished and are to be of a corrosion resistant material. The shaft sleeves shall be held in position by the impeller key and locked in position by a separate threaded sleeve nut. Water slingers of corrosion-resistant material shall be provided to seal the bearings at their inner ends.
6. The pump casing shall be hydrostatically strength tested to a minimum of 250 psi, or not less than twice the maximum shut-off pressure.

D. Provide casing relief valve, suction and discharge gauges and all other accessories required for the pump.

E. Pump Accessories:

1. 2-inch automatic air release valve
2. Suction and discharge gauges
3. ¾-inch casing relief valve
4. Eccentric suction reducer (125/250 lb.)
5. Concentric discharge increaser (125/250 lb.)

2.04 FIRE PUMP CONTROLLER

A. The main fire pump controller shall be a factory assembled, wired and tested unit and shall conform to all the requirements of the latest edition of NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection and NFPA 70, National Electrical Code. The controller shall be UL listed and FM approved.

B. Controller shall be combined manual and automatic type, with automatic transfer

switch as hereinafter described for emergency power supply, suitable for wye-delta, closed circuit transition starting of squirrel cage motor, and shall consist of the following components:

1. One isolating switch, 3 pole, non-fusible of approved capacity, with latch-in device manually operated.
2. One circuit breaker, manually operated, 3 pole, 600 volts, a.c., having a rating of at least 115% of the rated full load current of the motor. Breaker shall permit normal starting without tripping and shall provide stalled rotor protection and instantaneous short circuit protection. Breaker of the inverse time delay type with a time delay of not over 20 seconds on 600% (locked rotor current) of the motor full load current. The magnetic trips shall be calibrated at least up to and set at 300% of the motor full load amperes. The interrupting capacity of the circuit breaker shall be not less than 25,000 amperes at 460 volts.
3. One motor starter, magnetic, wye-delta, closed circuit transition type without overload protection, designed to be energized automatically through action of the pressure regulator, or manually by means of a start button on the front of the enclosure. Under emergency conditions it shall be possible to close the starter mechanically through an externally operated handle provided with a latch-in device.
4. One pressure regulator switch of the Bourdon tube type with mercury tube contact for controlling the running of the motor automatically and provided with independent adjusting screws for cut-in and cutout pressure points. Connection to the pressure switch shall be separated from all electrical components by a waterproof barrier.
5. One running period timer to determine the minimum length of time the motor will run when started automatically provided the pressure regulator has reached the cutout setting at or before the end of the timing interval. If not, the pressure regulator shall govern the stopping of the motor.
6. One control relay to operate in conjunction with the running period timer with provision to bypass the timer to permit an automatic start of the pump and continuous operation until manually stopped.
7. One deluge valve relay for remote starting.
8. One power availability relay energized from the load side of the circuit breaker so that it will drop out if the circuit breaker is opened or the power fails. This relay shall be provided with one normally closed and one normally open isolated contact for remote alarm indication.
9. One pilot light connected to load side of circuit breaker to indicate power is available at the controller.
10. Listed pressure recording device on the pressure sensing line capable of operating for seven days without being reset.
11. One start button on front of enclosure.
12. One manual release button on front of enclosure.
13. Terminal blocks and red nameplates shall be provided.

C. The controller components shall be housed in a NEMA Type 2 drip-proof, wall mounted enclosure with floor stand.

D. Withstand Ratings (Short Circuit Current Ratings): All controller components shall be front mounted, wired and front accessible for maintenance. The minimum withstand rating of the controllers shall not be less than 100,000 Amps RMS Symmetrical at 200-600 Volts. If the available system fault current exceeds these ratings, the controllers shall be supplied with a withstand rating of 150,000 or 200,000 Amps

RMS Symmetrical, as required.

2.05 MAIN FIRE PUMP POWER TRANSFER SWITCH

A. The fire pump controller specified in the foregoing, shall be factory assembled and wired with a power transfer switch listed by Underwriters' Laboratories, Inc and Factory Mutual. for transfer switch and fire pump service.

B. The power transfer switch and fire pump controller shall be factory assembled, wired and tested as a single unit and shall conform to all requirements of the latest edition of NFPA20, Centrifugal Fire Pumps and NFPA 70, National Electrical Code.

C. Power Transfer Switch for Generator Set Emergency Power Source:

1. The power transfer switch shall be housed within the fire pump controller enclosure directly attached directly to the fire pump controller. Where the power transfer switch is provided in an attached enclosure, the enclosures shall be fitted so that the assembly constitutes a single unit. The fire pump controller/power transfer switch shall be factory assembled, wired and tested as a unit prior to shipment.
2. The power transfer switch shall include a motor rated disconnect/isolating switch capable of interrupting the motor locked rotor current. The disconnect/isolating switch shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism. The disconnect/isolating switch shall be capable of being padlocked in the OFF position with up to three padlocks for installation and maintenance safety, and shall also be capable of being locked in the ON position. The enclosure door shall have a locking type handle and three-point cam and roller type vault hardware.
3. An auxiliary contract shall be provided on the transfer switch to prevent starting of the emergency generator set when the transfer switch or the main fire pump controller is being serviced.
4. The transfer switch circuitry shall be capable of sensing both the normal power source and the emergency power source. The normal power source pickup shall be set at 95 nominal voltage. The emergency power source shall be set to pick up at 90 nominal voltage and 95 nominal frequency. All voltage sensing, frequency sensing, and time delays shall be field adjustable to accommodate individual installation requirements. The transfer signal shall be delayed for one second, delaying the transfer and engine start signals so as to compensate for momentary, normal power outages. An automatic delay of three seconds shall be provided upon transfer to or from the emergency power source to allow the motor to slow sufficiently, preventing line disturbances that could trip either the generator set or fire pump circuit breakers.
5. The transfer switch shall have TRANSFER SWITCH NORMAL, TRANSFER SWITCH EMERGENCY and EMERGENCY ISOLATING SWITCH OFF LED's, TEST and TRANSFER BYPASS switches, an audible alarm device and SILENCE ALARM pushbutton mounted on the flange of the enclosure. The power transfer switch shall be furnished with both normally open and normally closed auxiliary contacts for an engine start signal when normal power failure occurs. Auxiliary contacts shall also be provided and wired to terminals to indicate the transfer switch position. The transfer switch shall be electrically operated and mechanically held, and shall be capable of being operated by a manual transfer mechanism located on the switch.

6. The power transfer switch shall be a normal utility power and engine generator set emergency power.

2.06 JOCKEY PUMP

A. Jockey Pump: Vertical-turbine, centrifugal multi-stage pump, Totally Enclosed Fan Cooled electric motor, cast iron base with drain plug, stainless steel impeller(s),shaft, & wet parts in compliance with NFPA standards.

B. Rating: Flow rate at approximate 1 percent of rating of fire pump, but not greater than 10 gpm at a minimum of 10 feet head greater than system design pressure, based on hydraulic calculations.

C. Jockey Pump Installation Accessories:

1. Provide inlet and outlet shutoff valves, check valve on outlet of pump and one half-inch type “L” copper sensing line that connects the sprinkler system to the jockey pump control panel pressure switch. Provide two orificed unions or orificed check valves in sensing line to protect the pressure switch from hydraulic shock. The sensing line shall connect between the jockey pump check valve and the jockey pump discharge isolation valve.
2. Provide pressure relief valve in discharge line piping of pump, if positive displacement regenerative turbine pump is used.
3. Provide 20 mesh “Y” strainer upstream of pump with ball valve on strainer plug opening between inlet shutoff valve and inlet of pump.
4. Provide casing relief valve on pump.

2.07 JOCKEY PUMP CONTROL PANEL

A. Jockey pump control equipment shall be completely assembled and wired, and tested at the factory. This controller shall be UL listed, and shall be of the same manufacturer as the main fire pump controller. The Controller shall be marked “Fire Jockey Pump Controller”.

B. The controller components shall be housed in a NEMA Type 2 drip-proof, wall mounted enclosure.

C. The controller shall incorporate a full voltage magnetic starter, main disconnect switch, motor fuse block with fuses, HAND-OFF-AUTOMATIC selector switch and a pressure switch.

D. Pressure Controls: The pressure switch shall have a range of 30-300 psi (2.1-20.7 bars) and have an adjustable differential range of 10-40 psi (.7-2.8 bars). The pressure switch shall be of the diaphragm type utilizing snap-action type contacts. The pressure switch shall be mounted inside the controller to prevent any unauthorized adjustment and/or accidental damage. The adjustment knobs shall be capable of being sealed after final adjustment. The pressure switch shall be directly pipe mounted to a bulkhead pipe coupling without any other supporting members. A system pressure gauge shall be mounted with the pressure switch to assist in pressure switch adjustments and provide an indication of current system pressure. Field connections shall be made externally at the controller coupling to prevent distortion of the pressure switch element and mechanism.

1. Running Period Timer: The controller shall have a running period timer to prevent too frequent automatic starting of the jockey pump motor. The timer shall be set to keep the motor in operation for at least one minute and interwired with the pressure switch.
2. Disconnect Switch: The disconnect switch shall be mechanically interlocked so that the enclosure door cannot be opened with the handle in the ON position except by a hidden tool operated defeater mechanism. The disconnect switch shall be capable of being padlocked in the OFF position with up to three padlocks for installation and maintenance safety.
3. Controls: All pushbuttons, selector switches, pilot lights shall be NEMA Type 12, oil tight. Pilot lights (when specified) shall be transformer type. No pushbuttons or pilot lights shall be mounted on the enclosure door.
4. The control circuit transformer shall be of the molded winding construction type with built-in molded terminals and shall be fuse protected. The fuse shall be built into the transformer.
5. Provide extra contacts (normally open & normally closed) for remote indication of pump operating, remote indication of pump fail to start, remote indication of pump overload, remote indication for pump power failure, remote indication for phase reversal/phase failure.
6. Testing: The controller manufacturer, prior to shipment, shall hook up and test the jockey pump controller as a completed assembly. This test shall include, but not be restricted to, each function the controller may be required to perform including manual start-stop, automatic start-stop and minimum run timing. The manufacturer shall perform a high potential test of the controller power circuits at not less than two times the rated voltage plus 1,000 volts.

PART 3 – EXECUTION

3.01 GENERAL

A. Information included in this specification and of various agency requirements are given as a guide only. The contract documents do not relieve Contractor's responsibility to provide all work and equipment necessary to complete the installation in accordance with all requirements.

3.02 HORIZONTAL CENTRIFUGAL FIRE PUMP INSTALLATION

A. Power and Control Wiring: Provide power and control wiring as required between controllers and fire pump system components, and in conformance with manufactures installation procedures and descriptions and Applicable Standards listed in the Part 1.

B. Driver Alignment:

1. Set fire pump and driver level on concrete base and align in accordance with NFPA 20 Centrifugal Fire Pump related appendixes.
2. Align pump driver and pump in accordance with latest edition of Hydraulics Institute Standards for Centrifugal, Rotary and Reciprocating Pumps and fire pump manufacturer’s recommendations.
3. Do not align pump and driver with coupling halves connected.
4. Provide final check for misalignment of coupling halves after 10 hours of operation or 3 months with weekly testing procedures performed in

accordance with NFPA 25. Provide dowels for pump and driver to base plate in accordance with pump manufacturer's instructions, upon confirmation coupling halves are properly aligned during final coupling check.

5. Include reports of alignment operations and maintenance manuals. Failure to submit documentation of alignment operations will be cause for equipment rejection.
6. Include cement grouting of base plate and anchoring of base plate to foundation upon completion of alignment of pump and driver.

C. Grout base plates completely to provide a non-deflecting support.

D. Secure pumps to bases with proper size anchor bolts.

E. Install and align mechanical seals in accordance with the manufacturer's recommendation.

F. Pump manufacturer to set packing, adjust impellers and check alignment prior to start-up.

G. Each concrete base (rectangular or 'T' shaped) for horizontally split pumps to include supports and base elbows for the suction and discharge connections. Base elbows to be bolted and grouted to the concrete foundation.

H. Construct all apparatus of materials and pressure ratings suitable for the conditions encountered during continuous operation.

I. Provide casing connections for vent, drain, suction and discharge pressure gauges.

J. Balance impellers and all other moving components statically and dynamically.

K. Match centrifugal pump impellers and casings so that at specified operating conditions the impeller diameter is not more than 90% of the maximum diameter impeller which can satisfactorily operate in the casing.

L. Pumps must operate stably without pulsation, vibration or internal recirculation. Pump operating characteristics at the design point must be such that a variation of 10% in head results in not more than a 15% variations in gpm and does not affect the stability of operation of the pump.

M. Select pumps so that when operating at rated RPM, the pump motor cannot be overloaded despite variations in pumping head.

3.03 JOCKEY PUMP INSTALLATION

A. Power and Control Wiring:

1. Provide power and control wiring as required between controllers and fire pump system components, and in conformance with manufactures installation procedures and descriptions and Applicable Standards listed in the Part 1.
2. The jockey pump shall be provided with power from an emergency AC power circuit or reliable source.

3.04 TESTING

A. Fire pump field acceptance test and performance:

1. Provide hydrostatic testing and flushing of fire pump suction piping, field acceptance pump test, and controllers acceptance test in Accordance with NFPA 20 “Centrifugal Fire Pumps”.
2. Conduct field acceptance pump test and controller’s acceptance test in presence of the Project Representative, local jurisdictional fire authority and insurance underwriter. Submit documentation of tests to the Project Representative and include copies in operations and maintenance manuals. Failure to submit documentation of factory and field test will be cause for equipment rejection.

B. The service of a factory trained representative shall be made available on the job site to check installation, field acceptance testing, start-up, and instruct operating personnel.

C. In order to insure the fire pump unit is properly coordinated and will function in accordance with the intent of these specifications, all the equipment required to comprise the fire pump unit will be supplied by the fire pump manufacturer in whom shall be vested unit responsibility for the proper function of the complete fire pump unit, including the fire pump, motor or engine, base plate, control equipment and other required accessories when applicable pre-pac fire pump package systems including fire pump skid and/or housed units. To verify compliance with this requirement of the fire pump, manufacturer will be required to submit a notarized Certificate of Compliance certifying that all components of the fire pump unit were in fact supplied by the fire pump manufacturer and acknowledging its responsibility for the proper function of the unit.

END OF SECTION

SECTION 22 00 00
PLUMBING TABLE OF CONTENTS

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END OF SECTION

SECTION 22 05 01
PLUMBING GENERAL PROVISIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. The General and Supplementary Conditions and Division 1 are a part of the requirements for the work under this Division of the Specification.

1.02 WORK INCLUDED

A. Provide labor and materials required to install, test and place into operation the plumbing systems as called for in the Contract Documents and according to applicable codes and regulations.

B. Provide labor, materials and accessories required to provide complete operating plumbing systems as described or which may be reasonably implied as essential for a complete operating system.

1.03 QUALITY ASSURANCE

A. Comply with current governing codes, ordinances and regulations of the Authority or Authorities Having Jurisdiction over any part of the work and secure all necessary permits. Comply with the regulations and requirements of the Owner's insurance underwriter.

B. Where codes or standards are referenced, the applicable portions apply.

C. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.

D. Should any change in drawings or specifications be required to comply with governing regulations, notify the Architect prior to submitting bid.

E. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, skillful and well-executed manner by competent workers. Provide a competent, experienced full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

F. The Architect or Architect's Representative may conduct unannounced field reviews of any work completed or in progress during the Contractor's working hours. A report will be issued to the Contractor if the field review of the plumbing systems construction has revealed elements of the work, which are inconsistent with the Contract Documents. All items in the report shall be addressed in writing by the Contractor within two (2) weeks and corrections in the field shall be made as directed.

1.04 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1. AABC American Association of Balancing Contractors
2. ABMA American Boiler Manufacturers Association

3.	AFBMA	Anti-Friction Bearing Manufacturers Association
4.	AGA	American Gas Association
5.	ANSI	American National Standards Institute
6.	ASA	Acoustical Society of America
7.	ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
8.	ASME	American Society of Mechanical Engineers
9.	ASTM	American Society for Testing and Materials
10.	AWWA	American Water Works Association
11.	EPA	Environmental Protection Agency
12.	FM	Factory Mutual
13.	IEEE	Institute of Electrical and Electronic Engineers
14.	NEBB	National Environmental Balancing Bureau
15.	NEMA	National Electrical Manufacturers Association
16.	NFPA	National Fire Protection Association
17.	OSHA	Occupational Safety and Health Administration
18.	SAE	Society of Automotive Engineers
19.	UL	Underwriters Laboratories Inc.
20.	ULC	Underwriters Laboratories of Canada

B. Definitions:

1. Where it is stated in the specifications to submit to Architect or Engineer for review, refer to Architectural General and Special Conditions for proper procedures.
2. “PROVIDE” means to “Furnish” and “Install”.
3. “INSTALL” means to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.
4. “FURNISH” means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.
5. “AS DIRECTED” means as directed by the Architect, or the Architect’s Representative.
6. “CONCEALED” means embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings.
7. “SUBMIT” means submit to the Architect for review.

1.05 GUARANTEE

A. Submit a single guarantee stating that the work is in accordance with Contract Documents. Guarantee work against faulty and improper material, fabrication, installation, start-up and commissioning for a period of one (1) year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified herein, the longer term shall apply. Correct any deficiencies, which occur during the guarantee period, within 24 hours of notification, at no additional cost to the Owner, to the satisfaction of the Owner. Obtain similar guarantees from subcontractors, manufacturers, suppliers and sub-trade specialists.

1.06 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

A. The Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of AutoCAD, BIM model or compatible format architectural and engineering drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media files.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Provide products and materials that are new, clean, free of defects and free of damage and corrosion.

B. Products and materials shall not contain asbestos, PCBs or any other material that is considered hazardous by the Environmental Protection Agency or any other Authority Having Jurisdiction.

C. Replace materials of less than specified quality and relocate work incorrectly installed as directed by the Architect.

D. Statically and dynamically balance rotating equipment for minimum vibration and lowest operating noise level.

E. Provide name/data plates on major components of equipment with manufacturer's name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.

F. Install materials and equipment with qualified trades people.

G. Maintain uniformity of manufacture for equipment used in similar applications and sizes.

H. Applicable equipment and materials to be listed by Underwriters Laboratories and manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by Authorities Having Jurisdiction. The energy-using products shall be certified for use in the State of New York and meet State energy efficient standards.

I. Fully lubricate equipment when installed.

J. Do not operate water systems until piping has been cleaned, and strainers are in place.

K. Install floor-mounted equipment on a 4-inch high concrete pad. Concrete work shall be provided by another trade. Coordinate size and location with actual equipment used and accepted layout shop drawings.

L. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts to have bottom plate and pipe sleeves.

Grout machinery set in concrete under entire bearing surface. After grout has set, remove wedges, shims and jack bolts and fill space with grout.

M. Locate valves, traps, shock absorbers, dielectric unions, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified. Obtain Architect's approval of access panel locations.

N. Follow manufacturers' recommendations and instructions for installing, connecting, and adjusting equipment. Provide a copy of such instructions at the equipment during installation.

O. Pressure vessels and relief valves shall be selected, built and labeled in accordance with ASME.

P. Equipment capabilities, etc., are scheduled or specified for job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on shop drawings.

2.02 ALTERNATIVE EQUIPMENT AND MATERIALS

A. Contract Documents are based on materials specified and on equipment manufacturers indicated. Acceptance of alternative equipment manufacturers does not relieve Contractor of the responsibility to provide equipment and materials, which meet the quality and performance as stated or implied in the Contract Documents.

B. Equipment manufacturers listed in individual sections are acceptable for this project, subject to requirements of Contract Documents.

C. Submit proposals to supply alternate materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain project schedule. Reimburse Owner for costs associated with the review of the proposed alternative whether alternative is accepted or rejected.

D. Include revisions required to adapt alternatives in such proposals, including revisions by other trades. No increase in the contract price will be considered to accommodate the use of alternative equipment.

E. Wherever quality standards (such as serviceability, longevity or durability) and operating results (such as noise levels, quantity delivered or pressure obtained) are specified or scheduled, or when the manufacturer and size of equipment, for which such operating results are published or determinable, is specified, the substitution being proposed must conform substantially to the quality and quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

F. In making a request for a proposal for alternative equipment or materials, the Contractor:

1. Represents that the Contractor has personally examined the Contract Documents and has determined that the proposed substitution is appropriate for the use intended in the Contract Documents, and is equal or superior in all aspects to that specified.

2. Represents that the substitution has received the necessary approvals of the Authorities Having Jurisdiction
3. Will coordinate installation of the accepted substitution into the work, making such changes as may be required for the work to be complete in all aspects.

G. Proposed changes and substitutions of systems, equipment and manufacturers shall be submitted and include the following information with the proposal:

1. A description of the difference between the existing contract requirements and that proposed, the comparative features of each, and the effect of the change on the end result performance. Include the impact of all changes on other contractors and acknowledge the inclusion of additional costs to other trades.
2. Schematic drawings and details to supplement the description.
3. A list of the contract requirements that must be revised if the change is accepted, including any specification revisions.
4. Complete list of materials and equipment proposed for use in the change.
5. Include a description and estimate of costs the Owner may incur in implementing the change, such as additional space requirements, permits, architectural and aesthetic impact, design costs, tests, permits evaluation, operating and support costs.
6. A projection of any effects the proposed change would have on collateral costs to the Owner.
7. A statement of the time by which a contract modification accepting the change must be issued, noting any effect on the contract completion time or the delivery schedule.
8. A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.

PART 3 – EXECUTION

3.01 FEES

A. Pay all required fees and obtain required permits related to the plumbing installation.

B. Pay royalties or fees in connection with the use of patented devices and systems.

C. Provide controlled or witnessed inspection where required by Authorities Having Jurisdiction or by these specifications.

3.02 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer’s data, samples and test reports as specified.

B. Within two (2) months after notice to proceed by the Owner or Owner’s Representative, or after execution of Owner/Contractor Agreement, submit a complete typed list of all plumbing equipment manufacturers and material suppliers for the equipment proposed to be provided on this project as well as names of all subcontractors.

C. Within three (3) months after notice to proceed by the Owner or Owner's Representative or after execution of Owner/Contractor Agreement, prepare an index of all submittals for the project. Include a submittal identification number, a cross-reference to the specification sections or drawing number, and an item description. Prefix the submittal identification number by the specification sections to which they apply. Indicate, on each submittal, the submittal identification number in addition to the other data specified. All subcontractors shall utilize the assigned submittal identification number.

D. After the Contract is awarded, obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment as specified. Submit data and details of such materials and equipment for review. Prior to submission, certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Check all materials and equipment upon their arrival on the job site and verify their compliance with the Contract Documents. Modify any work, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

E. Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments does not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for techniques of construction, for performing the work in a safe manner, and for coordinating the work with that of other trades.

F. No part of the work shall be ordered, procured, started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted, reviewed and returned with either "No Exceptions Noted" or "Exceptions Noted" marked on the submission.

G. A minimum period of ten (10) working days, exclusive of transmittal time, will be required in the Architect/Engineer's office each time a shop drawing, product data and/or samples are submitted for review. This time period must be considered by the Contractor in the scheduling of the work.

H. Submit one (1) transparency and two (2) bond prints of all items requiring shop drawings. Submit three (3) copies of manufacturer's product submittals. One (1) transparency and one (1) bond print or two (2) copies of submittals will be returned. Additional copies are the responsibility of the Contractor. Electronic media will not be reviewed.

I. Submissions will be stamped as follows:

Stamp	**Interpretation**
No Exceptions Noted	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents.

Stamp	Interpretation
Exceptions Noted: [ ] Resubmit for Record [ ] No Resubmission Required	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents and Engineer's notations are complied with. Within this category are two options. A resubmission for our records is required when corrections are necessary. A resubmission is not required if there are only minor comments.
Revise and Resubmit	The submittal does not comply with the Contract Documents; do not proceed with fabrication, manufacture, or construction. The work and shop drawings are not permitted at the job site. Resubmit appropriate shop drawings.

J. Submit materials and equipment by manufacturer, trade name and model number. Include clear, legible copies of applicable brochure or catalog material. Maintenance and operating manuals are not suitable substitutes for shop drawings.

K. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as voltages, motor efficiencies, special tank linings, pump seals, materials or paint finishes. Cross out all references to "options". Cross out statements such as "subject to change without notice" or "not for construction". Anything not specifically excluded is assumed to be included.

L. Include dimensional data for roughing in and installation, technical data sufficient to verify that equipment meets requirements of the Contract Documents. Include wiring, piping and service connection data, motor sizes complete with voltage ratings, and schedules.

M. Maintain a complete set of the most current reviewed and stamped shop drawings and product data on site.

N. Prepare and submit detailed shop drawings for piping work and other distribution services in minimum ¼-inch to 1-foot scale, including elevations and locations and sizes of openings in floor decks, walls and roofs.

O. The work described in shop drawing and product data submittals shall be carefully checked by all trades for clearances (including those required for code compliance, maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with other trades on the job. Each submitted shop drawing to include a certification that related field conditions and requirements have been checked by all Contractors and Subcontractors and that conflicts do not exist.

P. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions or for deviations from requirements in the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data and samples.

Q. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

R. Indicate the following in the lower right hand corner of each shop drawing, and on the front cover of each product data brochure: the submittal identification number; title of the sheet or brochure; name and location of the Project; names of the Architect, Engineer, Contractor, Subcontractor, Manufacturer, Supplier, and Vendor; the date of submittal; and the date of each correction, version and revision. Number all pages and drawings in product data brochures, test reports or submittals consecutively from beginning to end. Unless the above information is included, the submittal will be returned for resubmission. Resubmittals of shop drawings or product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.

3.03 COORDINATION OF WORK

A. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Drawings are diagrammatic.

B. The Contract Documents show the general arrangement of equipment, ductwork, piping and accessories. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required but not shown on the Drawings. Investigate the site and review drawings of other trades to determine conditions affecting the work and provide such work and accessories as may be required to accommodate such conditions.

C. Certain products will be provided by other trades. Examine the Contract Documents to ascertain the requirements for installation of these products.

D. Carefully check space requirements with other trades to insure that material can be installed in the spaces allotted.

E. Wherever work interconnects with work of other trades, coordinate with other trades to insure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (valves, etc.) requiring access in order that the ceiling and partition contractors can install access doors and panels in the correct locations.

F. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.

G. Furnish and set sleeves for passage of pipes, and conduits through structural masonry and concrete walls, roofs and floors and elsewhere as will be required for the proper protection of each pipe passing through building surfaces.

H. Install firestopping around all pipes, conduits, etc., which pass through rated walls, partitions and floors in strict accordance with the manufacturer's published approval listing and rating.

I. Provide detailed information on openings and holes required in structural elements and pre-cast panels or components for plumbing work.

J. Provide required structural or architectural supports and hangers for piping and equipment, designed so as not to exceed allowable loadings of structures.

K. Examine and compare the Contract Drawings and Specifications with the drawings and specifications of other trades, report any discrepancies between them to the Architect and obtain written instructions for changes necessary in the work. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

L. Wherever the work is of sufficient complexity, prepare additional detail drawings to scale to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the Drawings as to the area to which it applies. Submit these drawings to the Architect for review. At completion include a set of these drawings with each set of record drawings.

M. Before commencing work, examine adjoining work on which this work is in any way dependent and report conditions that prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

N. Adjust location of pipes, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.

1. Right-of-Way: Lines which pitch have right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets and changes in direction of pipes as required to maintain proper head room and pitch on sloping lines. Provide traps, air vents, drains, etc., as required to effect these offsets and changes in direction.

O. Install plumbing work to permit removal (without damage to other parts) of heat exchanger, boiler tube bundles, heat exchanger plates, controls, sheaves and drives, and any other parts requiring periodic replacement or maintenance. Arrange pipes and equipment to permit access to valves, cocks, traps, starters, motors, and control components, and to clear the openings of swinging doors and access panels.

P. In cases of doubt as to the work intended, or in the event of need for explanation thereof, request supplementary instructions from the Architect.

3.04 CONTRACTOR'S COORDINATION DRAWINGS

A. The Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Architect) any information necessary to permit the work of all

trades to be installed satisfactorily and with the least possible interference or delay.

B. The Contractor and all trade contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment actually purchased and the exact routing for all lines such as piping, conduit, ductwork, etc., including conduit embedded in concrete floors and walls. The Coordination Drawings shall be submitted complete to the Architect and the Engineer within three (3) months after notice to proceed is given and in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than ¼-inch to 1-foot, shall serve as the base drawings to which all other Contractors shall add their work. Each separate Trade Contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical, fire protection and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and Coordination Drawings. If the Contractor allows one trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.

C. The Contractor's Coordination Drawings shall indicate structural loads at support points for all piping 10-inch and larger, racked piping, racked conduit. Submit to Structural Engineer for review and approval. The elevation, location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial construction. Penetrations shall be dimensioned for walls, floors and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the Drawings.

D. This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade contractors to make any unauthorized changes to the Contract Documents. Contract document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Architect to change them.

E. Prior to final acceptance of the work, the Contractor shall submit the Coordination Drawings as part of the Record Drawing submittal.

3.05 EXAMINATION OF SITE

A. The Contract Documents do not make representations regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work.

B. Evaluate existing conditions that may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine

the Drawings or other information does not relieve the Contractor of responsibility for satisfactory completion of the work.

3.06 EXCAVATION AND BACKFILL

A. Provide excavation for the work of this Division. Excavate all material encountered, to the depths indicated on the Drawings or as required. Remove excavated materials not required or suitable for backfill from the site. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water that accumulates. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.

B. Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum overdepth of four inches below the trench depths indicated on the Drawings or as required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine tamped to a compaction level of at least 95 percent of standard proctor density or 75 percent relative density or as specified by the Architect. Whenever unstable soil that is incapable of properly supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

C. Excavate trenches for utilities that will provide the required minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown.

D. Trenches shall not be placed within ten (10) feet of foundation or soil surfaces that must resist horizontal forces.

E. Do not backfill trenches until all required tests have been performed and the installation observed by the Architect. Comply with the requirements of other sections of the specifications. Backfill shall consist of non-expansive material with limited porosity. Deposit backfill in 6-inch thick layers and tamp carefully until the plumbing work is covered by not less than 12 inches of material. Backfill and tamp remainder of trench at 1-foot intervals until complete. Uniformly grade the finished surface.

3.07 CUTTING AND PATCHING

A. Where cutting, channeling, or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of piping or equipment, lay out the work carefully in advance. Repair any damage to the building, piping, equipment or finishes using skilled tradesmen for all required work.

B. Do not cut, channel or drill unfinished masonry, tile, etc. unless written permission is obtained from the Architect. Perform this work in a manner acceptable to the Architect.

C. Where piping or equipment are mounted on a painted finished surface, or a surface to be painted, paint to match the surface. Cold galvanize bare metal whenever support channels are cut.

D. Provide slots, chases, openings and recesses through floors, walls, ceilings and roofs as required. Where these openings are not provided, provide cutting and patching to accommodate penetrations at no additional cost to the Owner.

3.08 PROHIBITED LABELS AND IDENTIFICATIONS

A. Prohibited Markings: In all public areas, tenant areas, storage areas and similar locations within the project, the inclusion or installation of any equipment, fixture or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited.

B. Exception: Required Underwriters Laboratories labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.09 EQUIPMENT PAD AND ANCHOR BOLTS

A. Provide concrete pads under all floor-mounted plumbing equipment. This includes electrical components, equipment mounted on legs and pipe support stands. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 2-inch margin around the equipment and supports. Pads shall be a minimum of 4 inches high and made of a minimum 28-day, 2500-psi concrete reinforced with 6-inch by 6-inch 6/6-gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a ¾-inch radius. Use shop drawings stamped “NO EXCEPTIONS NOTED” or “EXCEPTIONS NOTED” for dimensional guidance in sizing pads.

B. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Verify bolts size, number and embed depth recommended by the manufacturer of the equipment with seismic calculations as specified, and locate by means of suitable templates.

C. Where equipment is mounted on gypsum board partitions, the mounting screws will pass through the gypsum board and be securely attached to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6-inch square, 18-gauge galvanized metal backplates that are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not acceptable.

3.10 DELIVERY, DRAYAGE AND HAULING

A. Include all drayage, hauling, hoisting, shoring and placement in the building of equipment specified and be responsible for the timely delivery and introduction of equipment to the project as required by the construction schedule. If any item of equipment is received prior to the time it is required, be responsible for its proper storage and protection until the time it is required. Pay for all costs of demurrage or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc., at no additional cost to the Owner.

3.11 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment and material of other trades from damage by work or workers of this trade, and correct damage caused without additional cost to the Owner.

B. The Contractor shall be responsible for all work, materials and equipment until finally inspected, tested and accepted. Protect work against theft, injury or damage; and carefully store material and equipment received on site that is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of dust, dirt, water or other obstructing material. Cover and protect equipment and materials from damage due to water, moisture, humidity, paint, spray-on fireproofing, construction debris, etc. Store equipment subject to moisture damage, such as insulation or electrical components in dry heated spaces.

C. Provide adequate means for fully protecting finished parts of the materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair. Replace all wet or damp insulation.

3.12 ELECTRICAL EQUIPMENT AND ELECTRICAL ROOM PRECAUTIONS

A. Do not install piping or equipment not included as part of the electrical work, in the following rooms: switchgear, transformer, generator, elevator equipment, telephone, fire command, security, dimmer or electrical equipment rooms.

B. Do not install piping, equipment above switchboards, disconnects, panelboards, dimmers, control panels, VFDs, motor control centers, individual motor controllers, electronics, etc or the code required service space for these electrical devices.

3.13 EQUIPMENT GUARDS

A. Provide easily (without tools) removable expanded metal guards for all hot surfaces, belts, couplings, and other moving parts of machinery. Provide tachometer openings in the guards at least 2 inches in diameter, for all belt-driven, gear-driven or variable speed machinery. Comply with OSHA requirements for all equipment guards.

3.14 LUBRICATION

A. Provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a metallic lubrication

tube with suitable fitting to an accessible location and identify it with permanent laminated plastic nameplates. Identify this location in the maintenance manual.

B. After installation, properly lubricate all parts requiring lubrication and keep them adequately lubricated with a lubricant recommended by the equipment manufacturer until Owner acceptance.

3.15 DATE OF COMPLETION AND TESTING OF PLUMBING SYSTEMS

A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and the Contract closeout. Complete any adjustments and/or alterations that the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual sections for extent of testing required.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when tests will be performed. Submit completion schedule for review within three (3) months after the notice to proceed by Owner or Owner's Representative has been given. Update this schedule periodically as the project progresses.

3.16 OPERATING INSTRUCTIONS AND OPERATOR TRAINING

A. Provide the services of factory-trained specialists to supervise the operation of all equipment and systems specified and train the Owner's operating and maintenance personnel for a three (3) day operating/instruction period. Operating instruction time is defined as straight time working hours and not including nights, weekends or travel time to and from the project. Refer to individual sections for additional training and instruction by manufacturer's trained specialists.

B. Notify the Owner in writing at least three (3) weeks before the operating/instruction period begins. Do not commence until the Owner has issued written acceptance of the starting time and schedule.

C. In addition to the operating/instruction period, organize and conduct a seminar to instruct the Owner's Representatives in the operation and general preventative maintenance of equipment and systems provided at the completion of the project.

D. Instruct Owner's operating personnel in proper starting sequences, operation, shutdown, and maintenance procedures, including normal and emergency procedures.

E. Make arrangements to give instructions by system and not by building areas.

F. Provide services of qualified personnel, including each sub-trade, each major equipment supplier to attend seminar and instruct on respective equipment or systems. Seminar shall be conducted by the Contractor and may be videotaped and attended by the Architect or Architect's Representative.

G. Submit seminar agenda, schedule and list of representatives to the Owner for review thirty (30) days prior to seminar. Confirm attendance at seminar by written notification to participants.

H. At seminar, submit final copies of record drawings and operating and maintenance manuals to Owner.

I. Submit a written record of the seminar, complete with an attendance list to the Owner.

3.17 OPERATING AND MAINTENANCE MANUALS

A. Provide operating instructions and maintenance manuals for all equipment and materials furnished under this Division.

B. Submit three (3) final copies of operating and maintenance data books for review at least ten (10) weeks before the completion date. Provide 8.5-inch by 11-inch, expanding spine catalog binders bound with heavy red fabric, hot stamp lettering on front and spine identifying project name and Owner's name. Assemble data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item.

C. Index the maintenance manual according to the following system:

1. Tab – 1.0 Plumbing Systems: Title page identifying project, Owner, Contractor and Engineer with clear plastic protection cover.
2. Tab – 1.1 List of Plumbing Drawings.
3. Tab – 1.2 Description of Systems: Provide complete descriptions of the operating sequence for each system. Include detailed system description, with individual components described, and description of how components interface with others and to the complete system.
4. Tab – 1.3 Operating Division: Provide information on locations of components, how to energize switches and controls, how components interface with other components, operation of controls including operational sequence, complete troubleshooting sequence, and failure and safeguards to indicate if equipment goes off-line.
5. Tab – 1.4 Maintenance and Lubrication Division: Provide general maintenance and lubrication schedule for major components and include daily, weekly, monthly, quarterly, semiannual and yearly checks and tasks. Explain how to execute maintenance tasks required for typical equipment such as bearings, drives, motors and filters. Compile this information for equipment separate from shop drawings.
6. Tab – 1.5 List of Equipment Suppliers and Contractors: Provide list of equipment suppliers and contractors, including street addresses, website addresses, fax and toll-free telephone numbers.
7. Tab – Certification (2.0, 2.1, etc.): Include copy of test data on disinfection, chlorination and flushing of systems, analysis of water quality taken at time system was put into operation, hydrostatic or air tests performed on piping systems, equipment alignment certifications, copy of balancing data for water systems, copy of valve identification and pipe color code and inspection approval certificates from Authorities Having Jurisdiction.

8. Tab – Shop Drawings and Maintenance Bulletins (3.0, 3.1, 3.2, etc.): Provide material received in compliance with clause "Submittals and Reviews".

D. The manual divider and tabs shall be laminated mylar plastic and colored as follows:

Plumbing Systems	1.0	–	1.5	Orange
Certification	2.0	–	2.4	Green
Shop Drawings & Maintenance	3.0	–	3.17	Yellow

E. Plastic tabs with typewritten card insertions will not be accepted.

F. Maintenance information shall include complete lubrication, cleaning, and servicing data compiled in clearly and easily understandable format. Show model and serial number of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

G. Provide the following equipment maintenance information where applicable:

1. Identifying name and number
2. Locations (where several similar items are used, provide a list)
3. Complete nameplate data
4. Parts list
5. Performance curves and data
6. Wiring diagrams
7. Lubrication charts
8. Manufacturers' recommended operating and maintenance instructions, with all non-applicable information deleted
9. List of spare parts recommended for normal service requirements
10. Assembly and disassembly instructions with exploded view Drawings, where necessary
11. Trouble shooting diagnostic instructions, where applicable

3.18 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the project site a complete set of Record Drawings. The Record Drawings shall initially consist of a set of blueline prints or AutoCAD files of the Contractor's Coordination Drawings. The prints shall be marked or the AutoCAD files electronically updated to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, and all changes and deviations in the plumbing work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite written instructions from the Architect or Engineer. The updated Coordination Drawings shall be used to produce the final Record Drawings that shall be delivered to the Owner in AutoCAD electronic format media upon project completion.

B. Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two (2) dimensions to permanent structures.

C. The Contractor and subcontractor shall mark all in-progress Record Drawings on the front lower right hand corner with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
(⅜-inch high letters)

To be used for recording Field Deviations and Dimensional Data Only
(5/16-inch high letters)

D. Upon completion of the work, the Contractor and subcontractors shall certify all Record Drawings on the front lower right hand corner adjacent to the above marking with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
CERTIFIED CORRECT
(⅜-inch high letters)

(Printed Name of General Contractor)
(5/16-inch high letters)

Date: _____

(Printed Name of Subcontractor)
(5/16-inch high letters)

Date: _____

E. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Record Drawings to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the Record Drawings. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

3.19 CERTIFICATION

A. Any certifications required by the Specifications, in addition to those required for shop drawings, product data, equipment and other items, are to be so certified in writing by the Owner, a Partner, or a Corporate Officer of the firm required to provide the Certification, or by another person duly authorized to sign binding agreements for and on behalf of the Owner, Partner or Corporation.

3.20 FINAL REVIEW

A. At a time designated by the Owner, the entire system shall be reviewed for compliance with the Contract Drawings and Specifications. Be available at all times during this review.

B. Demonstrate to the Owner and/or the Architect's personnel prior to the Final Review that systems and equipment have been properly balanced and adjusted and are in compliance with the requirements of the Contract Documents. After these demonstration tests are satisfactorily completed, but prior to the Final Review, submit a written certification that: 1) attests to the Contract Document compliance for this project; and 2) certifies that the equipment and materials installed in this project contain no lead, asbestos or PCB. Prior to the final review, the Contractor shall confirm the following items regarding the status of key elements of the work. Negative responses to any of the items indicate that the construction is not substantially complete, and the building is not ready for a final review. The Contractor shall confirm the following in writing:

1. Building has normal electrical power.
2. The emergency or stand-by power system has been started up, commissioned, and is standing by.
3. Building systems have been cleaned.
4. Seismic restraints have been inspected as specified. Any required special inspections have been completed.
5. Building systems have been balanced and copy of balance report submitted to the Architect.
6. Building fire and life safety systems have been tested and accepted by the local authorities. Any required special inspections have been completed.
7. All final wiring connections have been rechecked.
8. All base building lighting systems are completely installed and operating.
9. The domestic cold water system has been installed, flushed, disinfected, tested and operating.
10. The domestic hot water systems are completely installed, flushed, disinfected, tested and operating.
11. The sanitary sewer and storm sewer systems are completely installed, operating, connected to the required city, public or private utilities and pressure tested.
12. There are no deviations or non-compliance with the Contract Documents; otherwise, provide a detailed account of any and all deviations or non-compliance.
13. All items on field review reports have been responded to in writing and are resolved to the satisfaction of the Owner.
14. All outstanding items on submittals and shop drawings have been addressed in writing and are resolved to the satisfaction of the Owner.
15. Schedule the final review only after providing written confirmation of all items above. Provide a minimum of ten (10) days notice.

C. Certificates and Documents required by the Contract shall be presented to the Architect at least two (2) weeks prior to the Final Review.

D. After the Final Review, any changes or corrections noted as necessary for the work to comply with the Contract Documents shall be accomplished without delay in order to secure final acceptance of the work.

3.21 EARLY OCCUPANCY

A. Be responsible for completing those systems, which are necessary to allow partial occupancy of the building even if systems in the unoccupied areas are incomplete.

B. Verify and comply with requirements for temporary occupancy with the local Building Department.

END OF SECTION

SECTION 22 05 13
ELECTRIC MOTORS FOR PLUMBING EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Constant speed, variable speed and two-speed squirrel cage, polyphase electric induction motors for plumbing equipment.

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 14 – Variable Frequency Drives for Plumbing

C. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

D. Section 22 33 19 – Acoustics for Plumbing

E. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

A. Institute of Electrical and Electronic Engineers (IEEE)

1. ANSI/IEEE 112 – 2004: Standard Test Procedure for Polyphase Induction Motors and Generators

B. National Electrical Manufacturers Association (NEMA)

1. ANSI/NEMA MG-1 – 2011: Motors and Generators

C. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70 – 2008: National Electric Code (NEC)

D. Underwriters Laboratories Inc. (UL)

1.04 QUALITY ASSURANCE

A. Electrical Coordination

1. Unless otherwise indicated on the drawings, all starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are provided as specified by Division 26.
2. Division 26 drawings and specifications show number and horsepower rating of all motors furnished by this Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are

awarded, Contractor shall immediately notify the Architect of such discrepancy. Refer to Section 22 05 01 – Plumbing General Provisions.

3. Furnish project-specific wiring diagrams to Division 26 Contractor for all equipment and devices furnished under this Section.

B. Motors intended for variable speed applications shall have UL approval for use on "Generic" pulse width modulated and/or 6-Step waveforms. Motors requiring one specific manufacturer of VFD to meet the UL criteria are not acceptable.

C. Motors shall conform to applicable requirements of ANSI, IEEE, NEMA, and NEC standards and shall be UL Listed for the service specified.

D. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

1.05 SUBMITTALS

A. Submit motors under the sections covering the driven equipment.

B. Submit motor efficiencies at full load, 75 percent full load, and 50 percent full load.

C. Submit certified dimensions, insulation class, NEMA frame size, materials of construction, base details and mounting details.

D. Include, with the motor-driven equipment submittal, the following motor information: manufacturer, horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project-specific wiring diagrams prepared by the Contractor specifically for this work.

E. Include manufacturer's instructions in the operating and maintenance manuals for the specific equipment. Include the following information, if not previously documented on shop drawings: full load power factor, service factor, NEMA design designation, insulation class, frame type.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Constant Speed Applications: Toshiba Model E.Q.P., Magnetek E-Plus III, Baldor Super-E®, Reliance XE Premium, General Electric Energy Saver, Marathon Series E

B. Inverter Duty Motors: U.S. Electrical Motors "Inverter Grade"®, Baldor "Inverter Drive"®, or approved equal

2.02 GENERAL

A. Provide electric motors for driving the plumbing equipment. Motors shall be of proper power, construction and speed to suit the specified manufacturers of plumbing equipment. If other manufacturers of equipment are accepted, the proper adjustment of motor speed, torque and power must be included without additional cost. Submit drawings for review before the equipment is purchased.

B. Motors scheduled for use with variable speed drives shall be “inverter ready” and shall meet NEMA MG-1 Part 31.4.4.2. Motor shall incorporate ISR (Inverter Spike Registered) copper windings and Class F insulation. Motor shall withstand 1,600 volt spikes. Motors shall be suitable for 10:1 speed reduction.

C. Motor temperature rise when operating on a variable frequency drive shall not exceed Class F insulation limits at full load, with 115 degrees C allowable winding hot spot temperature, across its nameplate speed and torque envelope. Sine-wave temperature rise shall be Class F or better.

D. Motors shall have minimum Class B insulation for continuous full load duty at 40 degrees C and a maximum altitude of 3,300 feet above sea level. Where normal operating temperatures will exceed the Class B insulation rating, provide Class F insulation. For all motors driven by variable frequency drives, provide Class H insulation.

E. Motors shall be of quiet operating type, guaranteed to fulfill the specified requirements without producing any objectionable sound exceeding room NC levels as specified. All belt-connected motors shall have adjustable bases and set screws to maintain proper belt tension. Provide proper belt guards, in accordance with OSHA Standards.

F. Motors and accessories shall be UL Listed and comply with NEMA standards.

G. Minimum Service Factor:

1. Constant speed applications: 1.15.
2. Variable speed application: Nameplate sine-wave service factor shall be 1.15 or greater.

H. Coordinate the NEMA type of each motor with the torque and inertia load of the equipment served, and the in-rush current characteristics of the motor with the motor starter selection, so that all items furnished constitute a complete motor control and protection package. Motor shall not operate in the 15 percent service factor range.

I. Motors subject to outside air elements shall be totally enclosed fan cooled; others shall be open drip-proof design. Motors one horsepower or larger shall have encapsulated stator windings of the epoxy or silicone type.

J. All motors ½ horsepower and larger, except two-speed motors, specially wound motors and in-line pump motors frame size 56 and smaller, shall be high efficiency design with full load efficiencies (in percent) which meet or exceed the values listed below when tested in accordance with NEMA MG:

MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED						
Horsepower	1,200 rpm		1,800 rpm		3,600 rpm	
	ODP	TEFC	ODP	TEFC	ODP	TEFC
½ and ¾	80.0	80.4	82.1	82.7	79.1	78.5
1	82.5	82.5	85.5	85.5	80.0	85.5
1.5	86.5	87.5	86.5	86.5	85.5	86.5
2	87.5	88.5	86.5	86.5	86.5	88.5
3	89.5	89.5	89.5	89.5	86.5	89.5

MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED						
Horsepower	1,200 rpm		1,800 rpm		3,600 rpm	
	ODP	TEFC	ODP	TEFC	ODP	TEFC
5	89.5	89.5	89.5	89.5	89.5	91.0
7.5	91.7	91.7	91.0	91.7	89.5	91.7
15	92.4	91.7	93.0	91.7	91.0	91.7
20	92.4	92.4	93.0	92.4	92.4	92.4
25	93.0	92.4	93.6	93.0	93.0	93.0
30	93.6	93.0	94.1	93.6	93.0	93.0
40	94.1	93.6	94.1	93.6	93.6	93.6
50	94.1	94.1	94.5	94.1	93.6	94.1
60	95.0	94.1	95.0	94.5	94.1	94.1
75	95.0	94.5	95.0	95.0	94.5	94.5
100	95.0	95.0	95.4	95.4	94.5	95.0
125	95.4	95.4	95.4	95.4	95.0	95.4
150	95.8	95.4	95.8	95.4	95.4	95.4
200	95.4	95.8	95.8	95.8	95.4	95.8

K. Each motor shall be factory-wired to a junction box mounted on the motor or on the driven piece of equipment to facilitate single point of field power connection under Division 26.

2.03 TWO-SPEED MOTORS

A. Advise Division 26 Contractor and verify availability of speed combinations for all two-speed motors. Verify motor starter compatibility for two-speed, two winding and/or two-speed, single-winding.

B. Unless otherwise indicated, three-phase two-speed motors shall be single winding, consequent pole, variable torque type and single phase motors shall be capacitor start capacitor run type having two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

2.04 VARIABLE SPEED APPLICATIONS

A. Motors used with variable frequency drives shall be designed specifically for use on AC inverter power and adjustable speed applications, with the following requirements:

1. Frame materials shall be cast iron, aluminum or rolled steel.
2. Motor insulation shall be Class H and designed to meet the voltage spike limits defined by NEMA MG-1, Part 31. Insulation systems shall utilize 200 degree C magnet wire with a Pulse Endurance Index greater than 100. Insulation systems utilizing heavy film wire are not acceptable. Complete insulation of the slot, cell and phase groups is required. The system shall be rated for Class F rise or better.
3. Stator core designs shall be of high rigidity with reinforced end turn construction to minimize mechanical fatigue of the winding, and to reduce resonant noise. Varnished materials shall be double dip, double bake using polyester phenolic Class H varnish. Single dip and bake cycles are not acceptable.
4. Winding thermal protection, utilizing normally closed contacts, shall be sized to match the maximum safe operating temperature of the insulation

system. Contacts shall open when winding temperature reaches 155 degrees C. Hazardous location motors shall have winding thermal protection sized as required to meet UL or as auxiliary devices where not required by UL.

5. Low loss electrical steel shall be utilized in the stator and rotor core assemblies.
6. Maximized copper content shall be utilized to achieve high motor efficiency and thermal transfer.
7. Rotor cores and/or assemblies shall be of a low vibration design that meets one-half of the NEMA MG-1 recommended levels for balance.
8. The final motor design shall be evaluated by factory test on inverter power over the full range of speeds.

B. Variable Torque, Variable Speed Motors:

1. Motors shall meet NEMA design “B” performance levels. Design “A” motors are acceptable when higher than normal efficiencies are required.
2. Motors shall be nameplated for 6 to 60 Hertz operation. Hazardous location motors may be nameplated 10 to 60 Hertz.

C. Constant Torque, Variable Speed Motors:

1. Motors intended for constant torque applications shall be TEFC, TENV or TEBC (Totally Enclosed Fan Cooled, Totally Enclosed Non-Ventilated, or Totally Enclosed Blower Cooled) construction.
2. TEFC motors rated for 3:1 constant torque on “GENERIC” inverter power shall meet NEMA design “B” levels. TENV motors and motors rated for speed ranges greater than 3:1 may be rated as NEMA design “A”. TEBC motors shall meet NEMA design “B” levels.
3. Motors shall meet NEMA criteria for mechanical construction.

D. Nameplates:

1. Performance data for adjustable speed operation shall be stamped on a steel data plate and permanently attached to the motor frame.
2. The minimum amount of adjustable speed nameplate data shall include:

    a. Application Type – Constant Torque, Variable Torque or Constant Horsepower.
    b. Maximum approved continuous torque.
    c. Approved RPM and frequency operating range.
    d. Typical motor full load amps on VFD (inverter) power.

E. Motors used in variable-speed applications shall have the following minimum NEMA nominal efficiency levels nameplated on the motor:

Horse-power	**Open Drip-Proof**			**TEFC**		
	2 Pole	4 Pole	6 Pole	2 Pole	4 Pole	6 Pole
1	—	85.5	80.0	—	85.5	81.5
1.5	82.5	85.5	84.0	84.0	85.5	85.5
2	84.0	85.5	86.5	86.5	85.5	87.5
3	84.0	89.5	88.5	87.5	89.5	90.2
5	87.5	89.5	88.5	88.5	90.2	90.2

Horse-power	Open Drip-Proof			TEFC		
	2 Pole	4 Pole	6 Pole	2 Pole	4 Pole	6 Pole
7.5	87.5	91.0	91.0	91.0	91.0	91.0
10	88.5	91.0	91.0	91.0	91.7	91.0
15	89.5	92.4	91.7	91.0	92.4	91.7
20	91.0	93.0	91.7	91.0	93.0	91.7
25	91.7	94.1	93.0	91.7	93.0	92.4
30	93.0	94.1	93.6	91.7	93.6	93.0
40	93.0	94.1	94.5	92.4	93.6	94.5
50	93.0	94.5	94.5	93.0	94.5	94.5
60	93.6	95.0	94.5	93.0	94.5	94.5
75	94.1	95.0	94.5	93.6	95.0	94.5
100	94.1	95.4	95.0	94.5	95.4	94.5
125	95.4	95.4	95.4	94.5	95.0	95.0
150	94.5	95.8	95.4	94.5	95.4	95.4
200	94.5	95.8	95.4	95.4	95.4	—

F. The above efficiency values represent motor designs rated for 230 VAC or 460 VAC at 1,800 rpm nominal speed. Other base speeds and/or voltages may deviate from the above levels, but the NEMA nominal efficiency must be provided at the time of the bid.

PART 3 – EXECUTION

3.01 INSTALLATION

A. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts. Adjust as necessary so that run-out does not exceed 0.002 inches. Set all direct driven equipment with not more than one-half of the coupling manufacturer's recommended maximum tolerance for parallel and angular variance in alignment.

B. Align all belt-driven equipment to provide minimum wear on belts and drives, with belts properly tensioned.

C. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot for a secure and level installation.

3.02 START UP

A. Coordinate overload heater requirements with motor starter provider.

B. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

C. Lubricate all motors requiring lubrication. Record lubrication material used and the recommended frequency of lubrication. Include this information in the maintenance manuals.

END OF SECTION

SECTION 22 05 14
VARIABLE FREQUENCY DRIVES FOR PLUMBING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Variable Frequency Drives (VFD) for plumbing equipment where indicated.

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 13 – Electric Motors for Plumbing

C. Section 22 11 23 – Plumbing Pumps

D. Section 22 33 19 – Acoustics for Plumbing

E. Section 23 09 00 – Building Management System (BMS)

F. Section 23 09 93 – Automatic Control Sequences

G. Section 23 21 23 – Pumps

H. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

A. International Electrotechnical Commission (IEC)

1. IEC 61800-1 Ed. 1.0 (1997) – Adjustable Speed Electrical Power Drive Systems – Part 1: General Requirements – Rating Specifications for Low Voltage Adjustable Speed D.C. Power Drive Systems
2. IEC 61800-2 Ed. 1.0 (1998) – Adjustable Speed Electrical Power Drive Systems – Part 2: General Requirements – Rating Specifications for Low Voltage Adjustable Speed A.C. Power Drive Systems

B. Institute of Electrical and Electronic Engineers (IEEE)

1. IEEE 519-1992 (revised 2004): Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

C. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS 7.0 – 2006 – Industrial Control and Systems Adjustable-Speed Drives
2. NEMA ICS 7.1 – 2006 – Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems

D. National Fire Protection Association (NFPA)

1. NFPA 70, Edition 2008 – National Electrical Code

E. Underwriters Laboratories Inc. (UL)

1. UL 508C – 2002 Revised 2008: Power Conversion Equipment

1.04 QUALITY ASSURANCE

A. Provide a 2-year unconditional parts and labor warrantee on all VFD components. The warranty shall include all parts, labor, travel time and expenses.

B. Qualifications: VFDs and components shall be UL Listed as a complete assembly. VFDs that require field-supplied external fuses for the VFD to be UL Listed are not acceptable.

1.05 SUBMITTALS

A. Product Data as specified, including outline dimensions, weights, power and control wiring schematics, and equipment schedule.

B. IEEE – Standard 519 compliance calculation and harmonic analysis for this particular installation:

1. Total harmonic voltage distortion and total harmonic current distortion. Provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5 percent.
2. Input line filters shall be sized and provided as required by the manufacturer to ensure compliance with IEEE standard 519.
3. All VFDs shall include a minimum of a 3 percent impedance reactor.

C. Start-up Service Report and Guarantee.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Variable Frequency Drives: Toshiba, ABB, Graham/Danfoss

2.02 AC VARIABLE FREQUENCY DRIVE

A. Provide completely assembled VFD, factory-tested by the manufacturer. The VFD shall operate from a line overvoltage of 30 percent over nominal. The undervoltage trip level shall be 35 percent under the nominal voltage as a minimum.

B. The alternating current variable speed drive system shall include the microprocessor based variable frequency controller, the required signal logic and control. The electrical drive equipment specified including the variable frequency controller and its associated microprocessor control system shall be of the same

manufacturer. Coordinate with driven equipment supplier to ensure compatibility between drive and AC Motors.

C. All equipment shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and NEMA. The electrical equipment, as well as the design, construction, and installation thereof, shall comply with all the applicable provisions of the National Electrical Code and be ETL-SEMKO or UL approved.

D. The variable frequency drive shall be mounted in a NEMA 1 enclosure for drives inside the building, NEMA 12 enclosure for drives in air handling plenum spaces, parking garages (or other public accessible spaces), and NEMA 3R enclosure for drives outside the building. The control circuitry shall be isolated from the power circuitry.

E. The manufacturer shall submit calculated line distortion percentages in accordance with IEEE Standard 519, based upon the total connected horsepower and source kilovolt-amperes of the utility and emergency power distribution system. Request electrical data for calculation from the Division 26 contractor.

F. The speed controller shall respond to a speed adjusting potentiometer from the VFD sequence panel when in the manual mode or shall respond to a milliamp or voltage electrical signal when operating in the automatic mode.

G. The cabinet shall require front access only. The unit shall be suitable for operation in ambient air at 0 degrees C to 40 degrees C and up to 95 percent RH at rated load and switching frequency.

H. The variable frequency controller shall convert 230 or 480 volt (plus or minus 30 percent) 3-phase, 60 hertz (plus or minus 3 percent) utility supplied or standby generator supplied power to variable frequency, variable voltage three-phase AC power for induction motor speed control. The controller shall be selected to have sufficient capacity to provide stepless speed control of the specified horsepower motors throughout a continuous speed range under a variable torque load not exceeding the motor full-load rating.

2.03 VARIABLE FREQUENCY CONTROLLER

A. The controller shall be of the pulse width modulated (PWM) type and shall have three sections including a minimum 3 percent line impedance reactor as follows:

1. AC-DC section (a 3-phase, full wave, half diode bridge or transistor bridge)
2. Capacitor section
3. 3-phase output module

B. The controller shall be capable of performing the following functions:

1. Adjustable linear timed acceleration and deceleration
2. Plus or minus 0.5 hertz frequency stability
3. 10:1 controlled speed range
4. Manual/automatic operation
5. Other functions as described

C. Include the following protective devices and/or features:

1. Regulator with self-contained test module or panel.
2. Contactor shall be vacuum break design to carry specified current (OLT) on continual basis without damage (normal condition), designed to break specified locked rotor ampere current repeatedly without damage (abnormal operation). Entire VFD assembly shall be rated for minimum 60,000 amperes interrupting capacity root mean square symmetrical (AIC RMS).
3. AC overload protection to continuously monitor peak current and shut down the DC module gate signals if the instantaneous electrical trip motor current exceeds 180 percent of the controller full load current rating.
4. Monitor lamps or LED read-out on VFD front panel to provide immediate indication of controller functions.
5. Current limit.
6. Adjustable volts/hertz.
7. Adjustable offset voltage increases starting and accelerating torque capability.
8. All output phase modules shall turn off instantly when a high DC bus occurs or when the current exceeds 150 percent of rated current.

D. The following controller adjustments shall be contained on one regulator card of microprocessor control board:

1. Minimum hertz/maximum hertz
2. Acceleration rate (adjustable 0 to 125 seconds)
3. Deceleration rate (adjustable 0 to 125 seconds)
4. Volts/hertz
5. Offset voltage

E. Provide a test panel or module to permit on-line monitoring and troubleshooting of the drive. Monitor the following regulator signals:

1. Internal power supplies
2. Ramp generator output
3. DC bus voltage

2.04 SAFETY CONTROLS AND PROTECTIVE COMPONENTS

A. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.

B. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which shall utilize the inertia of the load to keep the drive powered.

C. The overload rating of the drive shall be 110 percent of its normal duty current rating for 1 minute every 10 minutes. The minimum full-load ampere rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

D. The VFD shall have an integral 3 percent impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients.

E. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that allow for drive acceleration from zero speed without signaling a false underload condition.

F. Provide surge reduction filter for electrical circuit lengths in excess of 200 feet.

G. The following shall be provided:

1. Motor thermal overload relays at the output for motor protection.
2. Enclosure door interlocked disconnect switch.
3. All coils for relays and contactor shall be suppressed.
4. Automatic Restart: Controller shall automatically attempt to restart five (5) times after a fault. After five (5) restarts, a manual start of the drive equipment is required.
5. The following contacts shall be wired to terminal boards of users control and indication:

    a. Motor running speed
    b. Drive faults
    c. Remote stop-starting

6. A complete factory-wired and -tested bypass system consisting of an output contactor and bypass contactor. Overload protection and single phase protection shall be provided in both drive and bypass modes. Include door-mounted manual by-pass switch with bypass contactor and indicator light. Electronic bypasses are not acceptable.

H. Drive faults shall consist of the following:

1. Motor thermal overload.
2. AC input voltage dips to 60 percent or less of its nominal value.
3. Drive output current exceeds 110 percent of controller full load rating.
4. A fault condition in any of the 3 output power module phases.

2.05 ADJUSTMENTS AND CONTROLS

A. All VFDs shall have the following operator adjustable components:

1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
2. PID setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 milliamp of 24 volts DC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
3. Two (2) programmable analog inputs shall accept a current or voltage signal.

4. One (1) programmable analog output.
5. Two (2) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times. Default settings shall be for run and not faulted (fail safe).
6. Seven (7) programmable preset speeds.
7. Two (2) independently adjustable acceleration and deceleration ramps.

B. All VFDs shall have the same interface, including backlit LCD digital display and keypad, regardless of horsepower rating.

1. The keypad shall be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable/lockable to the cabinet, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
2. The keypad shall include Hand-Off-Auto selections. When in “Hand”, the VFD shall be started and the speed will be controlled from the up/down arrows. When in “Off”, the VFD shall be stopped. When in “Auto”, the VFD shall start via an external contact closure and the VFD speed shall be controlled via an external speed reference. Manual pilot devices are not acceptable.
3. Display shall indicate drive frequency, output voltage or output current. Provide an indication of the activation of the drive protection features and/or status in plain English without the use of code abbreviations as follows:

    a. Overcurrent
    b. Overvoltage
    c. Current Limit
    d. Decel Voltage Limit
    e. Ground Fault
    f. Overtemperature
    g. I^2T Protection
    h. Improper Input Voltage Selected
    i. Minimum/Maximum Speed Improperly Adjusted

C. Serial Communications:

1. The VFD shall have an RS-485 port as standard. The standard protocol shall be Modbus. Optional protocols that must be available are: Johnson Controls N2 bus, Profibus and DeviceNet.
2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. A minimum of 15 field parameters shall be capable of being monitored. The DDC system shall be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. The drive shall have the capability of allowing the DDC to monitor feedback as a minimum, with 5 additional:

    a. Process variable feedback
    b. Output speed/frequency
    c. Current (in amps)

d. Percent torque
e. Power (kW)
f. Kilowatt hours (resettable)
g. Operating hours (resettable)
h. Relay outputs
i. Diagnostic warning and fault information
j. Remote VFD fault reset shall be possible

3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. This control shall be independent of any VFD function. The outputs can be used for modulating chilled water valves via the analog output, actuate a damper etc. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

D. The following shall be furnished and mounted by the drive manufacturer and shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL 508 label:

1. Fused VFD only disconnect (service switch). Fast acting semi-conductor fuses exclusive to the VFD to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which do not have fuses, or that, incorporate fuses common to both the VFD and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.
2. The following operators shall be provided:

a. Bypass Hand-Off-Auto
b. Drive mode selector
c. Bypass mode selector
d. Bypass fault reset

3. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

a. Power-on
b. External fault
c. Drive mode selected
d. Bypass mode selected
e. Drive running
f. Bypass running
g. Drive fault
h. Bypass fault
i. Bypass H-O-A mode
j. Automatic transfer to bypass selected

4. The following relay (Form C) outputs from the bypass shall be provided:

a. System started
b. System running
c. Bypass override enabled
d. Drive fault
e. Bypass fault- motor overload or underload due to broken belt

f. Bypass H-O-A position

5. The digital inputs for the system shall accept 24-volt or 115-volt AC (selectable). The bypass shall incorporate internally sourced 24-volt power supply and not require an external control power source.
6. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass mode. The remote start/stop contact shall operate in VFD and Bypass modes.
7. The VFD shall include a "run permissive circuit" that will provide a normally open contact any time a run command is provided (local or remote start command in VFD or Bypass mode).
8. Class 20 electronic motor overload protection shall be included.
9. There shall be an internal switch to select manual or automatic bypass.
10. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication when in the Bypass mode.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall install the drive and power wiring shall be completed in accordance with the recommendations of the manufacturer as outlined in the installation manual.

B. Start-up Service: Provide certified factory-authorized start-up service for purposes of installation inspection, initial drive equipment setting, energization and adjustment. Start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner.

C. Coordinate with equipment supplier to ensure compatibility between variable frequency drive and the motor supplied with the equipment.

D. Division 26 shall mount and wire the drives in locations as shown on the Drawings.

E. Maintain code required electrical clearance around all VFD cabinets.

END OF SECTION

SECTION 22 05 19
METERS, GAUGES AND THERMOMETERS FOR PLUMBING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Pressure gauges
2. Pressure/temperature test ports
3. Thermometers

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 11 10 – Plumbing Piping and Accessories

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ASME – American Society of Mechanical Engineers

1. ASME B40.100 – 2013: Pressure Gauges and Gauge Attachments
2. ASME B40.200 – 2008: Thermometers, Direct Reading and Remote Reading

1.04 QUALITY ASSURANCE

A. Instruments shall be factory-calibrated for the temperature and pressure of the systems in which they are installed.

B. Pressure gauges shall be manufactured in accordance with ASME Standard B40.100.

C. Thermometers shall be manufactured in accordance with ASME Standard B40.200 and ANSI Specification B40.3.

1.05 SUBMITTALS

A. Submit list indicating use, operating range, total range and location.

B. Submit manufacturer's data for instrument types, materials, accessories and installation.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Thermometers: Weiss, Trerice, Weksler, Taylor, Ashcroft

B. Pressure Gauges: Weiss, Trerice, Weksler, Taylor, Ashcroft

C. Pressure/Temperature Test Ports: Peterson Engineering, Trerice, Weksler

2.02 PRESSURE GAUGES

A. Process type in an impact resistant phenolic case, 4.5-inch diameter glycerine-filled phosphor-bronze bourdon tube rated to 600 pounds per square inch. Stainless steel movement, ½-inch brass socket and 1-percent mid-scale accuracy, black figures on white background. Provide brass needle valve and snubber. Weiss Instrument Model LF4UGY1, or equal. Where fluid temperature exceeds 150 degrees F, provide non-liquid filled gauge Weiss Instrument Model NF4UGY1, or equal.

2.03 PRESSURE/TEMPERATURE TEST PORTS

A. Provide test ports ½-inch NPT made of brass with Nordel core. In addition, supply three (3) kits consisting of ¼-inch NPT pressure gauge, gauge adapter with ⅛-inch probe and protecting shield, bi-metal thermometer range 25 degrees F to 125 degrees F with 5-inch stem and 1.75-inch diameter dial, bi-metal thermometer range 20 degrees F to 240 degrees F with 5-inch stem and 1.75-inch diameter dial. Each kit to be provided in an impact-resistant carrying case.

2.04 THERMOMETERS

A. Adjustable angle dial face, bi-metal thermometer, with 2 degree F scale division, accurate to plus or minus 1 percent of scale range, Type 304 stainless steel case and bezel, shatter-proof glass window, silicone filled.

B. For pipes up to 2-inch diameter, Weiss Model SF3VBM, or equal.

C. For pipes larger than 2-inch diameter, Weiss Model SF5VBM, or equal.

D. Thermometers shall be installed where shown on the Drawings or as specified. Pressure temperature ratings of each thermometer shall be suitable for the system in which it is installed. Thermometers shall have the following insertion lengths:

1. Up to 5-inch pipe: 2.5 inches
2. 6-inch thru 8-inch pipe: 4 inches
3. 10-inch thru 16-inch pipe: 6 inches
4. Larger than 16-inch pipe: 9 inches

E. Provide Type 304 stainless steel wells for all pipe-mounted thermometers.

F. Provide extended wells and stem length to accommodate insulation thickness for insulated pipe applications.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install flow meters according to manufacturer's installation instructions. Allow minimum ten (10) pipe diameters upstream of metering station and four (4) pipe diameters downstream, or distances as recommended by the manufacturer.

B. Provide one pressure gauge per pump. Install piping from pressure gauge to taps before strainers and on suction and discharge of pump. Refer to details on the Drawings.

C. For pipes smaller than 2.5 inches, enlarge pipe for installation of thermometer wells.

3.02 SCHEDULE

A. Pressure Gauges:

1. Pumps, inlet and outlet
2. Expansion tanks
3. Storage tanks, inlet and outlet
4. Domestic cold water service, inlet
5. Heat exchangers, inlet and outlet
6. Water heaters, inlet and outlet
7. Pressure reducing valve and/or stations, inlet and outlet
8. Other locations as indicated on the Drawings

B. Pressure/Temperature Test Ports:

1. Pumps, inlet and outlet
2. Mixing valves, inlet and outlet
3. Pressure reducing valve and/or stations, inlet and outlet
4. Other locations as indicated on the Drawings

C. Thermometers:

1. Mixing valves, inlet and outlet
2. Domestic cold water service, inlet
3. Heat exchangers, inlet and outlet
4. Water heaters, inlet and outlet
5. Storage tanks, inlet and outlet
6. Other locations as indicated on the Drawings

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Pipe and un-isolated equipment hangers, anchors and supports.
2. Sleeves, escutcheons.
3. Through-penetration firestopping in fire-rated construction and through-penetration smokestopping in smoke partitions, including methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

C. Section 22 07 19 – Insulation for Plumbing

D. Section 22 11 10 – Plumbing Piping and Accessories

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ANSI – American National Standards Institute: ANSI/ASME B31.1 – 2004: Power Piping

B. ASME – American Society of Mechanical Engineers: ASME B16.19 – 2012: Factory-Made Wrought Butt-Welding Fittings

C. ASTM – American Society for Testing and Materials

1. ASTM A123 / A123M – 2013: Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM B695 – 2009: Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
3. ASTM C1107 / C1107M – 2013: Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
4. ASTM E814 – 1996 Revised 2013: Standard Test Method for Fire Tests of Penetration Firestop Systems

D. CIE/DIN Age Testing

1. Commission Internationale de L'Éclairage (CIE)

a. CIE 170-1:2006 – Fundamental Chromaticity Diagram with Physiological Axes

2. Deutsches Institut für Normung (DIN)

E. ISO – International Organization for Standardization

1. ISO 9001 – 2008: Quality Management System Requirements

F. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1. SP-58-2009: Pipe Hangers and Supports – Materials, Design and Manufacturer
2. SP-69-2003: Pipe Hangers and Supports – Selection and Application
3. SP-89-2003: Pipe Hangers and Supports – Fabrication and Installation Practices

G. UL – Underwriters Laboratories Inc.

1. UL Standard 1479 – 2003 Revised 2008: Fire Tests of Through-Penetration Firestops
2. UL Fire Resistance – 2009: Fire Resistance Directory set

a. Through-penetration firestop devices (UL-XHCR)
b. Fire resistance ratings (UL-BXUV)
c. Through-penetration firestop systems (UL-XHEZ)
d. Fill, void, or cavity material (UL-XHHW)

3. UL Building Materials – 2009: Building Materials Directory
4. UL Component Listing Test Criteria
5. Warnock Hersey Mark (Certification of Building Products)

1.04 QUALITY ASSURANCE

A. Hangers and supports to be constructed and applied according to the following standards:

1. Power Piping: ANSI/ASME B31.1.
2. Firestopping materials shall have been tested to provide fire rating at least equal to that of the construction.
3. Deliver products in original, unopened packaging with legible manufacturer's identification.
4. Mechanical sleeve seals shall be manufactured in an ISO 9001:2008 certified facility.
5. Submit written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

1.05 SUBMITTALS

A. Include on piping shop drawings a layout of masonry and concrete floor and wall sleeve locations for pipes. Include elevations and sleeve sizes.

B. Submit product data on through-penetration firestop. Submittal data for firestopping systems shall include the UL System Numbers listed in the UL Building Materials Directory under which the material was tested in accordance with ASTM E814 (UL 1479) for use in a Through-Penetration Firestop System. Where there is a firestop application that has not been tested by UL, obtain from the manufacturer an engineered judgment that the proposed application of the firestop product is suitable. Submit the engineered judgment to the Authority Having Jurisdiction.

1. Product Data: Manufacturer's specifications and technical data including detailed specification of construction and fabrication, manufacturer's installation instructions and details of each proposed assembly identifying intended products and applicable UL system number or UL classified devices.
2. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:

    a. Manufacturer or manufacturer's representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

C. Submit details of hangers, anchors and supports for each pipe size and service, and individual pieces of equipment.

D. Submit written guarantee as per sub-Clause 1.04, A.5.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pipe Hangers: Anvil, Fee & Mason, Elcen, Tube-Turn, F&S, Pipe Shields, B-Line Kindorf, Michigan Hanger, Power Strut, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by specified manufacturers is acceptable.

B. Sleeves: Pipe Shields, Insul, RK Industries

C. Pipe Wrap Tape: Polycen, Nassua, 3M

D. Firestop: Nelson, Dow, 3M, Hilti

E. Escutcheon Plates: Beaton & Corbin Manufacturing

F. Mechanical Sleeve Seals: Pipeline Seal and Insulator, Thunderline Linkseal, Calpico Pipe Linx, Metraflex Metraseal

2.02 GENERAL

A. Provide hangers of heavy construction suitable for the size of pipe to be supported. Materials shall be of steel, except pipe rolls of wrought or malleable iron.

1. Hangers for pipes six-inches or less shall be swivel ring, wrought pipe clamp, or adjustable wrought clevis type. Anvil Figure 260, MSS-SP-69, Type 1 and MSS-SP-58, Type 1.
2. Hangers for ductile iron or cast iron pipes four-inches or less shall be swivel ring, wrought pipe clamp or adjustable wrought clevis type. Anvil Figure 590, MSS-SP-69, Type 1 and MSS-SP-58, Type 1.
3. Hangers for pipes eight-inches and above shall have two rods and cross-rod with cast iron pipe roll complete with adjustable sockets and nuts. Anvil Figure 177, MSS-SP-69, Type 41 and MSS-SP-58 Type 41.
4. When an oversized clevis type hanger is used (i.e., insulate pipe) a pipe spacer shall be placed over the clevis bolt as a spacer to assure that the lower U-strap will not move in on the bolt.

B. Multiple or trapeze pipe hangers shall be steel channels with welded spacers and hanger rods if hanger load calculations are submitted.

C. Wall support shall be welded steel bracket with hanger.

Light Duty Wall Support:	Anvil Figure 194, MSS-SP-69, Type 31.
Medium Duty Wall Support:	Anvil Figure 195, MSS-SP-69, Type 32.
Heavy Duty Wall Support:	Anvil Figure 199, MSS-SP-69, Type 33.

D. Metal Framing Channels:

1. Provide perforated epoxy painted finish, 12-gauge minimum steel channels securely anchored to wall structure with interlocking, split type, bolt-secured, galvanized pipe/tubing clamps. B-Line type B22, S pattern with B-2000 series clamps, Power-Strut Type PS200 H with PS 1200 clamps or equal.
2. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion, or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Power-Strut PS 004T – PS 106N Series or equal.

E. Support stationary vertical piping with carbon steel double bolt riser clamps attached to the pipe. Weld shear lugs to the pipe. In general, use one clamp for each two floors and one clamp at each floor for copper tubing. Where pipes are in open shafts, provide forged steel bar brackets fixed to wall. Riser clamps shall be copper plated when used with copper pipe. Locate riser clamp immediately under coupling or other fitting. Anvil Figure 261, MSS-SP-69, Type 8 and MSS-SP-58, Type 8 for steel pipe; Anvil Figure CT121, MSS-SP-69, Type 8 and MSS-SP-58, Type 8 for copper pipe.

F. Floor Support for Pipe:

1. Sizes up to 4 inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support. Anvil Figure 264, MSS-SP-69, Type 38 and MSS-SP-58, Type 38.
2. Sizes 5 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support. Anvil Figure 265, MSS-SP-69, Type 38 and MSS-SP-58, Type 38.
3. Provide pipe stanchions for support of pipe elbows at base of riser and vertical piping. Stanchions shall be complete with base plate and vent hole. Anvil Figures 62 and 63.

G. Select hangers and supports in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

H. Hangers shall not be disengaged by movement of supported pipe.

I. Provide copper-plated or felt-lined hangers for copper piping or provide 10-mil pipe wrap tape on pipe at hangers. Tape shall extend a minimum of 2 inches beyond hanger saddle on both ends and be wrapped around pipe a minimum of 2 turns. Install vinyl-coated hangers for all plastic piping.

J. Steel hanger rods shall be threaded both ends, threaded one end, or continuous threaded, black finish. Provide rods complete with adjusting and lock nuts. Anvil Figures 146, 140 or 253.

K. Pipe Support Recommendations for Rigid Grooved Joint Systems: The maximum hanger spacing in the specification to ANSI/ASME B31.1 as noted and should be used only in conjunction with Victaulic 07 zero-flex rigid couplings. For flexible systems the hanger, support, spacing and location refer to the pipe support recommendations section in the Victaulic "Field Assembly and Installation Pocket Handbook" or equivalent provided by Grooved Joint Manufacturer.

L. Beam Clamps:

1. Provide MSS-SP-69 Type 23 malleable black iron clamp for attachment to beam flange up to 0.62 inches thick for single threaded rods of ⅜-, ½-, and ⅝-inch diameter, for use with pipe sizes 4-inch and less. Furnish with a hardened steel cup point set screw. Anvil Figure 86.
2. Provide MSS-SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes up to 1.5-inch diameter but limited in application to pipe sizes 8-inch and less without prior approval. Anvil Figure 228.

M. Continuous Concrete Insert Channels:

1. Provide steel inserts with industry standard pre-galvanized finish, nominally 1⅝-inch wide by 1⅜-inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices.
2. Installed channels shall provide a load rating of 2,000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed for use with continuous concrete inserts are acceptable.
3. Select insert length to accommodate all pipe and conduit in the area.

N. Anchors shall be fabricated using welding steel shapes, plates, and bars to secure piping to the structure.

O. Concrete inserts shall be MSS-SP-69 Type 18 wedge type or universal concrete inserts.

1. Wedge type shall be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to ⅞-inch diameter. Wedge design shall allow the insert to be held by concrete in compression to maximize the load carrying capacity. Anvil Figure 281.
2. Universal type shall be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to ⅞-inch diameter. Anvil Figure 282.
3. Use drilled steel shell with plug type inserts when the inserts are placed after the concrete is poured.

P. Drainage Piping: Provide MSS-SP-69 Type 8 or MSS-SP-69 Type 42 riser clamps for vertical piping, and MSS-SP-69 Type 52, spring hangers at the base of vertical piping.

2.03 SLEEVES

A. Construct sleeves for pipes passing through walls (other than foundation walls), floors, partitions, hung or furred ceilings, etc., of minimum 18-gauge galvanized steel, flanged on each side of wall, partition, hung or furred ceiling, etc.

B. Provide standard weight galvanized steel pipe sleeves with welded anchor flanges at foundation walls and reinforced concrete or masonry walls.

C. Provide cast iron or fabricated “wall pipe” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Provide manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing and underdeck clamping ring with setscrews.

E. Provide mechanical sleeve seals at exterior wall and tank wall penetrations. Seal shall be of the modular sealing element unit type, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic. Include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

F. Install escutcheons at exposed piping through floors, ceilings, walls and partitions in finished areas, within cabinets and millwork, and piping through all fire-rated separations. Provide manufactured wall and ceiling escutcheons and floor plates, with an inside diameter to closely fit around pipe, tube, and insulation of insulated piping and an outside diameter that completely covers opening. Escutcheons shall be cast iron or cast brass, deep-pattern escutcheons if required to conceal protruding fittings, sleeve hubs or firestopping projections.

2.04 PENETRATION FIRESTOP

A. Fire-Rated Construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, and sound or vibration absorption, and at other construction gaps.

B. Smoke Barrier Construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

C. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free. Mortar systems must be Warnock Hersey approved.

D. Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

E. All firestopping products must be from a single manufacturer.

F. Through-penetration smokestopping at smoke partitions: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded in a non-fire rated smoke barrier.

G. Seal all pipe penetrations through fire-rated construction with factory-built devices or with manufactured fill, void, or cavity materials “Classified” by Underwriters Laboratories Inc. for use as a Through-Penetration Firestop. All firestop devices and systems shall be approved for such use by the Authority Having Jurisdiction. The firesafing system used shall maintain the fire-resistance rating of the building component that is penetrated.

H. All materials shall be non-hardening and non-toxic. The firesafing system used shall accommodate expansion and contraction of the floating plumbing piping systems without damaging the firestop or reducing its effectiveness as a smoke barrier or water seal.

2.05 GROUT

A. Grout shall be slow-hardening after application, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

B. Provide ASTM C1107/C1107M, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

C. Design Mix: 5,000 psi, 28-day compressive strength from a premixed and factory pre-package.

PART 3 – EXECUTION

3.01 HANGERS AND SUPPORTS

A. Deflection of pipes shall not exceed $^{1}/_{240}$th (0.416 percent) of span.

1. Support horizontal steel/copper piping in accordance with the following schedule:

Pipe Size (inches)	Maximum Hanger Spacing (feet)		Hanger Rod Diameter (inches)	
	Steel	Copper	Steel	Copper
up to 1	7	5	⅜	⅜
1.25	9	7	⅜	⅜
1.5 & 2	9	8	⅜	⅜
2.5	12	9	0.5	0.5
3	12	10	0.5	0.5
3½	–	11	⅝	0.5
4	12	12	⅝	0.5
5	12	13	⅝	0.5
6	12	14	0.75	⅝
8 to 12	12	14	⅞	0.75
14 & 16	12	–	1	–
18 & 20	12	–	1.25	–
24	12	–	1.5	–

B. Provide hangers at each change in direction and both sides of valves 4-inch and larger. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item. Provide hanger on both sides of “no-hub” mechanical joints.

C. Support hangers from concrete inserts or beam clamps. Furnish, locate and set inserts. Construct inserts of malleable iron or pressed steel with space for rods of all sizes. Install inserts for pipes 3 inches and larger in size with a reinforcing rod ⅝-inch in diameter run through a slot in the insert specifically provided for this purpose.

D. If piping is required in a space where no inserts have been provided, drill holes in the slab (subject to Structural Engineer’s prior approval) and provide rods and hanger attached to an approved fishplate or install double expansion shields connected by a 2-inch by 2-inch angle, from which the hanger rod is to be suspended. For pipe size 2 inches and under use single shields but the hanger spacing shall be reduced to 5 feet. The carrying capacity and size of each shield shall be calculated on the basis of the spacing indicated above but the minimum size shall be ⅜-inch. Install additional shields of the same size so that the number of hangers is of adequate size to support the loads, which they carry. Shields may be used in concrete slabs only. Obtain from the expansion shield manufacturer an ICBO Evaluation Report for the product and submit to the Architect.

E. Regardless of the type of construction (i.e., concrete, concrete-deck-steel or other variations) take particular care to support main lines and large and heavy

pipes in an approved manner, including the provision of supplementary steel, if required. Supplementary steel shall be mill-rolled sections. Submit shop drawings, indicating support methods, point loadings to the building structure and hanger locations for review sufficiently in advance of concrete pouring schedules to permit evaluation, critique and any necessary changes to handling and support methods.

F. Hangers shall be directly bolted to steel beams of building construction, where they occur if approved by the Structural Engineer. Smaller pipes shall be suspended from crosspieces of pipe or steel angles, which in turn, are securely fastened to building beams or hung from building concrete construction by means of rods and inserts. The intention is to provide supports which shall be amply strong and rigid for the load, but which will not weaken or unduly stress the building construction.

G. Attachments to existing steel deck shall be limited to loads of 500 pounds. Heavier loads shall be supported by supplementary structural steel connected to structural beams. Provide all required supplementary steel.

1. Attachments with loads up to 500 pounds shall be accomplished by drilled-in expansion shield type anchors located on the centerline of the concrete-filled ribs.
2. No attachments shall be permitted to new or existing electrified decks. If hanger attachments are not existing, all new attachments shall be supported from supplementary steel.
3. 500-pound load attachments shall be spaced not less than 60 inches apart, and shall be located as close to steel beams as possible.

H. Provide approved roller support, floor stands, wall brackets, etc., for lines running near the floor or near walls, which can be properly supported or suspended by the floors or walls. Pipelines near walls may also be hung by hangers carried from approved wall brackets at a higher level than the pipe.

I. Do not hang piping from supports for other services. Installed supports shall accommodate free expansion of the piping system.

J. Wherever hangers using pipe rolls are used, provide approved steel pipe covering protection saddles, spot-welded to the piping at each hanger location.

K. Anchor piping where shown to localize expansion or to prevent undue strain on piping and branches. Anchors shall be entirely separate from hangers and of heavy forged or welded construction of approved design. All anchor designs, when submitted for approval, shall include piping reactions which respective anchors are capable of supporting. Provide indicated expansion loop.

L. Install anchors where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

M. Support copper tubing individually by approved hangers not more than 6 feet apart. Hangers for uncovered lines shall be specially designed for copper tubing

and of exact outside diameter of tubing. Hangers for covered tubing shall be broad straps fitting outside of covering.

N. Hangers for insulated piping shall support the pipe without piercing the insulation. Refer to Section 22 07 19 – Insulation for insulation protection shields and pipe inserts.

O. For piping 4 inches and larger, support the elbows of the piping adjacent to pumps with steel supports from the concrete housekeeping pad, or from the inertia base where pump is mounted to prevent loading heavy weights of piping on pump flanges or casing. Where inertia base or spring vibration isolation is not provided, base elbows shall be supported on concrete pad with 1-inch neoprene pad.

P. Use hangers, which are vertically adjustable 1.5-inch minimum after piping is erected. Install hangers so that ½-inch minimum clearance is maintained between finished covering of pipe and adjacent work.

Q. Support riser piping independently of connected horizontal piping.

R. Adjust hangers to obtain pipe slope where specified.

S. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior review.

T. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

U. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123/A123M, 1.5-ounces/square foot of surface, each side. Mechanical galvanize threaded products, ASTM B695 Class 150, 2.0 mil coating. Field cuts and damaged finishes shall be field-covered with zinc-rich paint of comparable thickness to factory coating. Corrosive atmospheres include the following locations:

1. Exterior locations, parking ramps, carwash areas
2. Swimming pool equipment, chemical storage or hazardous waste storage rooms
3. Wet wells, meter pits
4. Sanitary and storm sewer pumping stations
5. Food service/kitchen areas, walk-in coolers/freezers
6. Locker/shower rooms
7. Greenhouses

3.02 SLEEVES

A. Provide sleeves for pipe passing through floors, walls or partitions, hung or furred ceilings, of sufficient diameter to accommodate pipe covering where such is required. Locate sleeves secure in place so that an equal space is around the pipe, after the pipe is installed.

B. For sleeves at penetrations of metal deck, nail, screw or weld to the deck prior to the pouring of the deck concrete. Set sleeves in such a manner so that no concrete fills their interior during the concrete pouring and finishing operations.

C. For exposed pipes, caulk floor sleeves with firestop material watertight and project sleeve approximately 2 inches above the finished floor. Finish sleeves with specified flanges flush with the bottom of slab and also with the finished faces of wall.

D. Provide sleeves with an inside diameter at least ½-inch greater than outside of pipe served, including pipe insulation which must be continuous through sleeve.

E. Where piping penetrates walls (other than foundation walls), partitions, floor slabs, etc., pack space between piping and sleeve with mineral wool (for depth of sleeve), or firestop material.

F. Do not support pipes by resting clamps on sleeves. Clamps shall extend beyond sleeve and be supported outboard of sleeve in an approved manner. In no case shall sleeves be cut or slotted to accommodate pipe clamps.

G. Provide escutcheon plates of the proper size for piping in sleeves passing through floors, walls, soffits, furrings, partitions, hung ceilings, etc., throughout the building where exposed. Exposed escutcheons shall be cast brass chromium plated, bell type, with setscrews of sufficient diameter to include any required pipe insulation. Attach escutcheon to building material, not to pipe. Do not penetrate vapor barriers.

1. Split-casting, deep-pattern type cast-brass type with concealed hinge and set screw with polished chrome-plated and rough brass finish.
2. Split-casting, floor-plate type cast brass with concealed hinge and set screw.

H. Exterior-wall pipe penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install aboveground steel pipe for sleeves smaller than 6 inches.
2. Install aboveground cast-iron “wall pipes” for sleeves 6 inches and larger.
3. Install underground cast-iron “wall pipes” for all sleeves.
4. Mechanical Sleeve Seal Installation:

    a. Select type and number of sealing elements required for pipe material and size.
    b. Position pipe in center of sleeve.
    c. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.

d. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
e. For wall thickness up to 12 inches provide one mechanical sleeve seal at the interior side of sleeve, for wall thickness greater than 12 inches provide two mechanical sleeve seals, one at the interior side of sleeve and one at the exterior side of sleeve.

3.03 FIRESTOPPING

A. Where space for future pipes and conduits is required, provide sleeves and fill with lightweight concrete or firestop.

B. Provide firestopping and grouting around pipes penetrating concrete slabs, concrete walls and masonry walls with cement grout in the sleeved opening extending full depth through wall or floor slab. Provide sheet metal cover over the insulation before applying grout. Around pipes through fire rated gypsum board construction, pack the annular space between the wall sleeve and the insulation sheet metal cover with noncombustible approved firestop material and finish with escutcheons on pipe where exposed. Attach escutcheons to wall.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

D. Environmental Requirements:

1. Provide adequate ventilation if using solvent.
2. Provide forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

E. Clean surfaces that will be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

F. Install penetration seal materials in accordance with the UL Fire Resistance Directory or Mortars per Warnock Hersey approval and in accordance with manufacturer’s instruction.

G. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

H. Where large openings are created in walls or floors to permit installation of pipes or other items, close unused portions of opening with firestopping material tested for the application. See UL Fire Resistance Directory or Warnock Hersey approvals.

I. Install smokestopping as specified for firestopping.

3.04 GROUTING

A. Mix, install and cure grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout. Provide forms as required for placement of grout. Avoid air entrapment during placement of grout.

C. Place grout, completely filling equipment bases.

D. Place grout on concrete bases and provide smooth bearing surface for equipment.

E. Place grout around anchors.

END OF SECTION

SECTION 22 05 48
VIBRATION ISOLATION AND SEISMIC RESTRAINTS FOR PLUMBING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Vibration isolation elements for plumbing piping and rotating equipment
2. Equipment isolation bases
3. Flexible connectors
4. Seismic restraints for isolated and non-isolated equipment and piping
5. Supervision and inspection of installed vibration isolators, seismic restraints, anchorage and associated hardware

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing

C. Section 22 11 10 – Piping and Accessories

D. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ASCE – American Society of Civil Engineers

1. ASCE 7-05, 2006 Revised 2007 – Minimum Design Loads for Buildings and Other Structures

B. Federal Specifications

1. MIL-DTL-83420 (2005) – Wire Rope, Flexible, for Aircraft Control

C. IBC – International Building Code (2012)

1.04 QUALITY ASSURANCE

A. Provide control of excessive noise and vibration in the buildings due to the operation of machinery or equipment, and/or due to interconnected piping or conduit. Install vibration isolation units and associated hangers and bases under the direct supervision of the vibration isolation manufacturer's engineer.

1. Vibration isolators shall have either known undeflected heights or calibration markings so that after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load

is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

2. Isolators shall operate in the linear portion of their load versus deflection curve. Furnish load versus deflection curves that are linear over a deflection range of not less than 50 percent greater than the design deflection.
3. The ratio of lateral to vertical stiffness shall be neither less than 0.9 nor greater than 1.5.
4. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness shall not differ from the design objectives for the equipment as a whole by more than plus or minus 10 percent.
5. All neoprene mountings and components shall be oil resistant and have:

    a. Shore durometer hardness of 40 to 65, after minimum aging of 20 days or corresponding oven-aging
    b. Minimum tensile strength of 2,000 pounds per square inch
    c. Minimum elongation of 300 percent
    d. Maximum compression set at 25 percent

B. Mounting systems or components shall not be resonant with any of the supported equipment forcing frequencies.

C. Isolators shall be selected on the basis of the static and dynamic loads actually supported. Dynamic loads include those due to: wind, fluid flow, thrust and rotational inertia. Select each isolator independently for proper load distribution on each piece of equipment and pipe support, or base.

D. Vibration isolation hardware shall not be concealed until reviewed by the Architect.

E. Verify specified clearances, plumb installation of hanger rods and lack of interference – no contact permitted with gypsum board, framing, ceiling wires, light fixtures, conduit, ducts and piping.

F. Verify that the space below inertia bases is clean and clear of construction debris and obstructions.

G. Verify proper vibration isolator loading and deflection.

H. Vibration isolation field inspection engineer shall provide a punchlist report for the Architect's review.

I. Vibration isolation and seismic restraint field inspection engineer shall submit a close-out letter stating that the installation is complete and meets the requirements of the specification and the manufacturer's installation instructions, and all deficiencies noted have been corrected.

1.05 SUBMITTALS

A. Manufacturer's Data:

1. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with the specifications.

2. An itemized list showing the items of equipment and piping to be isolated, the isolator type and model number selected, isolator loading and deflection, and reference to specific drawings.
3. Written approval of the base design shall be obtained from the equipment manufacturer.

1.06 DEFINITIONS

A. Positive Attachment:

1. A positive attachment is defined as a cast-in anchor, a drill-in wedge anchor, a double-sided beam clamp loaded perpendicular to a beam, or a welded or bolted connection to structure. Single sided “C” type beam clamps for support rods of overhead piping, components involved with fire protection or any other equipment are not acceptable as seismic anchor points.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Vibration Isolation: Mason Industries (MII), Vibration Mountings & Control (VMC), Amber-Booth (AB), Vibration Eliminator (VEC), Vibrex Vibration Control Systems (VVC)

2.02 MATERIALS

A. All vibration isolation devices shall be the products of a single manufacturer.

B. Where exposed to the atmosphere, all steel shall be hot-dipped galvanized; hardware shall be cadmium plated; springs shall be powder coated.

2.03 EQUIPMENT BASES

A. Concrete Inertia Base, Type “B-1”:

1. Concrete inertia bases shall be formed in a structural steel perimeter base, reinforced as required to prevent flexure, misalignment of drive and driven unit or stress transferal into equipment. The base shall be complete with pump or piping base elbow support anchors and complete with height-saving brackets, reinforcing, equipment-bolting provisions.
2. Each pump with its driving motor shall be bolted and grouted to a spring-supported concrete inertia base reinforced as required. Provide a minimum of four spring vibration isolators as specified and/or shown on the Drawings.
3. Each rectangular concrete base shall include supports and base elbows for pump suction and discharge connections. Base elbows shall be bolted and grouted to the concrete foundation.
4. The suction and discharge pipe elbows of horizontal and/or vertical inline pumps shall be provided with welded vertical support stanchions of adequate strength and rigidity. These support stanchions along with the pump supports shall be bolted and grouted to a concrete inertia base, which in turn shall be supported on steel spring isolators. A minimum

operating clearance of 2 inches shall exist between the inertia base and the housekeeping pad.

5. Minimum thickness of the inertia base shall be as follows:

Motor Size (Horsepower)	Minimum Thickness (Inches)
5-15	6
20-50	8
60-75	10
100-250	12

Type K or BMK .....MII

PART 3 – EXECUTION

3.01 GENERAL

A. Install in accordance with manufacturer's recommendations and written instructions. Vibration isolators must not cause any change of position of equipment or piping resulting in piping stresses or misalignment.

B. Isolate plumbing equipment from the building structure by means of vibration isolators as specified and scheduled on the Drawings.

C. Vibration isolated piping shall pass freely through walls and floors without rigid connections. Maintain ¾-inch to 1.25-inch concentric clearance around outside surfaces of piping at penetration points. Pack this clearance space tightly with fiberglass, and caulk airtight after installation of piping, or provide resilient firestopping as required. Provide supports 6 to 8 inches from walls or partitions on both sides of penetrations.

D. Do not make rigid connections between equipment and building structure that degrades or short circuits the vibration isolation system specified herein.

E. Loop electrical circuit connections to isolated equipment to allow free motion. Include at least one slack 90-degree bend.

F. Bring to the Architect's attention prior to installation any conflicts with other trades, which will result in unavoidable rigid contact with equipment or piping as, described herein, due to inadequate space or other unforeseen conditions. Corrective work necessitated by conflicts after installation will be at the Contractor's expense.

G. Support vertical piping loads, including water strainers, and valves between pump base elbow supports and the suction and discharge header piping by means of the pump base spring isolators without stress or strain to the pump housing.

H. Provide a flanged steel pipe spool piece between suction and discharge valves and pumps to permit future installation of flexible connectors.

I. Level vibration isolated equipment under rated design operating conditions while maintaining the isolation criteria. Isolators shall be plumb and aligned during operation.

3.02 EQUIPMENT ISOLATORS

A. Mount vibration isolating devices and related inertia blocks on concrete housekeeping pads.

B. Support each pump and motor assembly on a single structural steel frame.

C. If the equipment to be mounted is not furnished with integral structural frames and external mounting lugs (both of suitable strength and rigidity), install approved structural sub-base in the field which will support the equipment to be hung and to which will be attached the hangers.

D. Additional Requirements:

1. Provide brackets to accommodate the isolator. Manufacturer shall indicate bolt hole sizes and locations, welds required, and specify the vertical position and size of the bracket.
2. Maintain a minimum operating balance between the equipment frame on rigid steel base frame and the concrete housekeeping pad of 1 inch. Maintain a minimum operating clearance between concrete inertia and base and concrete housekeeping pad or floor of 2 inches.
3. Temporarily support the structural steel or concrete inertia base with blocks or shims, as appropriate, prior to the installation of the equipment or isolators.
4. Install the isolators without raising the equipment and frame assembly.
5. Adjust the isolators after the entire installation is complete and under full operational load so that the load is transferred from the blocks to the isolator. When all isolators are properly adjusted, the blocks or shims will be barely free and shall be removed.
6. Verify that all insulated isolator and mounting systems permit equipment motion in all directions. Adjust or provide additional resilient restraints to flexibly limit equipment start-up lateral motion to ½-inch.
7. Prior to start-up, clean out all foreign matter between bases and equipment and under inertia bases. Verify that there are no isolation short circuits in the base or isolators.

3.03 AIR CO

3.04 INSPECTION

A. On completion of installation of all vibration isolation devices specified herein, the local representative of the isolation manufacturer, the manufacturer's engineer shall inspect the completed system and submit a report to the Architect indicating the adequacy of the installation and listing any corrective action required.

B. Replace any component found to be visibly deflected with more substantial components.

C. Unless otherwise scheduled on the Drawings provide the following Equipment Vibration Isolation and Seismic Restraints:

Equipment	Deflection (Inches)	Isolator Type	Restraint Type
Base-mounted pumps – inertia base required	2.0	"A"	I
Other small pumps and motor driven equipment	0.35	"C1"	II
Reciprocating air compressors – inertia base required	3.0	"A"	I
Wall- or floor-mounted pressure reducing stations and VFD's	0.15	"G"	-
Packaged laboratory vacuum pump systems	3.0	"A"	I
Packaged laboratory air compressor systems	3.0	"A"	I
Packaged high purity water treatment systems	0.25	"D"	I

END OF SECTION

SECTION 22 05 53
SYSTEMS IDENTIFICATION FOR PLUMBING

GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Valve identification
2. Equipment identification
3. Piping identification
4. Signage

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 50 – Access Doors in General Construction for Plumbing

1.03 REFERENCE STANDARDS

A. ASME – American Society of Mechanical Engineers

1. ASME A13.1 – 2007 Revised 2013: Scheme for the Identification of Piping Systems

B. ASTM – American Society for Testing and Materials

1. ASTM D709 – 2013: Standard Specification for Laminated Thermosetting Materials

C. APWA – American Public Works Association

1. Recommended Guidelines for Underground Utilities

1.04 QUALITY ASSURANCE

A. Above ground piping identification shall comply with ASME Standard A13.1.

B. Underground piping identification shall comply with APWA Recommended Guidelines for Underground Utilities.

1.05 SUBMITTALS

A. Submit the following:

1. Valve identification chart
2. Lists of pipe and equipment to be labeled
3. Color chart

B. Product Data: Manufacturer's latest published data for materials, equipment and installation, including samples of valve tags, equipment identification and piping identification.

C. Maintenance Manuals: Provide valve tag schedules for inclusion in maintenance manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seton

B. Stranco

C. Kolbi

2.02 VALVE IDENTIFICATION

A. All tagged components shall be in accordance with ASME A13.1.

B. For valves, use metal tags 2-inch minimum diameter, fabricated of 19-gauge polished brass, stainless steel or aluminum.

1. Attach tags with jack chain "S"-hook or split ring of same materials.
2. Provide engraved/stamped tags with black ink-filled ¼-inch high letters and ½-inch high numbers.
3. Provide minimum $^{5}/_{32}$-inch hole for fastener.

2.03 PIPE IDENTIFICATION

A. Pipe markers shall have 1.25-inch high letters and integral directional flow arrows. Smaller letters may be used only when space does not permit 1.25-inch high lettering.

B. For piping up to 5-inch diameter, use pre-formed snap-on markers.

C. For piping 6-inch diameter and up, use pre-formed strap-on markers with nylon straps.

D. Material: Semi-rigid colored vinyl; 15 gauge up to 1-inch pipe, 30 gauge for all other pipe sizes.

E. Seton "Setmark" or equal.

F. Pressure-sensitive tapes are unacceptable.

G. Exterior Underground Pipe Markers:

1. Material shall be detectable tape, nominal 5-mil thick, minimum 3 inches wide with aluminum backing.
2. Tape color, size and depth to be in accordance with APWA standards with black lettering and appropriate warning message.

2.04 EQUIPMENT IDENTIFICATION

A. Plumbing equipment shall be identified by means of nameplates permanently screw-fastened to the equipment. Nameplates shall be black surface, white core laminated bakelite with engraved letters. Plates shall be a minimum of 3-inch long by 1-inch wide with white letters ⅜-inch high.

2.05 SIGNAGE

A. Provide engraving stock melamine plastic laminate, complying with ASTM D709, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/16-inch for signs up to 20 square inches or 8-inch length; ⅛-inch for larger signs.
2. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

PART 3 – EXECUTION

3.01 VALVE IDENTIFICATION

A. Do not identify valves where the use is obvious, such as equipment isolation valves.

B. Provide schedules of all valves showing identification number, size, type and service of each valve. Provide separate list for each separate type of system. Incorporate in maintenance manuals.

3.02 EQUIPMENT IDENTIFICATION

A. Identify equipment with identical letter and/or number as used on the Drawings. Where space is available, use full name of equipment. Attach nameplates in a permanent manner in a location that will be clearly visible after installation is complete.

3.03 PIPING IDENTIFICATION

A. Piping identification shall be in conformance with the ASME A13.1.

B. Identify piping systems with color-coded bands, sharply contrasting with background. Locate bands near strategic points, such as valves, items of equipment, changes in direction, wall penetrations, capped stub-out for future connection and every 40 feet of straight runs. If necessary, paint a strip background of black or white to obtain contrast.

C. Apply bands where they can be easily read. Provide bands with backgrounds of different colors.

3.04 ACCESS IDENTIFICATION

A. Identify service, piping and equipment behind all architectural access doors.

B. Removable ceiling tile shall be marked by small color markings at corner of tile or door in accordance with the following color assignment:

Plumbing – Silver

3.05 INSTALLATION OF IDENTIFICATION

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.06 UNDERGROUND PIPING IDENTIFICATION

A. During backfilling/topsoil of each exterior underground piping system, install continuous detectable underground type plastic line marker, located directly over, buried in accordance with APWA standards.

B. For tile fields and similar installation, mark only edge pipe lines of field.

END OF SECTION

SECTION 22 07 00
INSULATION FOR PLUMBING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Piping insulation, jackets
2. Equipment insulation and covering

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 11 00 – Domestic Water Systems

C. Section 22 11 10 – Plumbing Piping and Accessories

D. Section 22 13 00 – Drainage Systems

E. Section 22 33 00 – Domestic Water Heating Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ASTM – American Society for Testing and Materials

1. ASTM B209 – 2007: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
2. ASTM C518 – 2004: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
3. ASTM C533 – 2007: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
4. ASTM C534/C534M – 2011: Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
5. ASTM C553 – 2008: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Application
6. ASTM C547 – 2012: Standard Specification for Mineral Fiber Pipe Insulation
7. ASTM C612 – 2004 Revised 2009: Standard Specification for Mineral Fiber Block and Board Thermal Insulation
8. ASTM E84 – 2012: Standard Test Method for Surface Burning Characteristics of Building Materials
9. ASTM E96 – 2012: Standard Test Methods for Water Vapor Transmission of Materials
10. ASTM F1249 – 2011: Standard Test Method for Water Vapor Transmission Rate

B. NFPA – National Fire Protection Association

1. NFPA 225, Edition 09 – Model Manufactured Home Installation Standard

C. UL – Underwriters Laboratories Inc.

1. UL 723 – 2008: Test for Surface Burning Characteristics of Building Materials

1.04 QUALITY ASSURANCE

A. All insulation shall be in accordance with applicable codes.

B. Insulation supplier and insulation installer shall have a minimum of 5 years' successful installation experience on projects of similar scope to this project.

1.05 SUBMITTALS

A. Product Data: Provide product description, current Product Data Sheets, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.

B. Submit details of sheet metal boxes for pieces of insulated equipment. Refer to sub-Clause 2.05, A.6.

C. Quality Assurance / Control Submittals:

1. Certificates: Submit manufacturer's certificate that product(s) meet or exceed specified requirements.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Fiberglass: Johns Manville, Knauf, Owens Corning.

B. Calcium Silicate: Johns Manville, Extol of Ohio, Inc.

C. Elastomeric: Armacell, Aeroflex.

D. Cellular Glass: Pittsburgh Corning.

E. Mastics, Adhesives and Sealers: Foster, IC, Childers.

1. Vapor Barrier Mastic: Foster 30-65, Childers CP-34, IC-501. Permeance shall be 0.03 perms or less at 45 mils per ASTM E96. Product must comply with California Department of Public Health (CDPH) Standard Method Ver. 1.1, 2010 Small Scale Environmental Chamber Test for VOCs for California Specification 01350.
2. Weather Barrier Breather Mastic: Foster 46-50, Childers CP-10/11 or approved equal.
3. Lagging Adhesive/Coating: Foster 30-36, Childers CP-50AMV1 or approved equal.

4. Reinforcing Mesh: Foster Mast a Fab, Childers Chil Glas #10.
5. Calcium Silicate Insulation Adhesive: Foster 81-27, Childers CP-97, Vimasco 760.
6. Fiberglass Insulation Adhesive: Foster 85-60, Childers CP-127, or approved equal. Comply with ASTM C916, Type II.
7. Metal Jacketing/Flashing Sealant: Foster 95-44, Childers CP-76 or approved equal.

F. Jackets:

1. Metal: Childers, RPR Products.
2. PVC: Ceel-Co, PIC Plastics.
3. Other: Venture Tape, Polyguard, Foster Vapor Fas 62-05.

G. Pre-Molded Fittings, Valves, Strainers and Equipment Insulation: Insul-Therm International; Extol of Ohio, Inc.; or approved equal.

2.02 GENERAL

A. Conform to application schedule for type and thickness of insulation.

B. Insulation, jacket, facing and adhesives shall be non-combustible material meeting Code requirements and fire and smoke hazard ratings as tested by procedure ASTM E84, National Fire Protection Association 225, and UL 723, not exceeding Flame Spread 25 and Smoke Developed 50.

C. Adhesive, mastic or insulating material shall not contain asbestos.

D. Vapor jacket permeance shall be 0.02 perms or less.

E. Jacket puncture resistance shall be 50 units (Beach) or greater.

2.03 PIPE INSULATION MATERIALS

A. Glass Fiber: ASTM C547; rigid molded, non-combustible.

1. Installed ‘K’ Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
2. Maximum Service Temperature: 850 degrees F.
3. Vapor Retarder Jacket: White kraft paper, vinyl coated, embossed and reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips.

B. Hydrous Calcium Silicate: ASTM C533; rigid molded pipe.

1. Installed ‘K’ Value: 0.40 BTU-inch per hour-foot²-degree F at 300 degrees F.
2. Maximum Service Temperature: 1200 degrees F.
3. Tie Wire: 16-gauge stainless steel with twisted ends on maximum 12-inch centers.

C. Elastomeric Foam: ASTM C534/C 534M flexible cellular elastomeric, molded or sheet.

1. Installed ‘K’ Value: 0.27 BTU-inch per hour-foot²-degree F at 75 degrees F.
2. Maximum Service Temperature: 220 degrees F.

D. Cellular Glass:

1. Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
2. Preformed Pipe Insulation with Jacket: Comply with ASTM C552, Type II, Class 2.

E. Field-Applied Jackets:

1. PVC Plastic (PVC): One-piece molded type fitting covers and sheet material, gloss white. Connections shall be pressure-sensitive color-matching vinyl tape.
2. Canvas Jacket (CJ): UL Listed fabric, 6 ounce per square yard, plain weave cotton treated with dilute fire-retardant lagging adhesive.
3. Aluminum Jacket (AL): 0.016-inch thick sheet, stippled finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory-attached protective liner.

2.04 PIPE INSULATION SCHEDULES

A. Insulation Schedules:

Service	**Temperature Range (degrees F)**	**Material**	**Insulation Thickness (inches) for Pipe Sizes:**				
			< 1	1 to < 1.5	1.5 to 4	4 to < 8	8 and up
Domestic hot water, domestic recirculated hot water	105 to 140	Glass fiber	1	1	1.5	1.5	1.5
Domestic cold water	40 to 60	Elastomeric foam, glass fiber, cellular glass	1	1	1	1	1
Horizontal roof drainage piping and first 18 inches of vertical riser	All	Glass fiber	–	1.5	1.5	1.5	1.5
Hot water and drain piping below lavatories	All	Glass fiber	1.5	1.5	1.5	–	–

B. Fittings, Valves and Flanges:

1. Use factory pre-molded fittings of the same materials and thickness as the adjacent pipe insulation. Such fittings shall be applied to all 90°s, 45°s, Tee’s, flanges, and valves.
2. Where pre-molded insulation fittings are not manufactured, insulate fittings, flanges, strainers and valves with mitered segments of the same

density as the adjoining pipe covering. Vaporseal for cold (below dew point) applications using vapor barrier mastic with open weave glass or polyester mesh lay in while wet. Provide a final coat of vapor barrier mastic. Overlap glass mesh and outer coat adjacent covering by a minimum of 2 inches. Vapor barrier mastic shall be IC 501. Childers CP-34 or 30-Permeance of mastic shall be 0.03 perms or less at 45 mils as tested by ASTM E96. Reinforcing mesh shall be foster Mast a Fab, Childers Chil Glas #10 or approved equal.

3. Provide insulation for the removable covers and flanges of pipe strainers on cold services with built-up sections of glass fiber pipe covering, arranged to facilitate servicing of the strainer. Complete applications with vaporseals as specified above. Vapor barriers shall be sealed and continuous through guides, hangers, walls, sleeves, etc. Adhesives and coatings shall be as noted herein.

C. Jacketing Schedule:

Service	Location	Jacket Type
Domestic hot water	Exposed in Plant Rooms	AL
Condensate	All locations	ASJ or painted finish
Domestic cold water	Minimum 25 feet from service entry	ASJ
Outdoor piping	All locations	AL

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that all surfaces are clean, dry and free of dirt, duct, debris, moisture or foreign material.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

B. Verify piping has been pressure-tested as specified in Section 22 11 10 – Plumbing Piping and Accessories before applying insulation materials to pipe joints.

C. Continue insulation and vapor barrier through penetrations.

D. Piping, Valve and Accessories Insulation:

1. Insulate domestic water supply lines inside chases and up to the plumbing fixture supply stop.
2. Locate insulation and cover seams in least visible locations where exposed.
3. Neatly finish insulation at supports, protrusions, and interruptions.
4. Provide insulated pipes, fittings, valves and accessories conveying fluids below ambient temperature with continuous vapor retarder jackets with

self-sealing laps. Insulate complete system and provide molded flexible polyvinyl chloride jacket(s) for all fittings and valves. Vaporseal all below ambient jacket seams with vapor barrier mastic as recommended by the insulation manufacturer.

5. For insulated pipes, fittings, valves and accessories conveying fluids above ambient temperature, secure jackets with self-sealing lap. Bevel and seal ends of insulation at equipment, flanges and unions.
6. Protect pipe insulation at hangers, guides, and rollers with 20-gauge galvanized metal shields, one-third the insulation circumference in width and minimum 10 inches in length up to 2½-inch pipe size, 12 inches in length on pipes 3-inch and larger, on the outside of the insulation and vapor barrier or jacket. Center shield on hanger and hold shield in place by straps or by manufactured centering tabs or channels on the shield itself. Do not pierce the insulation with hangers.
7. Provide insert between support shield and piping. Fabricate of calcium silicate, rigid phenolic or other heavy density non-deforming insulating material suitable for temperature. Length of insulation inserts shall match support shield length as specified.
8. For exterior applications or locations where abrasion or damage may occur, provide weather protection jacket. Insulated pipe, fittings, accessories joints, and valves shall be covered with ultra-violet light-resistant painted polyvinyl chloride, Foster Vapor Fas 62-05 flexible jacketing, or aluminum jacket. Jacket seams shall be located on bottom side of horizontal piping.
9. Apply prefabricated sectional insulation for straight pipes neatly fitted around the piping, and sealed with adhesive. Apply adhesive to only one side of each joint and not to pipe surface.
10. Seal all joints with Foster 30-35 or Childers CP-34 fire-resistant vapor barrier mastic. Oversized pipe sections or board type insulation may be used to fabricate and install insulation around pipe specialties. All void spaces shall be firmly filled with flexible insulation to support oversized pipe insulation.
11. Secure sectional insulation with 0.02-inch thick by ½-inch wide aluminum bands manufactured by Childers, or RPR Products nylon ties, on 24-inch centers for pipe sizes 2 inches and larger. Install at least two (2) bands per section of insulation.
12. Insulate domestic cold water vertical riser support clamps.
13. Insulate and thoroughly vaporseal control valve bodies where the valve actuator penetrates the insulation.
14. Thoroughly vaporseal the ends of all domestic cold water pipe, valve and fitting insulation sections to prevent condensation from wicking between sections.
15. Replace any self-sealing insulation or lap that is found to be not sealing properly. Do not use staples to secure the insulation or coverings.

END OF SECTION

SECTION 22 08 00
COMMISSIONING OF PLUMBING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Work under this Contract shall conform to the requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers commissioning of the complete plumbing systems for the project.
2. Furnish labor and material to accomplish the complete commissioning of the plumbing systems as specified herein.
3. Start-up and testing of the plumbing system equipment.
4. Testing and adjusting piping and central systems.
5. Cooperation with the Commissioning Authority.
6. Providing qualified personnel for participation in commissioning tests.
7. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
8. Providing Operation and Maintenance Manuals, and as-built drawings to the Commissioning Authority for verification.
9. Providing training and demonstrations for the plumbing systems.

B. Commissioning work shall be a team effort to ensure that all plumbing equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance parameters for fine-tuning of control sequences and operational procedures. Commissioning shall coordinate system documentation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

C. The commissioning team shall be made up of representatives from the Owner, design professionals, major equipment suppliers, and construction trades. The trades represented on the commissioning team shall include, but not be limited to, piping and fitting, Building Management System (BMS) (Division 23), equipment test and balance and electrical. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the commissioning team. Responsibility for various steps of the commissioning process shall be divided among the members of the commissioning team, as described in this Section.

D. The Commissioning Authority, retained by the Owner, shall have responsibility for coordinating and directing each step of the commissioning process.

E. Plumbing system installation, start up, testing, balancing, preparation of O&M manuals, and operator training are the responsibility of the Division 22 Plumbing Contractors, with coordination, observation, verification and commissioning the responsibility of the Commissioning Authority. The commissioning process does not relieve Division 22 (Plumbing) from the obligations to complete all portions of the work in a satisfactory and fully operational manner.

F. Definitions

1. Commissioning: The process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained to perform in conformity with the design intent. For this project, the commissioning includes construction, start up, acceptance, and training.
2. Commissioning Authority: The designated person, company, or agent, retained by the Owner, who implements the overall commissioning process.
3. Commissioning Plan: A document defining the commissioning process, which is developed by the Commissioning Authority.
4. Commissioning Report: The document that records the results of the commissioning process, including the as-built performance of the plumbing system and unresolved issues, and documents all sign-offs.
5. Commissioning Specification: The Contract Document that details the objective, scope, and implementation of the construction and acceptance phases of the commissioning process as developed in the design-phase Commissioning Plan.
6. Commissioning Team: Those people responsible for working together in carrying out the commissioning process.
7. Design Intent: A detailed explanation of the ideas, concepts, and criteria that are defined by the Owner to be important. This typically is an expansion of the information provided in the Owner's Program.
8. Design Intent Document: A detailed written document, evolving throughout the commissioning process, clearly defining items and criteria of the design intent.
9. Functional Performance Testing (FPT): The process of determining the ability of the plumbing system to deliver domestic water, natural gas and sanitary storm and any other plumbing system in accordance with the final design intent.
10. Construction Documents: Design plans and specifications. Also referred to as Contract Documents.
11. Design Professional: The Owner's Architectural, Engineering and Other Consultants who prepared the Construction Documents.
12. TAB: Testing and Adjusting work.
13. Verification: That full range of checks and tests carried out to determine if all components, systems, sub-systems, and interfaces between systems operate in accordance with the Contract Documents. In this context, "operate" includes all modes and sequences of control operation, interlocks and conditional control responses, and specified responses to abnormal conditions.

G. Purpose: The commissioning is a process and its purpose is to:

1. Clearly document the design intent.
2. Verify that the systems installation and performance is in accordance with the plans, specifications and design intent.
3. Train the Owner's operators so that they fully understand the design intent and the operation and maintenance requirements of the equipment.

H. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components,

systems, and sub-systems. The following equipment and systems shall be evaluated:

1. Domestic water systems
2. House pumps and controls
3. Sanitary drainage and vent systems
4. Plumbing systems
5. Domestic hot water heaters
6. Natural gas systems
7. Starters furnished by Division 22 (Plumbing)
8. Automatic temperature controls integrated with the plumbing systems
9. Coordination with the BMS (Division 23)

I. Timely and accurate documentation is essential for the commissioning process to be effective. Documentation required as part of the commissioning process shall include but not be limited to:

1. Progress and status reports, including deficiencies noted
2. Minutes from all meetings
3. Pre-start, and start-up procedures
4. Training agenda and materials
5. As-built records
6. Commissioning report
7. Operational and Maintenance (O&M) manuals

J. Detailed testing shall be performed on all installed equipment and systems to ensure that operation and performance conform to the Contract Documents. All tests shall be witnessed by the Commissioning Authority. The following testing is required as part of the commissioning process:

1. Verification tests are comprised of a full range of checks and tests to determine that all components, equipment, systems, and interfaces between systems operate in accordance with the Contract Documents. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.
2. Functional performance testing shall determine if the plumbing system is providing the required services in accordance with the finalized design intent.

K. Comprehensive training of O&M personnel shall be performed by the Plumbing Contractor, and where appropriate by other sub-contractors, and vendors prior to turnover of building to the Owner. The training shall include classroom instruction, along with hands-on instruction on the installed equipment and systems. All training sessions shall be videotaped or recorded on alternative audiovisual media.

1.02 RELATED DOCUMENTS

A. Division 1 Specifications

B. Section 22 05 01 – Plumbing General Provisions

C. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

D. Section 22 05 50 – Access Doors in General Construction for Plumbing

E. Section 22 05 53 – Systems Identification for Plumbing

F. Section 22 11 00 – Domestic Water Systems

G. Section 22 11 13 – Plumbing Pumps

H. Section 22 13 00 – Drainage Systems

I. Section 22 33 00 – Domestic Water Heating Systems

J. Section 22 63 13 – Natural Gas Systems

K. Division 21 – Fire Protection Specifications

L. Division 23 – Mechanical Specifications

M. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

The following references are a guideline to the commissioning process and shall be applied as appropriate:

A. AABC – Associated Air Balance Council

1. ACG Commissioning Guideline – 2005 – For Building Owners, Design Professionals and Commissioning Service Providers

B. ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE Guideline 1.1 – 2007: HVAC&R Technical Requirements for the Commissioning Process
2. ASHRAE Guideline 4 – 2008 Revised 2013: Preparation of Operating and Maintenance Documentation for Building Systems
3. The 2011 ASHRAE Handbook – HVAC Applications

1.04 QUALITY ASSURANCE

Commissioning Authority shall meet the following qualifications:

A. Commissioning Authority shall have a minimum of five (5) years of demonstrated experience in the commissioning of plumbing systems similar in size and complexity to this project.

B. Commissioning Authority shall hold a Certified Commissioning Professional (CCP) designation from the Building Commissioning Association.

1.05 SUBMITTALS

A. As-built records

B. Pre-test and Final Test Report Forms (forms format only) for each system and piece of equipment

C. Pre-test and Final Test Report Forms for each system and piece of equipment

D. Verification and functional performance testing procedures

E. Test and Balance report and verification datasheets

F. Commissioning Report

G. Operational and Maintenance (O&M) manuals

1.06 ROLES AND RESPONSIBILITIES

A. Contracting Officer is the Building Owner.

1. Contracting Officer will advise Commissioning Authority regarding changes in building occupancy and/or usage.
2. Assign maintenance personnel and schedule them to participate in meetings, training session as follows:

    a. Construction-Phase coordination meeting
    b. Initial Owner training session at initial placement of major equipment
    c. Maintenance orientation and inspection
    d. Piping test and flushing verification meetings
    e. Procedures meeting for Testing, Adjusting and Balancing
    f. Owner’s training session
    g. Verification demonstrations
    h. Final review at acceptance meeting

3. Provide qualified personnel for video taping and editing of training sessions.
4. Video tape construction process, hidden shafts, etc.
5. Provide any utilities required for the commissioning process.
6. Provide detailed program clearly stating the Owner’s objectives, parameters, budgets, etc. for this facility.

B. Commissioning Authority

1. Develop the commissioning requirements and all related testing, verification and quality control sections.
2. Prepare the commissioning program required as part of the Commissioning Specification. Include lists of all contractors for commissioning events by name, firm, and trade specialty.
3. Develop detailed pre-test and final test reports forms, to be used by the Commissioning Authority for data recording purposes throughout the testing process. The Commissioning Authority shall specifically develop these forms for each system and piece of equipment installed on the project. All forms to be submitted for approval a minimum of one hundred and twenty (120) days prior to initial testing.
4. Execute the commissioning program, through organization of all tests, meetings, demonstrations, training events and performance verifications

described in the Contract Documents and the approved commissioning program. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning event. The Commissioning Authority shall act as chairman at all commissioning events and assure the execution of all agenda items. The Commissioning Authority shall prepare minutes of every commissioning event and send copies to all those in attendance and the Owner within five (5) workdays of the event.

5. Review the Construction Documents which define the scope of the commissioning process and the final performance of the system. This includes verification that appropriate commissioning guidelines have been followed, and to document the performance of each piece of equipment and each system.
6. Review all approved submittals for coordination with the commissioning process and the performance testing of the systems.
7. Schedule regular Construction-Phase coordination meetings to include Owner and Contractor and Design Professional. These meetings shall be for the purpose of reviewing the complete commissioning program and establishing tentative schedules for plumbing system orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, test, adjust and balance (TAB) work and verification and functional performance testing.
8. Schedule Owner training sessions so that they will be held at an appropriate timeframe relative to the turnover of the systems to the Owner. These sessions shall be attended by the Owner's O&M personnel, the Contractor, the Design Professional, and the Commissioning Authority. The Design Professional shall conduct this session giving an overview of the system, the system design goals and the reasoning behind the selection of the equipment.
9. Conduct and record the results of periodic inspections, undertaken by the Commissioning Authority, of work in progress to ensure that all systems are installed according to specifications. The Commissioning Authority shall note in writing any deficiencies discovered. Once the deficiencies have been corrected, as reported by the Contractor, the Commissioning Authority shall re-inspect the work and report that the corrections have been made.
10. Assist the Contractor in recommending solutions to minor deficiencies.
11. Conduct the system orientation and inspection following the initial training session. Any subsequent system orientation and inspection shall be conducted by the Contractor. The emphasis of this system orientation and inspection shall be an observation of the equipment location with respect to accessibility. Prepare minutes of this meeting, with separate summary of deficiency findings by the Owner and Commissioning Authority. Distribute to attendees and the Owner.
12. Adequate accessibility for maintenance and component replacement or repair is the Contractor's responsibility and shall be checked by the Commissioning Authority.
13. Receive and review the Operation and Maintenance (O&M) manuals as submitted by the Contractor (ensuring that they follow the specified outline and format), and as reviewed and approved by the Design Professional. Insert systems description as provided by the Design Professional.
14. Witness equipment and system start-up and testing. Ensure the results are documented (including a summary of deficiencies), and incorporated

in the O&M manuals. The Commissioning Authority shall record all test results on pre-test and final test forms for each piece of equipment.

15. Prior to initiating the TAB work, meet with the Owner, Contractor, Design Professional, and TAB Contractor. The TAB Contractor shall outline TAB procedures and get concurrence from the Design Professional and Commissioning Authority. Ensure that the TAB Contractor has all forms required for the job database and understands their importance and use.
16. Schedule the O&M training sessions. All training sessions shall be on-site, except where otherwise specified. These training sessions are to be attended by the Owner, Commissioning Authority, Design Professional, Contractors and equipment suppliers as necessary. The format shall follow the outline in the O&M manuals. This system orientation and inspection should include hands-on training. The Commissioning Authority shall be solely responsible for recording all demonstration and training sessions on videotape, or alternative approved media, and furnish two (2) copies of the recording media to the Owner. Each session shall clearly reflect the content of each training session. Video tapes or other approved media and enclosures shall be neatly labeled.
17. Submit detailed verification test procedures and datasheets to the Design Professional for review.
18. Submit detailed FPT procedures to the Design Professional for review and acceptance.
19. Upon receipt of notification from the Design Professional that the systems have been completed and are operational, the Commissioning Authority shall proceed to verify the TAB report and operation of the control systems in accordance with the Commissioning Specification.
20. Conduct verification tests.
21. Record verification test data, and submit to the Design Professional for review and acceptance.
22. Provide detailed checklists datasheets to document verification tests.
23. Provide and install calibrated test instrumentation to monitor and record data as necessary.
24. Certify that the systems are ready for functional performance testing.
25. Observe and record functional performance tests.
26. Submit Functional Performance Test report to the Design Professional for review.
27. Re-test if performance deficiencies are found, corrected and additional testing is requested.
28. Review as-built drawings for accuracy with respect to installed systems. Review revisions to achieve accuracy.
29. Ensure that the O&M manuals and all other as-built records have been updated to include all modifications made during the Construction Phase.
30. Observe and record repeated functional performance tests to accommodate seasonal tests and/or correct any performance deficiencies. Revise and re-submit the commissioning report.
31. Prepare the final commissioning report.
32. Assemble the final project documentation, which shall include the commissioning report and all as-built records. Submit this documentation to the Design Professional for review and acceptance.
33. The Commissioning Authority shall verify that all O&M manuals, “as-built” documentation, and training manuals and training sessions are complete in every aspect and in accordance with the project specifications. The

Commissioning Authority shall supplement the above documentation, as required, to make them complete.

C. Architect

1. Provide support to the Design Professional who must provide a service as a part of the commissioning process. This shall include providing adequate space for equipment installation and maintenance.
2. Conduct periodic inspections of work in progress to ensure that all systems and equipment are installed according to specifications.
3. Provide data on structure, building materials, interior finishes, and furnishings for their effect on the plumbing system.

D. Plumbing Design Professional

1. Provide documentation of initial design concepts and Design Intent on the Owner's program.
2. Provide system design parameters and obtain approval of Owner.
3. Prepare Construction Documents incorporating the Commissioning Specification requirements and description of the system.
4. The Design Professional retains responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design.
5. Participate in O&M personnel orientation and inspection at the final construction stage.
6. Attend initial meeting with TAB representative as scheduled by the Commissioning Authority.
7. Review verification and functional performance testing procedures submitted by the Commissioning Authority, for conformance with the Construction Documents.
8. Review TAB report and verification datasheets for system conformance to the Contract Documents. Issue to the Commissioning Authority a report noting deficiencies requiring correction.
9. Review Functional Performance Testing report for deficiencies in meeting the finalized design intent.
10. Review as-built records as required by the Contract Documents and turn them over to the Commissioning Authority for inclusion in final project documentation.
11. Review and comment on the final commissioning report.

E. Electrical Design Professional

1. Provide documentation for electrical services to be provided for specific plumbing equipment requirements.
2. Provide electrical system information confirming compatibility with electrical service requirements specified by the plumbing design professional for all plumbing equipment and systems. Provide information necessary for the basis of design.
3. Prepare the Contract Documents that coordinate interfaces between life safety systems, BMS, and plumbing systems including commissioning specifications.
4. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority.
5. Participate in the start-up of plumbing equipment and systems.

6. Participate in the plumbing training sessions as required.
7. Participate in review of shop drawings for plumbing equipment.
8. Prepare electrical ladder wiring diagrams indicating power source connections to plumbing equipment and systems.
9. Prepare as-built electrical service record drawings as required by the Contract Documents.
10. Verify that any space requirements for electrical equipment are in accordance with relevant code requirements.
11. Participate in O&M personnel orientation and inspection sessions.

F. General Contractor

1. Include cost for commissioning requirements in the contract price.
2. Coordinate construction progress with the commissioning schedule to assure that the building envelope and systems that affect proper operation and control of plumbing equipment and systems being tested are completed prior to testing.
3. Include commissioning requirements in the Plumbing, Electrical, and Division 23 (BMS) controls contracts, as well as all other sub-contractors, to ensure cooperation of all parties in the plumbing commissioning program.
4. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the plumbing commissioning program as described in the Contract Documents.
5. Issue a statement that TAB work has been completed, and submit the final TAB reports for review.
6. Issue a statement that control systems have been tested and calibrated.
7. Remedy deficiencies identified in verification tests.
8. Evaluate any performance deficiencies identified in the FPT report for non-performance with the Contract Documents.
9. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.

G. Plumbing Contractor

1. Include cost of commissioning requirements in the contract price.
2. Include requirements for submittal data, O&M data, and training in each purchase order or sub-contract written.
3. Ensure cooperation and participation of specialty sub-contractors such as testing, adjusting and balance (TAB).
4. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
5. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority.
6. Assist the Commissioning Authority in all verification and functional performance tests.
7. Prepare preliminary schedule for plumbing system orientations and inspections, O&M manual submissions, training sessions, pipe system testing, flushing and cleaning, equipment start-up, TAB and task completion for use by the Commissioning Authority. Update schedule as appropriate throughout the construction period.
8. Attend initial training session.

9. Conduct plumbing system orientation and inspection at the equipment placement completion stage.
10. Update drawings to the record condition to date, and review with the Commissioning Authority.
11. Gather O&M data on all equipment, and assemble in binders as required by the Commissioning Specification and Section 22 05 01 – Plumbing General Provisions. Submit to Commissioning Authority prior to the completion of construction.
12. Coordinate with the Commissioning Authority to provide sufficient advanced notice so that the witnessing of equipment and system start-up and testing can begin.
13. Notify the Commissioning Authority a minimum of two weeks in advance of the time for start of the TAB work. Attend the initial TAB meeting for review of the official TAB procedures.
14. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the Commissioning Authority.
15. Provide written notification to the General Contractor and Commissioning Authority that the following work has been completed in accordance with the Contract Documents, and that the equipment, systems, and sub-system(s) are operating as required:

    a. Plumbing equipment including all controls, pumps, PRV valves, water heaters, and all other equipment furnished under this Division.
    b. Domestic water systems, sanitary and storm drainage systems, gas systems.
    c. Fire stopping in the fire-rated construction, including caulking, gasketing and sealing of smoke barriers.
    d. Installation of plumbing fixtures.
    e. Pipe hangers.
    f. Vibration isolation and seismic restraints.

16. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.
17. Provide a complete set of as-built records to the Commissioning Authority.

H. Test, Adjust, and Balance (TAB) Contractor

1. Include cost for commissioning requirements in the contract price.
2. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
3. Submit the TAB procedures to the Commissioning Authority and Design Professional for review and acceptance.
4. Attend the TAB review meeting scheduled by the Commissioning Authority. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the plumbing system.
5. Participate in training sessions as scheduled by the Commissioning Authority.
6. At the completion of the TAB work, and the submittal of the final TAB report, notify the Plumbing Contractor and the General Contractor.
7. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB where

required by the Commissioning Authority for verification or diagnostic purposes.

8. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.

I. Equipment Suppliers and Miscellaneous Contractors

1. Include cost for commissioning requirements in the contract price.
2. Provide submittals, and appropriate O&M manual section(s).
3. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
4. Participate in training sessions as scheduled by the Commissioning Authority.
5. Demonstrate performance of equipment as applicable.

J. Electrical Contractor

1. Include costs for commissioning requirements in the contract price.
2. Ensure participation in testing of equipment.
3. Ensure coordination, installation, and operation interfaces between heating, cable and plumbing systems.

1.07 DOCUMENTATION

The Commissioning Authority shall oversee and maintain the development of commissioning documentation. The commissioning documentation shall be kept in three-ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The commissioning documentation shall include, but not be limited to, the following:

A. Approved TAB report for domestic hot water return systems being commissioned.

B. All accepted shop drawings of plumbing equipment. Shop drawings shall be full-size sheets folded as required to fit in binders.

C. All pre-functional performance test checklists, signed by indicating personnel, organized by system and sub-system.

D. All verification and functional performance test checklists/results, signed by indicated personnel, organized by system and sub-system.

E. Three copies of the operation and maintenance (O&M) manual(s) specified in other sections of these specifications shall be included with the commissioning documentation. The manuals shall be incorporated in the commissioning documentation prior to commencement of O&M training required in this and other sections of the specification. Preparation of O&M manuals shall be as specified in Section 22 05 01 – Plumbing General Provisions, Paragraph 3.17 O&M Manuals.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Authority for approval.

B. The Owner shall furnish necessary utilities for the commissioning process.

2.02 TEST EQUIPMENT – PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

PART 3 – EXECUTION

3.01 GENERAL

A. A pre-construction meeting of all commissioning team members shall be held at a time and place designated by the Owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. The Contractor shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, wire, insulation, controls, etc. per the Contract Documents and related directives, clarifications, and change orders.

C. A Commissioning Plan shall be developed by the Commissioning Authority. The Contractor shall assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority shall notify the Contracting Officer.

D. Acceptance procedures are normally intended to begin prior to completion of a system and/or sub-systems, and shall be coordinated with the Division 22 Plumbing Contractor. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems as per the schedule.

E. The Commissioning Authority shall develop a detailed schedule for acceptance procedures and training. The Commissioning Authority shall work in a cooperative manner with the Contractor to assure that the commissioning process does not interfere with the completion of work in accordance with the overall schedule.

3.02 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Contractor shall provide skilled technicians to start up and debug all systems within Division 22 (Plumbing). These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program. Work schedules, time required for testing, etc. shall be requested by the Commissioning Authority and coordinated by the Contractor. Contractor shall ensure that the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Authority time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained.

C. The Commissioning Authority reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and a willingness to work with the Commissioning Authority. Contractor shall provide adequate documentation and tools to start up and test the equipment, systems, and/or sub-systems.

3.03 DEFICIENCY RESOLUTION

A. In some systems, improper adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Contracting Officer, with input from the Contractor, equipment supplier, and Commissioning Authority. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Contracting Officer shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority shall notify the Contracting Officer, indicating the nature of the problem, expected steps to be taken, and suggested deadline(s) for completion of activities. If the deadline(s) pass without resolution of the problem, the Contracting Officer reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner shall be the Contractor’s responsibility.

3.04 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor(s), suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their contractual obligations.

3.05 ACCEPTANCE PROCEDURES

A. Verification Tests

1. Scope

a. Operating tests and checks to verify that all components, equipment, systems, sub-systems, and interfaces between systems operate in accordance with the Contract Documents. These tests are to include all operating modes, interlocks, specified control responses, specific responses to abnormal or emergency conditions and verifications of the proper response of the Building Automation System controllers and sensors.
b. Verify the validity of the TAB report.

2. Participants

The Commissioning Authority shall be responsible for preparing the scope of these tests. The Commissioning Authority shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Following is a list of tasks and supporting information that shall be required:

a. Plumbing Contractor – Provide the services of technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cutsheets of all installed equipment.
b. Electrical Contractor – Provide a foreman electrician familiar with the electrical interlocks. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

3. Documentation and Reporting Requirements

a. Provide checklists for each component, piece of equipment, system, and sub-system, including all interfaces, interlocks, etc. Each item to be tested shall have a different entry line with space provided for comments. Separate checklists shall be prepared for each mode of operation. Provide space to indicate whether the mode under test responded as required or not. Also, provide space for all necessary parties to sign off on each checklist.
b. Datasheets used in verification of the proper operation of the control system shall include each controller to be verified, and its location. For each controller, provide space for recording the readout of the controller, the reading at the controller's sensor(s), and any comments. Also, provide space for all necessary parties to sign off on each checklist.
c. All test procedures and datasheets shall be submitted to the design professional for review and acceptance.

4. Instrumentation

a. The Commissioning Authority shall furnish all measurement instrumentation for the verification tests. All instruments will have calibrated within the six-month period prior to these tests.

5. Procedures

a. The Commissioning Authority shall direct and witness the verification operating tests and checks for all equipment and systems.

(1) Set the system equipment (i.e. house pumps, booster pumps, water heaters) into the operating mode to be tested, i.e. normal shut down, normal auto position, normal manual position, unoccupied cycle, and alarm conditions.
(2) The Commissioning Authority shall inspect and verify the position of each device and interlock identified on the checklist. Each item shall be signed off as acceptable (yes), or failed (no).
(3) This test shall be repeated for each operating cycle that applies to the plumbing system being tested.
(4) Operating checks shall include all safety cutouts, alarms and interlocks with tank-filling systems during all modes of operation of the plumbing system.
(5) If during a test an operating deficiency is observed, appropriate comments shall be added to the checklist datasheet.
(6) Verification of the interface of the Building Management System and the TAB criteria shall be included.
(7) Verification of the proper responses of Building Management System controllers and sensors shall be included.

b. The Commissioning Authority shall direct and witness the field verification of the final TAB report.

(1) The Commissioning Authority shall select, at random, 10 percent of the report data for verifications.
(2) The TAB Contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB Contractor must use the same instruments (by model and serial number) that were used when the original data were collected.
(3) Failure of an item is defined as:

(a) For pumps, as per manufacturer's recommendation.
(b) For pressure reading, a deviation of 8 pounds.
(c) For temperature reading, a deviation of 5 degrees F.
(d) For all other readings, a deviation of more than 10 percent.

(4) A failure of more than 10 percent of the selected items shall result in the rejections of the final TAB report.

c. If the deficiencies are identified during verification, the General Contractor must be notified, and action taken to remedy the deficiency. The final tabulated checklist datasheets shall be reviewed by the Design Professional and the Commissioning Authority, to determine if verification is complete, and the operating system is functioning in accordance with the Contract Documents.

B. Functional Performance Testing

1. Scope

a. Functional performance tests shall determine if the plumbing system is providing the required capacity pressure and temperature services in accordance with the final design intent. Following is a test example:

(1) Determine the ability of the pumps to deliver the services to the distribution system, at the design water temperature and minimum pressure, and required static pressure.

2. Submittals

a. Detailed procedures for each series of tests shall be submitted to the Commissioning Authority for review and acceptance. The procedures shall include samples of the datasheets that will be part of the reports.

3. Participants

a. Participants in the functional performance tests shall be the same as those listed in the verification tests.

4. Instrumentation

a. In addition to the instrumentation requirements detailed under verification, the Commissioning Authority may need to provide data acquisition equipment to record data for the complete range of testing.

5. Procedures

a. The Commissioning Authority shall supervise and direct all functional performance tests.

b. For each test, the Commissioning Authority shall install the measuring instruments and logging devices to record test data for the required test period. The instrumentation shall monitor and record all operating conditions to allow for complete evaluation of the test results.

c. Measurement will be required to allow for calculation of total capacity of the system for each mode of operation under test.

6. Documentation and Reporting Requirements

a. All measured data, datasheets, and a comprehensive summary, describing the operation of the plumbing system at the time of testing, shall be submitted to the Commissioning Authority.

b. A preliminary Functional Performance Test report shall be prepared by the Commissioning Authority and submitted to the Design Professional for review. Any identified deficiencies need to be evaluated by the Design Professional and Construction Manager to determine if they are part of the Contractor's contractual obligations. Construction deficiencies shall be corrected by the responsible Contractor(s) and the specific functional performance test repeated.

c. If it is determined that the plumbing system is constructed in accordance with the Contract Documents, and the performance deficiencies are not part of the Contract Documents, the Contracting Officer must decide whether any required modifications needed to bring the performance of the plumbing system up to the finalized design intent shall be implemented, or if the test shall be accepted as submitted. If corrective work is performed, the Contracting Officer shall determine if a portion or all required functional performance tests should be repeated, and a revised report submitted.

3.06 OPERATING AND MAINTENANCE MANUAL

A. The operating and maintenance manual shall consist of binders (as described in Section 22 05 01 – Plumbing General Provisions for Plumbing, Paragraph 3.17 O&M Manuals) with 8.5-inch by 11-inch sheets.

3.07 OPERATING AND MAINTENANCE TRAINING

A. The Plumbing Contractor, and appropriate sub-contractors, shall provide comprehensive operating and maintenance instruction on building systems in accordance with the Contract Documents prior to delivery. The instruction shall include classroom instruction delivered by competent instructors based upon the contents of the operating manual.

B. Each classroom training period shall be followed by an inspection, explanation and demonstration of the system concerned by the instructors. All specified equipment shall be started up and shut down, with the exception of any connection to fire suppression system.

C. The Contractor shall be responsible for organizing, arranging, and delivering in a manner and on a schedule agreeable to the Contracting Officer.

D. The Contractor shall provide, at or before substantial completion, a proposed agenda and schedule of the above training for approval by the Commissioning Authority and the Contracting Officer.

E. Each classroom training session and demonstration shall be recorded on videotape or alternative acceptable media and submitted to the Contracting Officer.

F. The Plumbing Contractor shall provide a letter of certification to the Project Representative stating that project site training session(s) of at least two (2) hours duration were conducted for this project for the Sub-contractor's supervisory and installing personnel.

END OF SECTION

SECTION 22 11 00
DOMESTIC WATER SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. General: Provide complete and operable domestic water systems within the intent of the Contract Documents; including but not limited to all materials and labor for complete installation and testing, in compliance with applicable provisions and recommendations in the Reference Standards.

B. Water service contract limit line shall be five feet from building wall or as indicated on the Drawings.

C. Make arrangements to provide domestic water services into this project.

D. The Contractor shall pay all connection fees, tap charges, and permit fees if any assessed by local authorities.

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 16 – Expansion Compensation for Plumbing

C. Section 22 05 19 – Meters, Gauges and Thermometers for Plumbing

D. Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing

E. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

F. Section 22 05 50 – Access Doors in General Construction for Plumbing

G. Section 22 11 10 – Plumbing Piping and Accessories

H. Section 22 21 01 – Hydronic Systems Specialties for Plumbing

I. Section 22 40 00 – Plumbing Fixtures

J. Section 23 09 00 – Building Management Systems (BMS)

K. Section 23 09 93 – Automatic Control Sequences

L. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. AGA – American Gas Association

B. ANSI – American National Standards Institute

1. The ANSI/AWWA C100/A21 series of standards for Ductile-Iron Pipe and Ductile-Iron and Gray-Iron Fittings for Water, Waste Water and Reclaimed Water Systems

C. ASME – American Society of Mechanical Engineers

1. ASME A112.1.2 – 2004: Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
2. ASME B16.10 – 2009: Face to Face and End to End Dimensions of Valves
3. ASME B16.18 – 2012: Cast Copper Alloy Solder Joint Pressure Fittings
4. ASME B16.22 – 2001 Revised 2010: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
5. ASME B16.24 – 2011: Cast Copper Alloy Pipe Flanges and Flanged Fittings, Classes 150, 300, 400, 600, 900, 1500 and 2500
6. ASME B16.34 – 2013: Valves – Flanged, Threaded and Welding End
7. ANSI/ASME B31.1 – 2012: Power Piping
8. ASME B31.9 – 2008: Building Services Piping

D. ASSE – American Society of Sanitary Engineering

1. ASSE 1010-2004 – Performance Requirements for Water Hammer Arresters
2. ASSE 1011-2004 – Performance Requirements for Hose Connection Vacuum Breakers
3. ASSE 1013-2011 – Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
4. ASSE 1017-2009 – Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
5. ASSE 1018-2001 – Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied
6. ASSE 1020-2004 – Performance Requirements for Pressure Vacuum Breaker Assembly

E. ASTM – American Society for Testing and Materials

1. ASTM B16 / B16M – 2010: Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
2. ASTM B32 – 2008: Standard Specification for Solder Metal
3. ASTM B62 – 2009: Standard Specification for Composition Bronze or Ounce Metal Castings
4. ASTM B88 – 2009 Standard Specification for Seamless Copper Water Tube
5. ASTM B813 – 2010: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube

F. AWWA – American Water Works Association

1. AWWA C104/A21.4 – 2008: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

2. AWWA C105/A21.5 – 2010: Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110/A21.10 – 2012: Ductile-Iron and Gray-Iron Fittings
4. AWWA C111/A21.11 – 2012: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C116/A21.16 – 2009: Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
6. AWWA C150/A21.50 – 2008: Thickness Design of Ductile-Iron Pipe
7. AWWA C151/A21.51 – 2009: Ductile-Iron Pipe, Centrifugally Cast, for Water
8. AWWA C153/A21.53 – 2011: Ductile-Iron Compact Fittings for Water Service
9. AWWA C509 – 2009: Resilient-Seated Gate Valves for Water Supply Service
10. AWWA C510 – 2007: Double Check Valve Backflow Prevention Assembly
11. AWWA C651 – 2005: Disinfecting Water Mains
12. AWWA C700 –2009: Cold Water Meters – Displacement Type, Bronze Main Case

G. AWS – American Welding Society: AWS A5.8/A5.8M – 2011: Specification for Filler Metals for Brazing and Braze Welding

H. CSA – Canadian Standards Association

1. CSA-B64 Series-07 (5th Edition) – Backflow Preventers and Vacuum Breakers (Contains B64.1.2 Pressure Vacuum Breakers (PVB); B64.4 Reduced Pressure Principle (RP) Backflow Preventers; etc.)
2. CSA 4.4-M99 (Revised 2008) – Relief Valves for Hot Water Supply Systems (same as ANSI Z21.22)

I. FM – Factory Mutual Approvals LLC

J. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry

1. MSS SP-70-2011: Gray Iron Gate Valves, Flanged and Threaded Ends
2. MSS SP-80-2013: Bronze Gate, Globe, Angle and Check Valves

K. NSF – National Sanitation Foundation: NSF/ANSI 61, Edition 2011: Drinking Water System Components – Health Effects

L. PDI – Plumbing and Drainage Institute: PDI WH 201 – 2006 Revised 2010: Water Hammer Arresters

M. UL – Underwriters Laboratories Inc.

N. USC's FCCC – Foundation for Cross-Connection Control and Hydraulic Research

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 Reference Standards and the requirements of the listed related documents in 1.02 Related Documents.

B. Valves construction shall be suitable for the pressure, temperature, and fluid quality of the service in which they are to be used.

C. All valves shall be manufactured in accordance with ANSI, AWWA, ASTM, MSS-SP-70 & 80 (Manufacturers Standardization Society of the Valve and Fittings Industry), standards and specifications.

D. ANSI/ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.

E. ASME 16.10 and ASME 16.34 for dimension and design criteria.

F. NSF Compliance: NSF 61 for valve materials for potable-water service.

G. Minimum test pressure for all valves shall be 1.5 times maximum system working pressure unless noted otherwise.

1.05 SUBMITTALS

A. For each type of valve indicated, submit body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; pressure differential range, shipping, installed, and operating weights; furnished specialties; and accessories.

B. Submit a schedule of all major control valves for review and acceptance, complete with all pertinent data, such as manufacturer, catalog number, cold water working pressure, etc.

C. Product Data: Submit manufacturer’s latest information on construction details, rated capacity data, operating characteristics and installation data.

D. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiate between manufacturer-installed and field-installed wiring and location and size of all required field connections.

E. Submit manufacturer’s installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories, and maintenance data.

F. Submit Domestic Water System cleaning and flushing test report.

G. Submit Domestic Water System chlorine residues and bacteriological samples testing.

H. Submit Operational and Maintenance (O&M) manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal shall have same quality, finish, free area, material construction, etc., as those specified under base Specification.

B. Approved Manufacturers:

1. Copper Piping: Mueller, Nibco, Cambridge-Lee, Cerro, Howell Metal, Wolverine, or approved equivalent.
2. Copper Fittings: NIBCO, Elkhart, Mueller, Arco, Grimmel, or approved equivalent.
3. Gate Valves: Jenkins, Crane, Kennedy, NIBCO, Stockham, or approved equivalent.
4. Ball Valves and Check Valves: Conbraco, NIBCO, Stockham, Watts Industries, or approved equivalent.
5. Balancing Valves: Armstrong, B&G, Taco, Tour & Andersson, Victalic, or approved equivalent.
6. Stop and Drain Valves: Conbraco (Apollo), or approved equivalent.
7. Solenoid Valves: Automatic Switch Company (ASCO), Golden Anderson, or approved equivalent.
8. Strainers – “Y” Type: Conbraco (Apollo), Watkins, or approved equivalent.
9. Strainers – “Plate” Type: Badger, or approved equivalent.
10. Water Meters: Hersey Meters, Badger Meter Inc., Invensys Sensus Metering Systems, or approved equivalent.
11. Vacuum Breakers – Atmospheric Type: Watts Industries, Wilkins, or approved equivalent.
12. Vacuum Breakers – Pressure Type: Conbraco, Wilkins, or approved equivalent.
13. Grooved Fittings: Anvil-Gruvlok, Victaulic, or approved equivalent.
14. Pressure Reducing Valves: Bermad, GA Industries, Golden Anderson Valves, Watts Industries, Wilkins, or approved equivalent.
15. Relief Valves: Wilkins, Watts Industries, or approved equivalent.
16. Thermostatic Mixing Valves: Leonard, Powers, Process Controls, or approved equivalent.
17. Shock Absorbers: Precision Plumbing Products, Zurn, Jossam, J.R. Smith, Sioux Chief, or approved equivalent.
18. Backflow Preventers: Ames, Febco, Conbraco, Watts Industries, Wilkins, Zurn, or approved equivalent.
19. Trap Primers: Precision Plumbing Products, MIFAB, or approved equivalent.
20. Air Gap Fittings: MIFAB, or approved equivalent.
21. Expansion Tanks: Amtrol, Wessels, Bell and Gossett, or approved equivalent.
22. Brazing Alloys and Fluxes: Harris Products Group, Canfield, or approved equivalent.

2.02 PIPING AND FITTINGS

A. Buried Piping Systems 4 inches and larger:

1. Pipe: Cement-lined mechanical joint ductile iron pipe: ANSI/AWWA C100/A21 Series of Standards, AWWA C151/A21.51, C150/A21.50, C111/A21.11, Class 53 or 54, with Polyethylene Encasement.

    a. Interior of Pipe: Cement-lined and seal coated, AWWA C104/A21.4 and listed by approved certifying agency as conforming to requirements of NSF/ANSI 61.
    b. Outside of Pipe: Asphaltic coated, AWWA C153/A21.53.
    c. Polyethylene Encasement: AWWA C105/A21.5 Standard (American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems).

2. Fittings: Mechanical joint ductile iron fittings: Complying with applicable requirements of ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11 with exception of manufacturer's proprietary design dimensions, 350 psi working pressure rating, and flexible restrained joint ductile iron components in accordance with ANSI/AWWA C110/A21.10.

    a. Inside of Fittings: Cement-lined and seal coated, ANSI/AWWA C104/A21.4 and listed by approved certifying agency as conforming to requirements of NSF/ANSI 61.
    b. Outside of Fittings: Epoxy coating, AWWA C116/A21.16.
    c. Polyethylene Encasement: AWWA C105/A21.5 Standard (American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems).

B. Buried Piping Systems 3 inches and smaller:

1. Piping: Type "K" Tubing ASTM B88 – seamless copper water tube.
2. Fittings:

    a. Cast copper alloy complying with ASME B16.18.
    b. Wrought copper solder type pressure fittings complying with ASME B16.22.

3. Field wrap with 50-mil PVC tape or factory-applied PVC coating.
4. Joints: Brazed using AWS A5.8/A5.8M, AWS BCuP Series, copper-phosphorus alloys, unless otherwise indicated; equivalent to:

    a. "Stay- Silv 15" by Harris Products Group
    b. "Sil Can 15" by Canfield

C. Above-Grade Piping Systems:

1. Piping: Type "L" tubing ASTM B88 – seamless copper water tube.
2. Fittings:

    a. Cast copper alloy complying with ASME B16.18.
    b. Wrought copper solder type pressure fittings complying with ASME B16.22.
    c. Class 150, flat-faced, flanges complying with ASME B16.24.

3. Joints:

a. ½ inch to 1.5 inches: Soldered using ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813. 100 percent lead free, 95 percent tin and 5 percent antimony composition, silver bearing solders, unless otherwise indicated; equivalent to:

(1) "Silverflo" by Canfield
(2) "Bridgit" by Harris Products Group

b. 2 inches and larger: Brazed using AWS A5.8/A5.8M, AWS BCuP Series, copper-phosphorus alloys, unless otherwise indicated; equivalent to:

(1) "Stay- Silv 15" by Harris Products Group
(2) "Sil Can 15" by Canfield

2.03 VALVES

A. General Characteristics: Provide valves with screwed or flanged ends as required by the piping system in which they are installed and as specified. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.

B. Shut-off Valves – 2 inches and smaller size:

1. Ball Valve: Bronze body, full port, 2-piece, extended handles that allow operation of the valve without breaking the vapor seal or disturbing the insulation, Type 316 stainless steel ball and stem, in-line repairable, rated for 600 psi non-shock WOG, TFE seats and seals, blowout-proof stem design, adjustable packing nut, extended solder connections and designed for soft solder and brazing installations; "T585-66-LF" by NIBCO, "Apollo 77CLF Series" or approved equivalent.

C. Shut-off Valves – 2.5 inches and larger size:

1. Gate Valve: Iron body, resilient wedge, outside screw and yoke, 175 psi minimum working pressure, FDA approved epoxy coating inside and out, flanged pattern, meeting AWWA C509 standard; "Fig. F-619-RW" by NIBCO, or approved equivalent.
2. Butterfly Valves: Gruvlok Series 6700.

D. Check Valves:

1. Swing Type – 2 inches and smaller: Bronze body ASTM B62, Y-Pattern swing-type, threaded ends, manufactured in accordance with MSS SP-80, Class 125, with TFE seat disc; "S413-Y" by NIBCO, or approved equivalent.
2. 2.5 inches and larger: Gray-Iron body Class 125, horizontal swing check valve, asbestos-free gasket, stop plug for screwdriver insertion to rotate and regrind seat, flanged ends; "G-933" by Stockham, or approved equivalent.

E. Balancing Valves:

1. Bronze body, full port, 3-piece, 2 inch extended handles of non-thermal conductive material and protective sleeve that allows operation of the valve without breaking the vapor seal or disturbing the insulation, ASTM B16/B16M, chrome plated bronze ball, in-line repairable, rated for 150 psi and 600 psi non-shock WOG, TFE seats and seals, blowout-proof stem design, adjustable packing nut, memory stop, extended solder connections and designed for soft solder and brazing installations; “S585-70NS” by NIBCO, or approved equivalent.
2. Bronze body, Y-Pattern multi-turn 360-degree adjustment with a micrometer type indicator located on valve handwheel, hidden memory feature which provides locking valve position after system is balanced, metering ports with Nordel check valves and gasketed caps located on both sides of valve seat; “Model CBV” by Armstrong, B&G Circuit Setter Plus, Taco Accu-Flo, Tour & Andersson STAS/STAD, Victaulic Series 786/787, or approved equivalent.

F. Stop and Drain Valves: Bronze body, full port, ASTM B16/B16M, chrome plated bronze ball, in-line repairable, rated for 400 psig WOG, TFE seats and seals, blowout-proof stem design, adjustable packing nut, drain cap, latch lock lever, sweat ends and designed for soft solder and brazing installations; “Apollo 95ALF Series” by Conbraco, or approved equivalent.

G. Thermostatic Mixing Valves (lead free):

1. Thermostatic Water Mixing Valve: Adjustable high temperature limit stop, inlet check-stops, wall support, outlet ball valve, outlet pressure gauges, inlet manifold piping, color-coded dial thermometer 0 degrees F to 140 degrees F factory-assembled and -tested, chrome plated brass, ASSE 1017 Certified; by Leonard, or approved equivalent.

2.04 DOMESTIC WATER SYSTEM MISCELLANEOUS COMPONENTS

A. Shock Absorbers:

1. Pre-charged sealed air chamber, piston type arrester, with EPDM “O”-rings in seamless copper tube chamber lubricated by FDA-approved silicone compound, meeting or exceeding PDI Standard WH 201, ASSE Standard 1010, and ANSI A112.26.1M.
2. Properly sized and selected per PDI Standard WH 201 and having sufficient displacement volume to dissipate the calculated kinetic energy generated by the piping system in accordance with PDI sizing guidelines.

B. Trap Primer:

1. General: Tested and certified to the ASSE Standard 1018, non-flow though type trap primer body consisting of brass body and fittings and “O”-ring seals with no springs or diaphragms; not requiring adjustments and operating on line pressure drop, complete four view holes, removable filter screen, distribution unit, air gap, distribution unit for multiple drain applications.
2. Style and Application:

a. Single drain up to 3 drains: Pressure-drop activated brass trap seal primer, with inlet opening of male ½-inch NPT and outlet

opening of female ½-inch NPT complete with four view holes and removable filter screen. Serves up to 3 floors drain traps and requires no adjustments and no air pre-charge; MIFAB® model M2-500, or approved equivalent.

b. Serves up to 6 drains: Pressure-drop activated brass trap seal primer, with inlet opening of male ½-inch NPT and outlet opening of female ½-inch NPT complete with four view holes and removable filter screen and requires no adjustments and no air pre-charge; MIFAB® model MR-500, or approved equivalent.

c. Serves up to 10 drains: Pressure drop activated brass trap seal primer, with inlet opening of male ½-inch NPT and outlet opening of female ½-inch NPT complete with four view holes and removable filter screen; MIFAB® model M1-500, or approved equivalent.

3. Accessories: Air gap copper air gap fitting complete with a male ½-inch NPT fitting at the inlet supply incorporating a stream directing nozzle, a female ½-inch NPT outlet, and a 1-inch vertical air gap, conforming to ASME A112.1.2 Air Gaps in Plumbing Systems Standard; “MI-GAP” by MIFAB, or approved equivalent.

C. Strainers:

1. “Y” Type Strainer: Sized to match line size, bronze “Y” type strainer, Type 304 stainless steel perforated screen 0.045-inch for domestic water service; “Series 59-300-L” by Conbraco, “Model YB Series” by Wilkins, or approved equivalent.
2. Plate Strainer: Sized to match line size, dual elliptical or flange, cast bronze housing, stainless steel plate screen, housing bolts, flange bolts and nuts, and rubber gasket; “Recordall Plate Strainer” by Badger, or approved equivalent.

D. Water Meter (lead free):

1. Bronze body, disc type water meter with 1-inch NPT test plug including remote readout ROM system, certified to comply with AWWA Standard C700 and acceptable to water utility authority; “4-In. Compound Meter” by Hersey Meters, or approved equivalent.
2. 1.5-inch bronze body, disc type water meter with 1-inch NPT test plug with remote readout ROM system, certified to comply with AWWA Standard C700 and NSF/ANSI 61 and acceptable to water utility authority; “Model M120LL” by Badger Meter, Inc., or approved equivalent.
3. Class II turbine principle measurement type water meter, with external strainer, with register providing contact closures to open or close an electrical circuit at pre-determined intervals proportional to the volume measured by the water meter, certified to comply with AWWA Standard C700, line size as indicated on the Drawing(s); “W Turbo Meter, Impulse Contactor Register Unit” by Invensys Sensus Metering Systems.

a. Connecting Cable Requirement: Belden #8760 or equivalent 2-conductor shielded cable is required. Maximum outside

diameter of the cable should be 0.156 inches to effect a water-tight seal at the register.

b. Contact Type: Single pole, double throw (Form C) dry contact switch operated by rotating cam.
Switch Output: One (1) contact operation per ten (10) cubic feet.
Contact Rating(s): 24 volts DC: 2 amps resistance. 125 volts AC: 2 amps resistance.

c. Contact Actuation Time: 100 milliseconds minimum at meter's maximum flow rate (i.e., N.O. Circuit: contacts closed 100 milliseconds minimum).

d. Contact Protection: On inductive load applications, suitable electrical suppression should be provided for contact protection.

4. ⅝ inch by ¾ inch size, bronze body, disc type water meter with digital output encoder register compatible with automatic meter reading system, cubic foot unit measure operating temperature up to 80 degrees F; "Model 25 Disc Meter – Recordall Transmitter Register (RTR) with Model 40 Integral or Remote ITRON – Encoder/Receiver/Transmitter (ERT)" by Badger-Meter, Inc., or approved equivalent.

5. ¾ inch size, bronze body, disc type water meter with digital output encoder register compatible with automatic meter reading system, cubic foot unit measure, temperature up to 80 degrees F; "Model 35 Disc Meter – Recordall Transmitter Register (RTR) with Model 40 Integral or Remote ITRON – Encoder/Receiver/Transmitter (ERT)" by Badger-Meter, Inc., or approved equivalent.

6. Automatic Meter Readout System: Radio read type for automatic meter reading systems; "ITRON" radio frequency system by Badger-Meter, Inc., or approved equivalent.

2.05 BACKFLOW PREVENTERS

A. Reduced Pressure Zone Backflow Preventer 2.5 inch and larger line size: Device meeting requirements of USC's FCCC & HR Manual, Sec. 10, ASSE 1013 and CSA B64 Series 7, B64.4; sized to accommodate line size indicated on the Drawings; with bronze body, strainer, soft seated bronze check valves with full port ball valve shut-off valves, pressure differential relief valve, air gap drain, and 4 bronze body ball type test cocks factory-installed on assembly; "Series LF909" by Watts, "Model 375" By Wilkinsor approved equivalent.

B. Reduced Pressure Zone Backflow Preventer 2 inch line size or smaller: Device meeting requirements of USC's FCCC & HR Manual, Sec. 10, ASSE 1013 and CSA B64 Series 7, B64.4; sized to accommodate line size indicated on the Drawings; with bronze body, strainer, soft seated bronze check valves with full port ball valve shut-off valves or non-rising gate valves, pressure differential relief valve, air gap drain, and 4 bronze body ball type test cocks factory-installed on assembly; "Model 375" by Wilkins, "Model Series LF009" by Watts..

2.06 VACUUM BREAKERS:

A. Atmospheric Type: Interior hose threads; "Series 8B" by Watts, "Series BFP-8" by Wilkins, or approved equivalent.

B. Pressure Type: Sized to match line size, internally loaded check valve and loaded air inlet valve opening to atmosphere on discharge side of check valve

with ball valves, bronze body construction, tight seating rubber discs, and ball type test cocks factory-installed on vacuum breaker, meeting requirements of USC's FCCC & HR Manual, Sec. 10, ASSE 1020 and CSA B64 Series 07, B64.1.2; "Model Series 40-500" by Conbraco, "Model Series 720-A" by Wilkins, or approved equivalent.

PART 3 – EXECUTION

3.01 APPLICATIONS

A. Piping:

1. Provide unions at connections to each piece of equipment for easy dismantling and at such other points to facilitate installation. Unions shall be of same strength and manufacturer as used in the respective piping systems, and shall be of the ground joint type as specified in specification Section 22 11 10 – Plumbing Piping and Accessories.

B. Shut-off Valves:

1. Provide shut-off valves for all water supplied, equipment and fixtures, and devices which do not have supply stop or integral isolation valves provided with equipment or fixtures.
2. Provide shut-off valves and capped outlets in water piping, as required and where indicated for future extension to equipment and fixtures provided under other Sections of the work.
3. Provide shut-off valves at connections in water piping for the work of other trades, within two feet of their related equipment.
4. Coordinate and include as part of this work final connections with applicable trade.
5. Provide shut-off valves on each water riser.
6. Provide shut-off valves for each shock absorber installation.

C. Backflow Preventers:

1. Provide vacuum breakers and/or backflow preventers in all water supplies to fixtures and equipment requiring inlet connections wherein a minimum air break cannot be attained, or where chance of contamination may exist.
2. Provide full size indirect waste from reduced-pressure backflow preventer's relief port's funnel drain connection to floor sink or floor receptor with air break at drain.
3. Comply with manufacturer's specific instructions for installation of backflow preventer, and install and test in accordance with requirements of local jurisdictional authority.
4. When required by the local Authorities Having Jurisdiction, reduced-pressure backflow preventers shall be installed in strict accordance with the regulations and requirements of that department.

D. Shock Absorbers:

1. Provide shock absorbers in the piping systems and adjacent to all pieces of equipment wherein quick-closing valves are installed.

2. Shock absorbers shall be properly sized and selected per PDI Standard WH 201 and having sufficient displacement volume to dissipate the calculated kinetic energy generated by the piping system. Install all units in a vertical position.
3. Provide access panels with Allen wrench key lock for each arrester.
4. Install shock absorbers as close as possible to inlet side of quick closure valves and devices.
5. Install shock absorbers in upright position on inlet side of solenoid valve.
6. Do not install shock absorber at greater than 90-degree angle from vertical position.

E. Gauges: Provide pressure gauges in locations shown on the Drawings and as specified in Section 22 05 19 – Meters, Gauges and Thermometers for Plumbing. Shut-off cock shall be provided between gauge and piping to permit gauge removal while system is under pressure.

F. Thermometers: Provide thermometers with wells on inlet and outlet of water heaters and on hot water circulation lines, as specified in specification Section 22 05 19 – Meters, Gauges and Thermometers for Plumbing, and where indicated.

G. Strainer:

1. Provide ball valve or hose bib on strainer blow-off port on strainers 2 inches and larger in line size.
2. Provide strainer on inlet side of hot water circulation pump.
3. Provide strainer upstream of solenoid valves.
4. Provide strainer upstream of pressure-reducing valves supplied without integral strainers.
5. Provide strainers in inlet line to all temperature-regulating mixing valves and automatic modulating control valves.
6. Flush strainer and supply piping after hydrostatic pressure test and prior to operation of solenoid valves and pressure-regulating valves.
7. Flush strainer prior to pump operation and at least once after pump has been placed into operation for period of no greater than 8 hours. Flush strainer as needed to assure piping is free of piping assembly sediment and debris.

H. Trap Primers:

1. Provide trap primer units with trap primer discharge piping, and connection to tailpiece or drain body for each floor drain.
2. Provide trap primer units with trap primer discharge piping, and connection to tailpiece or drain body for each floor sink.
3. Provide access panel for trap primers installed behind walls or above hard ceilings as specified in Section 22 05 50 – Access Doors in General Construction for Plumbing.
4. Trap primer discharge piping shall be same as specified for domestic water piping.
5. Provide field wrap of 50-mil PVC tape or factory-applied PVC coating around exterior of copper tubing that is buried in concrete floors.
6. Provide a line shut-off valve and union connection upstream of the trap seal primer in order to shut off the water supply when performing maintenance on the trap seal primer.

I. Relief Valves:

1. Provide adjustable bronze spring and diaphragm combination pressure and temperature type relief valves with test lever and automatically reseating type thermostatic element.
2. Pipe drain to spill over floor drain or to other safe location.
3. Locate on water heaters.

3.02 INSTALLATION

A. Piping:

1. Minimum cover on underground water piping shall be 3 feet, 0 inches below final grade.
2. Carry headers for groups of fixtures full size throughout their length.
3. All domestic water piping shall be arranged to drain to low points and to provide for air elimination at high points.
4. Mains, risers and branch connections to mains shall be arranged to permit expansion and contraction without strain by means of elbow swings and/or expansion joints **[and seismic movement]**.
5. All cut and threaded pipe shall have the cutting burrs and sharp edges reamed out. In erecting pipe, friction wrenches and risers shall be used exclusively, and any pipe cut, dented or otherwise damaged shall be replaced.
6. All ferrous to non-ferrous pipe connections shall be made with accepted dielectric pipe or flange union isolating joints to prevent any electrolytic action between dissimilar metals.
7. All copper tubing shall be cut and reamed to remove all burrs. Outside and inside of the fittings and outside of the tubing at each end shall be well cleaned with steel wool before soldering to remove all traces of oxidation regardless of how clean the surfaces of the pipe and fittings may appear.
8. Nipples: Any piece of pipe 8 inches in length and less shall be considered a nipple. All nipples with unthreaded portion 1.5 inches and less shall be extra heavy. All other nipples to be of weight corresponding to fitting connected. Only shoulder nipples shall be used; closed nipples will not be acceptable.
9. All fitting unions and connections at pumps, tanks or other major equipment 3 inches and over in size shall be assembled with flanged joints and approved gaskets.
10. Supports for vertical piping shall be double bolt riser clamps (consistent with pipe material, i.e., copper for copper pipe) with each end having equal bearing on the building structure. Vertical piping to be supported at every level. Refer to Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing.
11. Support piping for copper piping in accordance with Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing.
12. Install piping for copper piping in accordance with Section 22 11 00 – Plumbing Piping and Accessories.

B. Valves:

1. Arrange and orientate valves, check valves, pressure-reducing valves, shock absorbers, trap primer valves, etc., in manner accessible for maintenance and/or removal.
2. Provide shut-off valves for cold water and hot water branches serving more than two fixtures.
3. Install standard weight or extra-heavy weight valves in conformity with the requirements for water piping fittings as specified.
4. Provide valves with soldered, screwed or flanged ends as required by the piping system in which they are installed and as specified.
5. Provide shut-off valves for all plumbing equipment, fixtures, and fixture trim, which do not have supply stop or integral isolation valves included.

C. Solenoid Valve:

1. Install valve with pipe connection opening horizontal to floor and position coil and solenoid in upright and vertical position.
2. Verify power wiring provided by Division 26. Contractor matches voltage and current required to operate valve in accordance with solenoid valve UL listing and manufacturer's guidelines prior to energizing solenoid valve.
3. Install unions on inlet and outlet side of solenoid valves.
4. Remove solenoid valve from piping during hydrostatic pressure tests.

D. Strainer:

1. Flush strainer and supply piping after hydrostatic pressure test and prior to operation of solenoid valves and pressure-regulating valves.
2. Flush strainer prior to pump operation and at least once after pump has been placed into operation for period of no greater than 8 hours. Flush strainer as needed to assure piping is free of piping assembly sediment and debris.

E. Thermometers: Install oversize pipe tee and nipple for wells of thermometer installations.

F. Trap Primer:

1. Flush water line before installing trap primer. Ensure that all flux and other debris is removed.
2. Use only Teflon tape around threads. Do not use pipe dope. Do not solder fittings directly onto the inlet or outlet of the primer.
3. Cycle trap primer at least six (6) times to ensure optimum performance and view water discharge from the orifice.
4. Disassemble and clean trap primer in event of excess water discharge or lack of water discharge.
5. Do not install the trap seal primers closer than forty (40) feet apart when using the same potable water supply line.
6. Mount trap primer outlet one foot above the finished floor for every twenty (20) feet of floor drain trap make-up water line.

3.03 WATER METER

A. Contact water utility company to obtain size and type of water meter and obtain copy of “Standard Specifications for Interior Meter Setting Piping” along with all pertinent drawings, details, regulations, applications, etc.

B. Water Connection: Make arrangements with local Water Authority for tapping of public water main. The Contractor shall pay all fees and costs to the water authority as required for tapping sleeve valve, wet tapping and inspections.

C. Water Service: Provide all products, materials and services required for the complete installation, testing, disinfection and activation of this water service except for those products, materials and services which are provided by utility company.

3.04 TESTING AND ADJUSTMENTS

A. Provide, in written format, testing information including date of testing, starting pressure, pressure after test and length of test, pressure loss after test and witnesses present.

B. During the progress of the work, test the domestic water systems including fixture roughing-in sections as directed to permit general construction and building-in of rough work to proceed. Test entire piping systems or in sections after rough piping systems are installed where deemed advisable to meet construction schedule and sequencing of other work. Such tests shall be made in the presence of the Owner’s Representative, Building Department Inspectors and any other Authorities Having Jurisdiction. A minimum of 48-hours’ notice shall be given to the Architect prior to any testing.

C. The Contractor shall provide all apparatus, temporary work or any other requirements necessary for such tests and shall take all due precautions to prevent damage to the Building or its contents. If damage occurs, the Contractor shall repair and remedy all damages made without cost to the Owner.

D. Any defects or deficiencies discovered as a result of tests shall be immediately repaired and tests repeated until the test requirements are fully complied with. Retest piping section which fails tests until successful tests results are obtained. No caulking of pipe joints to remedy leaks shall be permitted.

E. Backfill trench between joints before testing to prevent movement of pipe during tests. Expose joints to detect visible leaks. Sufficiently harden thrust blocks prior to tests. Fill pipe with water for minimum 24 hours prior to applying test pressure to stabilize system.

F. The domestic water supply system shall be tested to a hydraulic pressure equal to 1.5 times the normal operating pressure, but no less than 125 pounds per square inch before being enclosed and before non-conducting covering is applied. Do not connect fixtures, equipment and solenoid valves into system during this test. All leaks or defects indicated by tests shall be repaired or replaced with new material, as directed by the Architect, and test repeated until all defects are removed. Disconnect apparatus for developing required pressures during stated periods. After fixtures are connected, test system for 2 hours at 75 psig or prevailing water pressure, whichever is higher.

G. Do not cover or conceal plumbing system or portion of plumbing system until after testing and approval by jurisdictional authority. Expose systems that has been covered or concealed before testing or inspection and retest.

3.05 DISINFECTION/CLEANING

A. Do not open valves separating new piping and existing water systems until piping tightness tests, flushing and disinfection has been completed. Provide temporary test valves piping and drain components to accomplish disinfection and cleaning.

B. Record flushing information including date of flushing, volume of flushing, length of time and witnesses present. Flush piping systems in accordance with the following:

1. Domestic Water – 3 inch and smaller pipe size:

a. Prior to testing, flush piping with clean water until clean water free of silt or grit is observed for at least one minute, for specific pipe size.
b. Flow rates per pipe size shall be as follows:

gpm	for pipe size (in inches)
220	3
150	2.5
100	2
55	1.5
40	1.25
25	1
16	¾
8	½

2. Buried Domestic Water Piping Systems – 4 inch and larger pipe size:

a. Prior to testing, flush piping with clean water until clean water free of silt or grit is observed for at least one minute, for specific pipe size.
b. Flow rates per pipe size shall be as follows:

gpm	for pipe size (in inches)
390	4
880	6
1,560	8
2,240	10

C. Disinfection of Potable Water Systems: Comply with local requirements, where local code requirements are more stringent. Provide necessary labor, equipment, material and test kits for chlorine application and tests. Make all arrangements with jurisdictional water authority for witnessing chlorination and tests of proper disinfection. The Contractor shall pay all fees and costs including water sample testing.

1. Exterior Water Service Line: Perform disinfection of water main piping in conformance of applicable local jurisdictional authorities' standards and requirements of AWWA Standard C651, "Disinfecting Water Mains" with exception of Item 7.3.

    a. Following flushing of main, provide for collection of samples of water by Local Water Authority or Local Department of Health.
    b. Do not place main in service until water has been approved and notification received from Local Water Authority or Local Department of Health.

D. Interior Water Piping: Sterilize all parts of building water services system with water solution containing 50 parts per million of available chlorine for at least a 24-hour contact period. After contact period, flush all parts of system with clear water until system tests at no more than 0.2 ppm residual chlorine.

END OF SECTION

SECTION 22 11 10
PLUMBING PIPING AND ACCESSORIES

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Piping
2. Fittings
3. Jointing Materials
4. Unions and Couplings
5. Mechanically Coupled Pipe
6. Heat Tracing
7. Welding and Jointing Procedures
8. Cleaning of Piping Systems
9. Testing of Piping Systems

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 16 – Expansion Compensation for Plumbing

C. Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing

D. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

E. Section 22 05 53 – Systems Identification for Plumbing

F. Section 22 07 19 – Insulation for Plumbing

G. Section 22 11 00 – Domestic Water Systems

H. Section 22 11 23 – Plumbing Pumps

I. Section 22 13 00 – Drainage Systems

J. Section 22 33 00 – Domestic Water Heating Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ANSI – American National Standards Institute

1. ANSI/ASME B1.20.1 – 2013: Pipe Threads, General Purpose (Inch)
2. ANSI/ASME B1.20.2M – 2006: Pipe Threads 60-deg., General Purpose(Inch)
3. ANSI/ASME B31.1 – 2012: Power Piping

B. ASME – American Society of Mechanical Engineers

1. ASME Standard for Boiler and Pressure Vessel Code – 2013

   a. ASME BPVC – Section IX – Welding and Brazing Qualifications

2. ASME B16.1 – 2010: Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250
3. ASME B16.3 – 2011: Malleable Iron Threaded Fittings, Classes 150 and 300
4. ASME B16.4 – 2011: Gray Iron Threaded Fittings, Classes 125 and 250
5. ASME B16.5 – 2009: Pipe Flanges and Flanged Fittings, NPS½ through NPS 24 (Metric/Inch Standard)
6. ASME B16.18 – 2012: Cast Copper Alloy Solder Joint Pressure Fittings
7. ASME B16.21 – 2011: Nonmetallic Flat Gaskets for Pipe Flanges
8. ASME B16.22 – 2013: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
9. ASME B16.24 – 2011: Cast Copper Alloy Pipe Flanges and Flanged Fittings, Classes 150, 300, 400, 600, 900, 1500 and 2500
10. ASME B16.26 – 2013: Cast Copper Alloy Fittings for Flared Copper Tubes
11. ASME B16.34 – 2013: Valves – Flanged, Threaded and Welding End
12. ASME B18.2.1 – 2012: Square and Hex Bolts and Screws (Inch Series)
13. ASME B31.9 – 2011: Building Services Piping

C. ASTM – American Society of Testing and Materials

1. ASTM A53/A 53M – 2012: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A105/A 105M – 2013: Standard Specification for Carbon Steel Forgings for Piping Applications
3. ASTM A106/A 106M – 2013: Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
4. ASTM A120 – 1984: Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized), Welded and Seamless for Ordinary Uses
5. ASTM A153/A 153M – 2005 Revised 2009: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A181/A 181M – 2013: Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
7. ASTM A182 – 2012: Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
8. ASTM A183 – 2003 Revised 2009: Standard Specification for Carbon Steel Track Bolts and Nuts
9. ASTM A312 – 2011: Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
10. ASTM A376 – 2013: Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
11. ASTM A403 – 2011: Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
12. ASTM A536 – 1984 Revised 2009: Standard Specification for Ductile Iron Castings
13. ASTM A674 – 2010: Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids

14. ASTM B32 – 2008: Standard Specification for Solder Metal
15. ASTM B43 – 2009: Standard Specification for Seamless Red Brass Pipe, Standard Sizes
16. ASTM B62 – 2009: Standard Specification for Composition Bronze or Ounce Metal Castings
17. ASTM B88 – 2009: Standard Specification for Seamless Copper Water Tube
18. ASTM B633 – 2013: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
19. ASTM B813 – 2010: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
20. ASTM B828 – 2002 Revised 2010: Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy tube and Fittings
21. ASTM D1330 – 2004 Revised 2010: Standard Specification for Rubber Sheet Gaskets
22. ASTM D1785 – 2012: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
23. ASTM D2104 – 2003: Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40
24. ASTM D2464 – 2013: Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
25. ASTM D2466 – 2013: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
26. ASTM D2467 – 2013: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
27. ASTM D2609 – 2002 Revised 2008: Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
28. ASTM D2657 – 2007: Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
29. ASTM D2846 – 2009: Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
30. ASTM D3261 – 2012: Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
31. ASTM F1290 – 1998 Revised 2011: Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

D. AWS – American Welding Society

1. AWS A5.8/A5.8M – 2011: Specification for Filler Metals for Brazing and Braze Welding
2. AWS B2.1/B2.1M – 2009: Specification for Welding Procedure and Performance Qualification
3. AWS C3.4M/C3.4 – 2007: Specification for Torch Brazing
4. AWS D10.12M/D10.12 – 2000: Guide for Welding Mild Steel Pipe

E. AWWA – American Water Works Association

1. AWWA C104/A21.4 – 2013: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C105/A21.5 – 2010: Polyethylene Encasement for Ductile-Iron Pipe Systems

3. AWWA C106/A21.6 – 2000: Cast-Iron Pipe Centrifugally Cast in Metal Molds
4. AWWA C111/A21.11 – 2012: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

F. ISO – International Organization for Standardization

1. ISO 9001, 4th Edition – 2008: Quality Management System Requirements

G. UL – Underwriters Laboratories Inc.

H. CCR – California Code of Regulations

1. Title 24 – Building Standards Code

I. Local Codes and Standards

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 and the requirements of the listed related documents.

B. Welding materials and labor to conform to ASME Code and applicable state Labor Regulations.

C. All welders shall be certified by ANSI/ASME B31.1 “Power Piping” or “Qualification Tests” in Section IX of the ASME Boiler and Pressure Vessel Code: Welding and Brazing Qualifications.

D. Each length of pipe, fitting, trap, fixture or device used in any piping system shall be stamped or indelibly marked with type, weight, quality and manufacturer’s name or mark.

1.05 SUBMITTALS

A. Submit the following for review:

1. Product Data: Submit manufacturer’s latest information on construction details, rated capacity data, operating characteristics and installation data.
2. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiates between manufacturer-installed and field-installed wiring and location and size of all required field connections.
3. Submit manufacturer’s installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories and maintenance data.
4. Submit schedule indicating the ANSI, ASME, ASTM, AWWA Standard Specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

5. Submit shop drawings indicating anchoring details, anchor points, guide details, etc.
6. Submit manufacturer's data for strainers and fittings.
7. Submit dimensioned drawings locating pipe penetrations through walls, slabs and other structural elements, anchor and guide locations, etc.
8. Submit pipe expansion and flexibility calculations.
9. Submit test reports on all systems tested. Tests required by Authorities Having Jurisdiction over the work shall be submitted on appropriate forms to the satisfaction of such authorities.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Strainers:

1. Y-type and Basket: Mueller Steam Specialty, Muessco, Spirax-Sarco, Bailey Div. of CMB Industries, Zurn Industries, Victaulic Company (all grooved end strainers)
2. Tee Type Grooved End: Victaulic Company (all grooved end strainers)
3. Basket Type: Viking

B. Dielectric Fittings:

1. Unions: Watts, Perfection, Central Plastics, EPCO, Zurn, Hart
2. Insulating Flanges: Watts, Capital, Central Plastics, EPCO, Walter Vallett Co., V-Line
3. Flange Kits: Calpico, Central Plastics, Advanced Plastics
4. Couplings: Calpico, Lochinvar
5. Nipples: Perfection, Sioux Chief, Victaulic Company

C. Flange Gaskets: John Crane, Garlock, Manville, Goodrich

D. Cleaning of Piping Systems: Use chemicals as recommended by the water treatment specialist engaged under Section 23 25 00: Water Treatment

E. Testing of Piping Systems: American Gas and Chemicals "Leak-Tee", Cosgille Scientific "Sho Gas", Flamort Chemical "Detect-A-Leak", Highside Chemicals "Leak Finder Foam"

2.02 PRESSURE PIPING AND FITTINGS

A. Pressure piping shall conform to requirements of ANSI/ASME B31.1 Power Piping. Pressure ratings herein are steam, unless specifically designated as "WOG" (Water, Oil or Gas) or "WWP" (Water Working Pressure).

B. Copper Tubing: ASTM B88:

1. Wrought copper, solder joint fittings, ASME B16.22, in sizes available with AWS A5.8/A5.8M or ASTM B32 filler metals per Article 2.4, C.
2. Cast bronze solder-joint fittings, ASME B16.18, only in sizes not available in wrought copper.
3. Cast bronze, threaded, ground-joint unions, ASME B16.18, 2 inches and smaller.

4. Cast bronze, flanged unions, ASME B16.24, 150 pounds per square inch class, 2.5 inches and larger.
5. Copper tubing flared fittings: Bronze castings for flared type joints, ASME B16.26.
6. Grooved end copper fittings conforming to ASME B16.18 and ASME B16.22, and couplings conforming to ASTM A536. Copper tubing dimensioned. Flaring of tube or fitting ends is not permitted.

C. Brass:

1. Standard weight and red brass pipe, 85 percent copper, 15 percent zinc, ASTM B43.
2. 125 pounds per square inch threaded brass fittings, ASME B16.15.

2.03 JOINING MATERIALS

A. Flange gaskets shall be rated ASME B16.21, non-metallic, flat, asbestos-free full faced or flat ring type to suit flange facings. Selected from one of the following materials:

1. General service, water, air, natural gas: 1/16-inch thick, non-asbestos. Crane Style 333, or approved equal.
2. PVC piping applications: ⅛-inch thick, Durometer 65 to 75; Goodrich “Koroseal”, Grade 116 polyvinyl chloride, or approved equal.
3. Hot water: Red rubber, ASTM D1330, 1/16-inch thick; Crane Style 555, or approved equal.
4. Gaskets shall be coated with thread lubricant when being installed.

B. Pipe threads shall be ANSI/ASME B1.20.1.

C. Flange bolts and nuts shall be rated ASME B18.2.1, carbon steel.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

1. 100 percent lead free, silver bearing solders; equivalent to:

a. “Silverflo” by Canfield
b. “Bridget” by Harris Products Group

2. 95 percent tin and 5 percent antimony composition.

E. Brazing Filler Metals:

1. General Duty: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys; unless otherwise indicated, equivalent to:

a. “Stay-Silv 15” by Harris Products Group
b. “Sil Can 15” by Canfield

2.04 UNIONS

A. Steel Piping 2 inches and smaller: ASME B16.3 malleable iron unions with brass seats. Use unions of a pressure class equal to or higher than that specified for

the fittings of the respective piping service but not less than 250 pounds square inch, ground joint.

B. Steel Piping 2.5 inches and larger: ASTM A181/A 181M or ASTM A105/A 105M, Grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2.5 inches may be used as required for connecting to equipment and piping specialties. Use raised face flanges ASME B16.5 for mating with other raised face flanges on equipment with flat ring or full-face gaskets. Use ASME B16.1 flat face flanges with full-face gaskets for mating with other flat face flanges on equipment. Gasket material to be non-asbestos and suitable for pressures and temperatures of the piping system.

C. Copper Piping: Nibco No. 633.

2.05 DIELECTRIC FITTINGS

A. Unions:

1. 1.25 inches and smaller: EPCO Model FX, or approved equal:

   a. 250 pounds per square inch WOG
   b. Provide standard gaskets for plumbing
   c. Female pipe thread by solder end connections, non-asbestos gaskets, having a minimum pressure rating of 250 psig at not less than the design operating temperature of the fluid being conveyed
   d. Clearflow dielectric waterways

2. 1.5 inches and larger: EPCO Model X, or approved equal:

   a. Brass half-union, ASME B16.1, 175 pounds per square inch WOG
   b. Clearflow dielectric waterways
   c. Steel weld neck by copper solder joint end connections, non-asbestos gaskets, having a minimum pressure rating of 125 psig at not less than the design operating temperature of the fluid being conveyed

B. Insulating Flanges:

1. Dielectric-Flange Kits: Provide companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
2. Provide separate companion flanges and steel bolts and nuts, 150 or 300 psig minimum working pressure where required to suit system pressures.
3. 2 inches and smaller: Walter Vallett Company, V line, or approved equal.
4. 2.5 inches and larger: Brass half-union, ASME B16.1, 175 pounds per square inch WOG; EPCO Model X, or approved equal.

C. Couplings: Provide galvanized-steel coupling with inert and non-corrosive, thermoplastic lining, threaded ends and 300-psig minimum working pressure at 225 degrees F.

D. Nipples: Provide electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 degrees F.

2.06 STRAINERS

A. Provide screwed ends up to 2-inch size, flanged or grooved end 2.5-inch and larger.

B. Body:

1. Up to 150 pounds per square inch – Y-type: Ductile or cast iron body; bolted, coupled or threaded screen retainer tapped for a blow-off valve; threaded body in sizes through 2-inch and rated at not less than 175 psi WOG; flanged or grooved end body in sizes over 2-inch and rated at not less than 125 psi WOG at 230 degrees F. Cast iron body with clamped cover, tapped for a blow-off valve; 125 psig flanged body for 2.5-inch and larger.
2. Up to 150 pounds per square inch – Basket type: Cast iron body with clamped cover; body tapped for a blow-off valve; 125 psig flanged body for 2.5-inch and larger.
3. Over 150 pounds per square inch – Y type: Ductile or cast iron or cast steel body; stainless steel screens; bolted, coupled or threaded screen retainer tapped for a blow-off valve; threaded or socket weld body in sizes through 2-inch and rated at not less than 300 psi WOG at 150 degrees F; flanged, grooved end or butt weld body in sizes over 2-inch and rated at not less than 300 psi WOG at 150 degrees F.

C. Strainer screen shall be Type 316 stainless steel or monel, reinforced, with free area not less than 2.5 times inlet area.

1. Perforations:

a. Water:

(1) Up to 2-inch: 1/32 inches
(2) 2.5-inch to 8 inch: ⅛ inches
(3) 10-inch and larger: 5/32 inches

2. Magnets:

a. Water strainers:

(1) All 8-inch and larger
(2) Each pump suction

b. Provide continuous magnetic field around entire circumference of screen.
c. Removable cast Alnico No. 5 channel magnets or approved baskets constructed of magnetic alloy.

d. Secure magnets with stainless steel retaining lugs and threaded rods.

D. Y-Type:

1. Screwed: Faced cap, straight thread and gasket; Muessco No. 11M, or approved equal
2. Flanged: Bolted cover; Muessco No. 751 or No. 752, or approved equal

E. Basket Type: Bolted cover, bottom drain connection.

1. Up to 6-inch: Provide cast iron or steel body with bolted cover, stainless steel ball valve and integral mechanism to permit servicing without interrupting flow; Muessco 792FD, or approved equal.
2. 8-inch and larger: Diverting type, cast iron body with stainless steel basket and integral mechanism to permit servicing without interrupting flow; Zurn Series 570, or approved equal.

PART 3 – EXECUTION

3.01 APPLICATION

A. In addition to applicable portions of the PART 3, refer to the following specification sections for installation, testing and cleaning requirements for specific piping systems identified in these sections.

1. Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing
2. Section 22 11 00 – Domestic Water Systems
3. Section 22 13 00 – Drainage Systems

3.02 INSTALLATION

A. General:

1. Except as otherwise indicated, protect piping as specified below:

a. Allowance for thermal expansion and contraction shall be provided for piping passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation, and by installing through an appropriately sized sleeve to allow for thermal movement.
b. No ashes, cinders, refuse, stones, boulders or other materials that can damage or break the piping or promote corrosive action shall be used in backfilling any trench or excavation in which piping is installed.

2. Install piping at indicated slope free of sags, bends, and kinks. Install components having pressure rating equal to or greater than system operating pressure. Support all piping per Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing.
3. Brace all piping per Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing.

4. Clean off scale, rust and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
5. Install (at traps, instruments, etc., and wherever else directed) approved unions, to permit easy connection and disconnection.
6. Use main sized saddle type branch connections for directly connecting branch lines to main piping lines in steel piping if main is at least one pipe size larger than the branch for up to 6-inch main and if main is at least two pipe sizes larger than branch for 8-inch and larger main. Do not project branch pipes inside the main pipe.
7. Cap all openings in pipes during progress of the work.
8. Do not connect bottom of pipe risers until riser is complete. Rod or tap to clear loose material before making bottom connection.
9. Correct leaks in piping immediately using new materials. Leak-sealing compounds or peening is not permitted.
10. Install drains throughout the systems to permit complete drainage.
11. Not acceptable: mitered ells, bullhead tees, notched tees, bushings on threaded piping.
12. Do not allow any other subcontractor (electrical, telephone company, BMS, elevator, etc.) to electrically ground to any plumbing system.
13. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Encase underground piping with polyethylene film according to ASTM A674 or AWWA C105/A21.5.

B. Arrangement:

1. Except for large scale details, piping is diagrammatically indicated. Install generally as shown.
2. Do not scale the Drawings for exact location of piping.
3. Install piping to best suit field conditions and coordinate with other trades.
4. Piping arrangement: Arrange piping along walls in horizontal groups in an organized, orderly, well executed manner. Each group shall be in one plane if possible. Maintain required slope.
5. Do not sleeve structural members without consent of Architect.
6. Maintain 1-inch clearance from adjacent work, including insulation, except as noted or approved.
7. Install piping concealed above as high as possible above ceilings or in walls unless otherwise indicated. Install all piping parallel to building walls and ceilings and at heights that do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

C. Expansion, Contraction and Bending:

1. Install piping with provisions for expansion and contraction. Provide expansion loops, swing joints, anchors and/or expansion joints where indicated or otherwise required so that piping may expand and contract without damage to itself, equipment, or building.
2. Do not spring or force piping during installation.

3. Do not bend piping without use of pipe bending machine.
4. Refer to Section 22 05 16 – Expansion Compensation for Plumbing.

D. Sloping, Air Venting and Draining:

1. Slope piping as indicated, true to line and grade, and free of traps and air pockets.
2. Unless otherwise indicated, slope piping in direction of flow as follows:

Service	**Inclination in Direction of Flow**	**Slope**
Storm Sewer	Down	⅛ inch per foot
Sanitary Sewer:		
2.5 inch and smaller	Down	¼ inch per foot
8 to 6 inch	Down	⅛ inch per foot
8 inch and larger	Down	1/16 inch per foot

3. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
4. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
5. Reducers:

    a. Eccentric:

        (1) Between water piping and pump suction, top side flat

    b. Concentric:

        (1) In vertical piping
        (2) May be used as increasers in horizontal piping

6. Provide drain valves and hose adapters at all low points in piping.
7. Provide drain valves for float type controllers.
8. Provide manual air vents at all high points in water piping:

    a. ¼-inch copper tube
    b. Discharge vented water into nearest janitor's sink or floor drain
    c. If no fixture is near provide 180-degree bend to discharge into portable container

E. Strainers:

1. Install at following locations:

    a. Ahead of pump suctions

b. Ahead of control and regulating valves
c. Elsewhere as indicated on the Drawings

2. In water service, up to 250 degrees F maximum; and compressed air:

a. Install globe valve for blow-off with full outlet size and same pressure rating as piping system.
b. Hose-end fittings are acceptable for water service only.

F. Piping Specialties:

1. Locate thermometers and gauges to permit observation by personnel standing on floor.
2. Provide instrument cocks at pressure gauges.

G. Copper:

1. Crimping of copper tubing prohibited.
2. Isolate copper pipe and tubing from contact with ferrous materials.
3. For branch drops and rises to plumbing fixtures, anchor branch to wall with drop-ear ell or tee.
4. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.

H. Coatings: Reapply mastic coating on buried piping, after installation, to surfaces from which coating has been removed or scraped.

I. Care of Floors:

1. Do not set pipe vises or threading machines on unprotected concrete floors.
2. Cover floor when making plumbing connections to avoid staining floors with oil, white or red lead or other substances. Bear cost of removing any stains.

3.03 SYSTEMS INSTALLATION

A. Underground Piping:

1. Install piping where indicated and according to manufacturer’s instructions.
2. Install closures at points of field joints between straight units or fabricated fittings by welding them centrally over conduit ends between such adjacent units.
3. After welding, conduct a 25 psig air pressure test on the outer casing and examine for leaks with a soap solution.
4. Repair any leaks and re-test until the system is airtight at 25 psig air pressure for a two-hour period.
5. Clean closures of all welding slag, burned coating, mud, etc. by wire brushing.

6. Finish coat in accordance with the system manufacturer's instructions, using materials supplied. Final outside coating to be subjected to a spark test and be capable of maintaining dielectric strength at 5,000 volts.
7. Contractor shall furnish all necessary equipment and labor to perform the spark test and the air test, including air compressor, gauges, conduit caps, temporary pipe and connections, etc., and complete the tests to the satisfaction of the Architect.

3.04 PIPE JOINTING

A. Fittings:

1. Provide standard, manufactured fittings in all cases.
2. Prohibited fittings:

   a. Field fabricated
   b. Bushings on pressure piping
   c. Clamp-on branch connections

3. Dielectric separation:

   a. Provide insulating couplings or dielectric fittings at all connections or metal-to-metal contact of ferrous materials to non-ferrous materials.
   b. Locations shall be accessible. Coordinate with General Contractor.

4. Branch connections, steel piping:

   a. Equal to main and to two pipe sizes smaller: weld tees, same weight as piping.
   b. Three or more pipe sizes smaller than main, but 2.5 inches and larger: Bonney Weld-o-lets.
   c. To two inches and smaller: Bonney Weld-o-lets, Thread-o-lets, threaded Nip-o-lets, or steel couplings.

B. Unions: Provide unions or flanges to render all items in systems easily removable, including:

1. Valves
2. Piping specialties
3. Both sides of pumps and equipment
4. Where indicated on the Drawings

C. Pipe Ends: Perform pipe cutting and end preparation to result in clean ends with full inside diameter. Grind and ream ends of pipe and tube and remove burrs to restore full inside diameter.

D. Nipples: Provide extra heavy pipe for nipples where unthreaded portion is less than 1.5 inches long. Close nipples not permitted.

E. Threaded Joints: Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Apply appropriate tape or thread compound to external pipe threads (except where dryseal threading is specified).
3. Align threads at point of assembly.
4. Tighten joint with wrench and back-up wrench as required.
5. Damaged threads: Do not use pipe or pipe fittings having threads that are corroded or damaged.
6. Sealed with sealant compounds or teflon tape. Hard setting pipe thread cement or caulking shall not be allowed.
7. Sealant compounds: John Crane or Rector Seal:

    a. General service: John Crane JC-40
    b. Chemicals and corrosive service piping: John Crane JC-30

F. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. When required, use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using a torque wrench.

G. Mechanical Joints: Grooved copper tube and grooved-tube fitting joints shall be assembled with coupling, gasket, lubricant, and bolts per coupling and fitting manufacturer's standard written procedure. Grooved ends on copper and copper alloy tube shall be roll-formed only using the appropriate roll-groove tool to construct a groove meeting the coupling and fitting manufacturer's written specifications. Cut grooving methods shall not be used on copper and copper alloy tube.

H. Flared tube Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings conforming to ASME B16.26. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose. Copper alloy tube shall be reamed to remove burrs and restore full inside diameter prior to forming the flared end.

I. Welded Joints:

1. Where required, peen and wheel-grind welds.
2. Ends of pipe may be burned for welding:

    a. Grind, bevel and remove scale between welding joint.
    b. Ragged edges with metal beads, poor alignment or other inferior work shall be rejected.
    c. Preparation of pipe ends: For wall thickness up to 3/16-inch, ends shall be finished square or with 37.5-degree bevel with a 1/16 inch band; for wall thickness 3/16-inch to ¾-inch inclusive, ends shall be machined or ground to have a 37.5-degree bevel with a 1/16-inch band per latest edition of ANSI/ASME B31.1.

3. Perform welding with oxyacetylene or electric arc process.
4. Welding shall be from outside only on pipe configurations.

5. Tack welds shall be of same quality as required in the completed weld and shall be visually examined for defects before applying any complete passes. The ends (starts and stops) of the tacks shall blend in smoothly with the base metal so that subsequent passes can be applied without interruption.
6. Inspection: Visual inspection shall be done by the welder after each pass.
7. Inspection Criteria: Cracks, cold laps, open porosity and tungsten inclusions shall not be allowed. If the above occurs, the weldment shall be removed and rewelded per this specification. Weld beads shall be applied in such a manner that they are smooth into adjacent beads and the base metal with no areas, such as crevices, undercuts, or overlaps, that would weaken the structure or prevent adequate penetration of subsequent weld passes. Undercut of the final pass, which reduces the initial material thickness, shall be repaired by additional welding.
8. Repair: All materials welded using this procedure or which fall within the requirements of this procedure may also be repair-welded using this procedure.

J. Grooved End Joints:

1. Pipe Preparation: The pipe ends must be clean from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. The dimensions must be according to the standard roll groove specifications as recommended by the manufacturer. Cut grooves are not acceptable.
2. Pipe Preparation Plain End: Black pipe must be thoroughly cleaned down to bare metal for one-inch from the pipe end to receive mechanically coupled fittings; removed pipe coatings, mill scale, rust and raised weld beads.
3. Tighten all nuts to assure firm metal contact of the coupling pads.
4. Groove width depth and outside diameter must conform to the standard groove specifications in the latest “Field Assembly and Installation Instruction Pocket Handbook”.
5. Before assembly of couplings, lightly coat pipe ends and outside of gasket with cup grease or graphite paste to facilitate installation.
6. Support branch pipes independently to eliminate stress on coupled joint.
7. Determine that gasket material and lubricant are compatible with service of pipe.
8. Hammer welds to remove slag and weld beads.

K. Soldered and Brazed Joints: Construct soldered joints per ASTM B828. Construct brazed joints per AWS C3.4M/C3.4.

1. Install solder-joint to male-thread adapters, or solder-joint to male-thread unions meeting the requirements of ASME B16.18 or ASME B16.22, adjacent to each threaded valve and threaded equipment connection in a copper tube system.
2. Install ASME B16.24 cast copper alloy pipe flanges adjacent to each flanged valve and flanged equipment connection in a copper tube system.
3. Provide brazing for refrigerant piping system using AWS A5.8/A5.8M, BAg-1 with 15 percent silver, 80 percent copper and 5 percent phosphorous.

4. Provide solder joint for building domestic cold water and domestic hot water supply and return systems.
5. Clean surfaces to be jointed of oil, grease, rusts and oxides.

    a. Remove grease from fittings by washing in solution of 1/16 sodium carbonate and three gallons hot water.
    b. Clean socket of fitting and end of pipe thoroughly with emery cloth to remove rust and oxides. After cleaning and before assembly or heating, apply Handy or Aircosil flux to joint surface and spread evenly.

6. Any joints showing evidence of overheating, cracking, poor penetration, or other defects of fit-up or workmanship shall be replaced as directed by the Architect at the Contractor's expense.

3.05 FIELD QUALITY CONTROL

A. General:

1. Any deviation from the cleaning, installation, testing, and certification requirements herein shall be approved in writing by the Architect.
2. All materials and workmanship shall be subject to inspection and examination by the Architect at any place where fabrication or erection occurs.
3. The Architect reserves the right to reject all or any part of the system that does not conform to the requirements herein. Rejected materials or equipment shall be returned at the Contractor's expense for re-cleaning and certification.
4. The Architect reserves the right to remove random samples of the installed work sufficient to establish the quality of materials and workmanship. If such samples indicate materials and workmanship do not meet the contract specification, the Contractor shall be required to replace or re-clean the installed work at no expense to the Owner. The Owner shall reimburse the Contractor on a time and materials basis for such work if the system proves to be installed to specification.
5. All testing shall be done in the presence of the Owner's Representative.
6. Upon completion of this work, all systems shall be adjusted for use. Should any piece of apparatus or any material or work fail in any of the required pressure tests, it shall be immediately removed any replaced by new materials. The defective portion of the work shall be replaced by new materials. The defective portion of the work shall be replaced by the Contractor in the presence of the Owner at no expense to the Owner.
7. Test gauges shall be installed and test medium source connections shall be made to convenient process connections. After completion of testing, the gauges and source connection shall be removed and the specified process attachments replaced.
8. Any leaks found shall be repaired in the following manner:

    a. Welded joint – Grind out defect and re-weld.
    b. Brazed and/or Soldered joint – Cut out and re-braze/solder.
    c. Screw joint – Taken apart and re-do (do not use compound).

B. Test Preparation:

1. Clean new piping internally by flushing with water before the application of pressure tests, and before the performance of disinfection procedures as specified in Section 22 11 00.
2. Block off and isolate circulating pumps, plumbing fixtures and heat exchangers during the preliminary flushing and draining process.
3. Thoroughly flush piping with water under pressure, clear of foreign matter, and then drain before proceeding with pressure testing. Blow down accumulations of grit, dirt and sediment at each strainer and each low point in the piping systems.
4. Leaks and Defects:

    a. Repair or replace as directed.
    b. Repair damage caused by test failure without additional cost.
    c. Re-test repaired and/or damaged systems until tests are accomplished successfully.

5. Refer to other sections and divisions for tests to plumbing systems and other special piping systems.
6. Notify Architect in writing one week before test.
7. Maintain a log book of all pressure tests showing dates, personnel performing test, test observer and test results.
8. Furnish written report and certification that tests have been satisfactorily completed.

C. Pressure Tests:

1. Less than 100 pounds per square inch operating pressure: Test hydrostatically to 150 pounds per square inch.
2. Over 100 psi operating pressure:

    a. Test hydrostatically to 1.5 times operating pressure.
    b. Never exceed test pressure ASME B16.1 basis.

3. With system valves capped and pressure apparatus disconnected, a 4-hour duration pressure test shall exhibit:

    a. No pressure change (zero).
    a. Compensate for temperature change.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed
    b. Procedures, materials, and gases used
    c. Test methods used
    d. Results of tests

END OF SECTION

SECTION 22 11 23
PLUMBING PUMPS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Domestic water booster pump system

B. Circulating pumps

C. Pump discharge valves

D. Miscellaneous components and accessories

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 13 – Electric Motors for Plumbing

C. Section 22 05 14 – Variable Frequency Drives

D. Section 22 05 19 – Meters, Gauges and Thermometers for Plumbing

E. Section 22 05 29 – Supports, Hangers, Anchors and Sleeves for Plumbing

F. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

G. Section 22 05 53 – Systems Identification for Plumbing

H. Section 22 11 00 – Domestic Water Systems

I. Section 22 11 10 – Plumbing Piping and Accessories

J. Section 22 13 00 – Drainage Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. AASHTO – American Association of State Highway and Transportation Officials

B. AISI – American Iron and Steel Institute

C. ASME – American Society of Mechanical Engineers

1. ASME Standard for Boiler and Pressure Vessel Code – 2013

a. ASME BPVC – I through XII

2. ASME B40.100 – 2013: Pressure Gauges and Gauge Attachments

D. ASTM – American Society for Testing and Materials

1. ASTM A48 / A48M – 2003 Revised 2012: Standard Specification for Gray Iron Castings
2. ASTM A108 – 2013: Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
3. ASTM A126 – 2004: Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
4. ASTM A536 – 1984 Revised 2008: Standard Specification for Ductile Iron Castings
5. ASTM B36 / B36M – 2013: Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
6. ASTM B148 – 1997 Revised 2009: Standard Specification for Aluminum-Bronze Sand Castings
7. ASTM B584 – 2013: Standard Specification for Copper Alloy Sand Castings for General Applications
8. ASTM C32 – 2013: Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)
9. ASTM C923 – 2008 Revised 2013: Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals
10. ASTM D3753 – 2012: Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells

E. ISO – International Organization for Standardization

1. ISO 9001 – 2008: Quality Management System Requirements

F. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry

1. MSS SP-71-2011: Gray Iron Swing Check Valves, Flanged and Threaded Ends

G. NEMA – National Electrical Manufacturers Association

H. NFPA – National Fire Protection Association

1. NFPA 70, Edition 08 – NEC: National Electrical Code

a. Article 90.7 – Examination of Equipment for Safety

I. OSHA – Occupational Safety & Health Administration
29 CFR – Code of Federal Regulations, Title 29

1. Part 1910: Occupational Safety and Health Standards

a. Section 303: General requirements
b. Section 399: Definitions applicable to this subpart

J. UL – Underwriters Laboratories Inc.

1. UL Standard 508A – 2013: Industrial Control Panels

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 and the requirements of the listed related documents.

B. Alternates to scheduled pumps shall operate at or near their point of peak efficiency, allowing for operation at capacities of approximately 25 percent beyond design capacity. Maximum impeller size shall not exceed 85 percent of the difference between the maximum and minimum impeller diameter.

C. In order to insure stable operation and prevent any possibility of hunting, the pump curve shall be continuously rising from maximum capacity up to the shut-off point. Pumps shall be non-overloading over the full range of the pump curve.

D. Furnish each pump and motor with a metal engraved nameplate giving the manufacturer's name, serial number of pump, capacity in gpm and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.

E. All pumps shall operate without excessive noise or vibration.

F. Furnish to Owner one spare seal and casing gasket for each pump.

G. After completion of balancing, provide replacement of impellers, or trim impellers to provide specified flow at actual pumping head, as installed.

1.05 SUBMITTALS

A. Comply with requirements of Section 01 33 00 – Submittal Procedures, and as modified below.

B. Product Data: Submit manufacturer's product literature including material specifications, pump curves and power requirements, wiring diagrams and other information required to demonstrate compliance with specified requirements for following items:

1. Water pressure booster pumps systems
2. Circulating pumps
3. Miscellaneous components and accessories

C. Shop drawing submittals shall include pump curves, net positive suction head requirements, and pump performance characteristics with pump and system operating points plotted.

D. Submit construction details, materials of construction, type of seals, pump base, and mounting details.

E. Submit motor construction, winding type and efficiencies as specified in Section 22 05 13 – Electric Motors for Plumbing.

F. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiate between manufacturer-installed and field-installed wiring and location and size of all required field connections.

G. Submit performance test reports, where required, prior to shipping of equipment from the manufacturer's factory.

H. Submit manufacturer's installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories and maintenance data.

I. Submit factory start-up report for the Water Pressure Booster Pump System.

J. Submit list of spare parts to be turned over to the Owner for the Water Pressure Booster Pump System.

1.06 PERFORMANCE REQUIREMENTS

A. Design Requirements: Provide pressure booster package systems independently third-party labeled as suitable for intended use by Nationally Recognized Testing Laboratory in accordance with OSHA Federal Regulations 29CFR1910.303 and 29CFR1910.399, NFPA Pamphlet 70, and National Electric Code, Article 90-7.

B. Domestic water pumps shall meet or exceed the performance requirements specified in this specification section.

C. LEED Credit EQ4.2: Low Emitting Materials, Paints and Coatings.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Domestic Water Booster Pumps: Syncroflow, PACO, Bell & Gossett, G & L Pumps, or approved equivalent.

B. Circulation Pumps: Bell & Gossett, Taco, Grundfos, or approved equivalent.

C. Hydropneumatic Tank: Armstrong, Bell & Gossett, Amtrol, Taco, Wessels, or approved equivalent.

2.02 WATER PRESSURE BOOSTER PUMP SYSTEMS

A. Variable Speed Booster Pump System – Duplex:

1. Duplex, factory assembled, skid mounted, variable speed control for constant pressure and variable flow using microprocessor controller, with factory-supplied hydropneumatic tank; "SSV Series with Aquavar Controls" by G & L Pumps, Auburn, New York.
2. Pump Controls:

   a. Microprocessor controller located within UL Listed enclosed industrial control panel in a NEMA 4 enclosure on pump motor with frequency inverter controlling pump based upon input from pressure transducer. Program settings for constant pressure variable volume. Panel shall have the UL Listing mark for UL 508A – Industrial Control Panels.
   b. Display: 2-line LCD display, on, run, and fault display lights.
   c. Control: Modified PID with two pint control.

d. Input/output: Analog and SIO via RS-485.
e. Protection short circuit, ground fault, under voltage, overheating, overload, over voltage, motor over-temperature, low/no water with external switch, radio emission.

3. Field Assembly Accessories:

a. 2-inch Series 300 stainless steel braided flexible pump connectors at inlet and outlet manifold connections.
b. Elastomer pads for anti-vibration control at pump mounting to housekeeping pad.
c. Testing: Provide factory testing and certification that booster pump system meets flow rate under design conditions. Components tested for hydraulic shock, vibration or excessive noise.

4. Replace any defective parts prior to shipment.
5. Provide full documentation showing flow rates, pressures and amp draw for future service and trouble-shooting reference including X-Y plotter test data.
6. Spare Components: Provide, to the Owner, three (3) fuses (of each size), two (2) lights, one (1) can of touch-up paint, one (1) mechanical seal, one (1) shaft sleeve, and one (1) gasket for each pump.

2.03 CENTRIFUGAL CIRCULATING PUMPS

A. Furnish centrifugal close coupled single stage circulating pumps with capacities as scheduled in the Pump Schedule on the Drawings.

1. Centrifugal circulating pumps shall be of the in-line type suitable for vertical or horizontal installation and be serviceable without dismantling the circulator piping connections.
2. Casings shall be cast brass, ASTM B584.
3. Pump working pressure shall be 175 psi.
4. Impeller shall be cast bronze, closed type, ASTM B584, 304 stainless steel impeller key, keyed to the shaft, brass impeller washer, 304 stainless steel impeller lock washer and a 304 stainless steel impeller cap screw.
5. Pump shall be ASTM A108 grade 1045 carbon steel. Shaft sleeve shall be copper alloy 110 or aluminum bronze, ASTM B584.
6. Shaft seal assembly shall be an internally flushed single seal of the stuffing box design with EPR “O”-rings, Carbon-Tungsten Carbide faces, all metal parts and spring shall be stainless steel. Seal shall be rated for continuous operation at 225 degrees F. The wetted area under the seal shall be completely covered by a bronze shaft sleeve.
7. Pump casing shall have gauge ports and vent and drain tapings at the suction and discharge nozzles.
8. Pump motor shall be as specified on the Drawings for horsepower, voltage and phase, and in Section 22 05 13 – Electric Motors for Plumbing. Motor shall be non-overloading throughout the entire range of the pump curve.
9. Impeller shall be hydraulically and dynamically balanced to ANSI-Hydraulic Institute Pump Standards, Grade G6.3.

10. Each pump shall be factory-tested per the ANSI-Hydraulic Institute Pump Standards.
11. Furnish strap on thermostat installed on each hot water return line for each hot water pump to cycle pump on and off.
12. Pump manufacturer shall be ISO-9001 certified.
13. Pump shall be a Bell & Gossett, all bronze pump, Series 90 or approved equivalent, suitable for use in a domestic water system.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General

1. The Contractor shall be responsible for aligning in the field prior to start-up of all flexibly coupled pumps. Alignment accuracy of plus or minus 0.002 inch shall be verified with a dial indicator. Prior to start-up, the manufacturer shall submit a written report certifying that the alignment work has been performed and that the pumps are ready for operation.
2. Pump motor, suction and discharge openings shall be covered during construction period. If the motor is started, the Contractor shall be responsible to ensure that the environment in which the motor is running is clean.
3. Install all pumps in strict accordance with manufacturer's instructions. Access/service space around pumps shall not be less than minimum space recommended by pump manufacturer.
4. Support piping adjacent to pump such that weight is not carried on pump casings.
5. Decrease from line size at pump connections with long radius reducing elbows or concentric reducers/increasers in the vertical piping, or eccentric reducers/increasers for horizontal piping. Install eccentric reducers/increasers with the top of the pipe level.

B. Water Booster Pump System: Install in accordance with manufacturer's instructions.

1. Pumps:

a. Remove air from system prior to running pump.
b. Install pumps and piping system properly for quiet and vibration free operation.
c. Install booster pump on 4-inch high concrete housekeeping pad.
d. Provide copper tubing from the over-temperature protection purge valve on the pressure booster pump system to discharge into a floor drain with air gap. Provide corrosion-proof supports on floor to support tubing and route in a neat and uniform manner.

2. Hydropneumatic Tank:

a. Anchor tanks rigid to housekeeping pads using corrosion-resistant fasteners.
b. Flush and sterilize tanks prior to start-up of booster pump system.

c. Check air pressure in tank, and adjust pressure to meet system requirements.
d. Pressurize tank with oil-free compressed air or nitrogen gas only.
e. Check air charging fill valve for leakage or damage. Replace with new valve if there are any signs of damage.

3. Circulating Pumps:

a. Install in accordance with manufacturer's instructions.
b. Remove air from system prior to running pump.
c. Install pumps and piping system properly for quiet and vibration-free operation.
d. Do not support pump at motor.
e. Do not mount motor shaft in vertical position.
f. Brace vertical piping to wall or floor.

4. Pumps Control and Alarm Panels:

a. Locate control and alarm panels with bottom of panels at no less than 4 feet-6 inches above finished floor.
b. Provide identification system identifying function of switches, control devices, panel lights, and buttons; and securely fasten to panels.
c. Provide power and control wiring for submersible type pumps.
d. Provide conduit and junction boxes for power and control wiring outside of sump to control and alarm panels.
e. Provide sufficient length of control and power wiring to connect to pumps, pump controls, and alarm controls to reach pump control panel and alarm panel locations.
f. Provide wiring from panels to pumps and controls for complete and operating system.

3.02 FIELD QUALITY CONTROL

A. Water Booster Pumps:

1. Pump Start-up:

a. Water Booster Pump Systems:

(1) Do not operate pumps until piping tightness tests, flushing and disinfection has been completed on water piping systems.
(2) Verify power source and wiring is adequate and connected to specified power source which meets the operating conditions of the pump motor.
(3) Confirm pump rotation matches pump manufacturer's specifications.
(4) Document suction pressure and boosted pressure conditions at all operating mode.
(5) Confirm relief valves and discharge lines are installed and operable.

b. Circulator Circulating Pumps:

(1) Adjust balancing valves so that amount of water circulated by circulating pump under actual normal operating conditions is not less than 90 percent, nor more than 120 percent of required amount, unless otherwise noted or approved.

(2) Do not operate pumps until piping tightness tests, flushing and disinfection has been completed.

2. Pump Testing and Adjustment:

a. Compute pump capacities from pump curves supplied by pump manufacturer and from actual pressure readings taken from pressure gauges located at proper points in the pump inlet and outlet. Apply all necessary corrections due to static head differences, etc.

b. Adjust impeller size by trimming or factory replacement, if necessary to reduce pump capacity beyond that which can be accomplished by reasonable adjustment of balancing cocks or valves or to obtain necessary quiet and vibrationless operation within specified operating conditions. Trim impeller in accordance with recommendations of pump manufacturer using factory or competent machine shop approved by pump manufacturer.

END OF SECTION

SECTION 22 13 00
DRAINAGE SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. General: Provide complete and operable drainage systems within the intent of the Contract Documents, including, but not limited to, all materials and labor for complete installation and testing, in compliance with applicable provisions and recommendations of the Reference Standards.

B. Drainage and vent systems, including, but not limited to, the following:

1. Drainage and vent piping systems
2. Drainage specialties

C. House drains and sewers contract limit line shall be five feet from building wall, or as indicated on the Drawings.

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 29 – Supports, Anchors and Sleeves for Plumbing

C. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

D. Section 22 11 00 – Domestic Water Systems

E. Section 22 11 10 – Plumbing Piping and Accessories

F. Section 22 11 23 – Plumbing Pumps

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. ANSI – American National Standards Institute

1. ANSI/ASME B31.1 – 2012: Power Piping

B. ASME – American Society of Mechanical Engineers

1. ASME B1.20.1 – 2013: Pipe Threads, General Purpose (Inch)
2. ASME B16.1 – 2010: Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250
3. ASME B16.3 – 2011: Malleable Iron Threaded Fittings, Classes 150 and 300
4. ASME B16.5 – 2013: Pipe Flanges and Flanged Fittings, NPS½ through 24 (Metric/Inch Standard)

5. ASME B16.10 – 2009: Face to Face and End to End Dimensions of Valves
6. ASME B16.34 – 2013: Valves – Flanged, Threaded and Welding End
7. ASME B31.9 – 2011: Building Services Piping

C. ASTM – American Society for Testing and Materials

1. ASTM A47 / A47M: Standard Specification for Ferritic Malleable Iron Castings
2. ASTM A53 / A53M – 2012: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A74 – 2013: Standard Specification for Cast Iron Soil Pipe and Fittings
4. ASTM A106 / A106M – 2013: Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
5. ASTM A153/A153M – 2009: Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
6. ASTM A183 – 2003 Revised 2009: Standard Specification for Carbon Steel Track Bolts and Nuts
7. ASTM A197 / A197M – 2011: Standard Specification for Cupola Malleable Iron
8. ASTM A395 / A395M – 1999 Revised 2009: Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
9. ASTM A518/A518M – 1999 Revised 2012: Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
10. ASTM A536 – 1984 Revised 2009: Standard Specification for Ductile Iron Castings
11. ASTM A615 / A615M – 2012: Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
12. ASTM A861 – 2004 Revised 2013: Standard Specification for High-Silicon Iron Pipe and Fittings
13. ASTM A888 – 2013: Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
14. ASTM B633 – 2013: Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
15. ASTM C150/C150M – 2012: Standard Specification for Portland Cement
16. ASTM C564 – 2011: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
17. ASTM C1277 – 2012: Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
18. ASTM D1248 – 2012: Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
19. ASTM D1599 – 1999 Revised 2011: Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
20. ASTM D1784 – 2011: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
21. ASTM D1785 – 2012: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
22. ASTM D2000 – 2012: Standard Classification System for Rubber Products in Automotive Applications

23. ASTM D2122 – 1998 Revised 2010: Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
24. ASTM D2564 – 2012: Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
25. ASTM D2665 – 2011: Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
26. ASTM D3222 – 2005 Revised 2010: Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding, Extrusion and Coating Materials
27. ASTM D3311 – 2011: Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
28. ASTM D3753 – 2005 Revised 2012: Standard Specification for Glass-Fiber-Reinforced Polyester Manholes and Wetwells
29. ASTM E84 – 2012: Standard Test Method for Surface Burning Characteristics of Building Materials
30. ASTM F1290 – 1998 Revised 2011: Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings
31. ASTM F1412 – 2009: Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems
32. ASTM F1673 – 2010: Standard Specification for Poly(Vinylidene Fluoride) (PVDF) Corrosive Waste Drainage Systems

D. AWS – American Welding Society

1. AWS B2.1/B2.1M – 2005 Revised 2009: Specification for Welding Procedure and Performance Qualification

E. CISPI – Cast Iron Soil Pipe Institute

1. CISPI 301-05: Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
2. CISPI 310-04: Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
3. CISPI Designation HSN 85: Specification for Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

F. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry

1. MSS SP-70-2011: Gray Iron Gate Valves, Flanged and Threaded Ends
2. MSS SP-80-2013: Bronze Gate, Globe, Angle and Check Valves

G. NFPA – National Fire Protection Association

1. NFPA Standard 262, Edition 07 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

H. NSF – National Sanitation Foundation

1. NSF 14-2013: Plastics Piping System Components and Related Materials

I. Local Code and Code Amendments

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 Reference Standards and the requirements of the listed related documents in Paragraph 1.02 Related Documents.

B. Valves construction shall be suitable for the pressure, temperature, and fluid quality of the service in which they are to be used.

C. All valves shall be manufactured in accordance with ANSI, AWWA, ASTM, MSS-SP-70 & MSS-SP-80 (Manufacturers Standardization Society of the Valve and Fittings Industry), standards and specifications.

D. ANSI/ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.

E. ASME 16.10 and ASME 16.34 for dimension and design criteria.

F. Minimum test pressure for all valves shall be 1.5 times maximum system working pressure unless noted otherwise.

1.05 SUBMITTALS

A. For each type of valve indicated, submit body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; pressure differential range, shipping, installed, and operating weights; furnished specialties; and accessories.

B. Product Data: Submit manufacturer’s latest information on construction details, rated capacity data, operating characteristics and installation data.

C. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiates between manufacturer-installed and field-installed wiring and location and size of all required field connections.

D. Submit manufacturer’s installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories, and maintenance data.

E. Submit report indicating the required rod clean of each roof drain, each roof overflow drain, each area drain and each leader. Submit test report of each drain tested with appropriate water flow for drain type in the presence of the Owner’s Representative.

F. Submit all test reports witnessed by Plumbing Inspectors and Owner’s Representative.

G. Submit Operational and Maintenance (O&M) manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equivalent, shall have same quality, finish, free area, material construction, etc., as those specified under base Specification.

1. Cast Iron Piping and Fittings: AB&I Foundry, Anaco, Charlotte Pipe, Clamp-All Corporation, Mission Rubber Company, Tyler Pipe, or approved equivalent.
2. Cast Iron Drainage Products: J.R. Smith, Wade, Josam, Zurn Industries, Mifab, or approved equivalent.
3. Copper Piping: Anaconda, Cambridge-Lee, Cerro, Howell Metal, Wolverine, or approved equivalent.
4. Copper Fittings: NIBCO, Elkhart, or approved equivalent.
5. Low Torque No Hub Couplings: Anaco, Mission, Tyler Pipe, or approved equivalent.
6. High Torque No Hub Couplings: Clamp-All Corporation, Husky by Anaco, or approved equivalent.
7. Cleanouts: J.R. Smith, Zurn Industries, or approved equivalent.
8. Floor Drains: J.R. Smith, Zurn Industries, or approved equivalent.
9. Downspout Nozzles: J.R. Smith, Zurn Industries, or approved equivalent.
10. Air Gap Fittings: J.R. Smith, Zurn Industries, or approved equivalent.
11. Traps: Charlotte Pipe, or approved equivalent.
12. Auxiliary Inlet Fittings: J.R. Smith, Zurn Industries, or approved equivalent.

2.02 DRAINAGE AND VENT PIPING SYSTEMS

A. Above Grade – Sanitary Vent, Sanitary Sewer and Storm Sewer:

1. No hub, service weight, cast iron soil pipe labeled with the CI mark of quality and permanence as illustrated in latest standards of Cast Iron Soil Pipe Institute (CISPI) Standard 301, ASTM A888 or ASTM A74, and no hub drainage pattern fittings.

a. Couplings:

(1) Low Torque No Hub Couplings: Series 301 stainless steel hubless coupling band conforming to CISPI Standard 310, using calibrated torque trench of 60 inches per pound, with gaskets conforming to ASTM C564; “TYLER NO HUB“ by Tyler Pipe.

(2) High Torque No Hub Couplings: Series 304 stainless steel hubless coupling band conforming to CISPI Standard 310 and ASTM C1277 installed using calibrated torque trench of 80 inches per pound, with gaskets conforming to ASTM C564; “Husky SD4000“ by Anaco, “Heavyweight Coupling” by Mission Rubber Company, “Clamp-All High Torque 80” by Clamp-All Corporation.

B. Underground – Sanitary Vent, Sanitary Sewer and Storm Sewer Pipe – Application: All underground sanitary, storm and vent piping systems under building and within 5 feet-0 inches of the building's exterior foundation, unless otherwise noted on the Drawings.

1. Hub and Spigot Type Pipe and Fittings: Service weight cast iron soil pipe with weight per foot and maker's name clearly stamped or cast on each length, in conformance with ASTM A74 and CISPI HSN, and push-on rubber gasketed joint to effect a water-tight seal, in conformance with ASTM C564.

C. Indirect Waste Piping:

1. Unfinished Spaces: Type DWV copper tube with solder-fitting drainage type, cast copper couplings.
2. Finished Spaces: Chrome plated brass piping with chrome plated brass threaded drainage pattern fittings.

2.03 CLEANOUTS

A. Floor Type (FCO):

1. Carpeted Areas: Cast iron cleanout with round adjustable scoriated nickel bronze top, vandal-proof screws, plastic plug or bronze gasketed plug, carpet clamping collar, spigot outlet; "No. 4021-U-X Series" by J.R. Smith, "No. ZN1400-CF-VP Series" by Zurn Industries, Inc., or approved equivalent.
2. Carpeted Areas: Cast iron cleanout with round adjustable scoriated nickel bronze top, vandal-proof screws, plastic plug or bronze gasketed plug, carpet marker, spigot outlet; "No. 4021-U-Y Series" by J.R. Smith, "No. ZN1400-CM-VP Series" by Zurn Industries Inc, or approved equivalent.
3. Ceramic and Porcelain Tile Areas: Cast iron cleanout with square adjustable scoriated nickel bronze top with tile recess, vandal-proof screws, plastic plug or bronze gasketed plug, spigot outlet; "No. 4161-U Series" by J.R. Smith, "No. ZN1400-TX-VP Series" by Zurn Industries, or approved equivalent.
4. Terrazzo and Similar Poured Floor Material Areas: Cast iron cleanout with square adjustable scoriated nickel bronze top with recess, vandal-proof screws, plastic plug or bronze gasketed plug, spigot outlet; "No. 4201-U Series" by J.R. Smith, "No. ZN1400-Z-VP Series" by Zurn Industries, Inc., or approved equivalent.
5. Boiler Room and Mechanical Rooms: Extra heavy-duty cast iron cleanout with round adjustable galvanized cast iron top, vandal-proof screws, plastic plug or bronze gasketed plug, spigot outlet; "No. 4220-G Series" by J.R. Smith, "No. Z1400-G-VP Series" by Zurn Industries, Inc., or approved equivalent.

B. Wall Type (WCO):

1. Cleanout Wall Plate: Cast iron cleanout tee with round stainless steel cover, vandal-proof screws, plastic or gasket sealed bronze plug and spigot outlet; "No. 4531-U Series" by J.R. Smith, "No. Z1446-VP Series" by Zurn Industries, Inc., or approved equivalent.

C. Exposed Type (CO):

1. Vertical:

a. 6-inch pipe size and smaller: Cleanout tee with gasket seal cast bronze plug; “4512S Series” by J.R. Smith, “Z1445-BP Series” by Zurn Industries, Inc., or approved equivalent.
b. 8-inch pipe size and larger: Cast bronze tapered plug with tapped test tee cast iron fitting.

2. Horizontal:

a. All pipe sizes: Cast iron tee “Y” fitting with tapped spigot ferrule and cast bronze taper thread plug.

D. Ferrules:

1. Provide ferrules of “Extra Heavy” cast brass, and of weight and size as follows:

Size	Minimum Length (in Inches)	Weight (in Pounds)
2 inches	4.5	1
3 inches	4.5	1.75
4 inches & larger	6	2.5

2.04 DRAINAGE SPECIALTIES

A. General:

1. Drains:

a. Provide all required extension collars, flashing devices, etc., to suit roof, floor and deck construction in addition to features described for drains.
b. All drains in public areas shall include vandal-proof features. All floor drains, roof drains and overflow drains shall have integral no-hub outlets when connecting to above-grade sanitary piping.
c. Floor drain outlets connecting to buried piping shall be as style as required to comply with piping manufacturer recommendations and jurisdictional plumbing code.

B. Size of drain outlets shall be same as connecting pipe and as indicated on the Drawings.

C. Downspout Nozzle (DSN): Cast bronze body and flange, threaded inlet same size as connecting overflow storm pipe; “Series 1770T” by J.R. Smith, or approved equivalent, “Series ZARB199” by Zurn Industries, Inc., or approved equivalent.

D. Air Gap Fitting: Cast bronze fixed air gap with set screw on inlet, 1.5-inch thread outlet, inlet size to match connecting pipe size; “Series 3950T-CP” by J.R. Smith, or approved equivalent, “Series Z1024” by Zurn Industries, Inc., or approved equivalent.

E. Traps:

1. General:

a. No hub cast iron “P” trap; “Fig No. NH43” or “NH42” and provide cast iron tailpiece with ½-inch tapping by Charlotte Pipe, or approved equivalent. Material same as piping system. Type of trap shall be approved by local code(s).
b. Service weight cast iron “P” trap; “Fig No. SV 169” by Charlotte Pipe, or approved equivalent. Material same as piping system. Type of trap shall be approved by local code(s).
c. Provide trap with trap primer connection where required for trap primer discharge piping connection to be at tailpiece of trap instead of body of drain.

2. Deep Seal “P” Trap:

a. No hub cast iron cast iron deep seal “P” trap; “Fig No. NH44A” by Charlotte Pipe, or approved equivalent. Hub service weight cast iron cast iron deep seal “P” trap; “Fig No. NH44” by Charlotte Pipe, or approved equivalent.
b. Hub and spigot or service weight cast iron deep seal “P” trap.
c. Provide trap with trap primer connection where required for trap primer discharge piping connection to be at tailpiece of trap instead of body of drain.

F. Auxiliary Inlet Fittings:

1. No hub cast iron with ½-inch trap primer connection; “No. 2695” by J.R. Smith, “No. Z1023” by Zurn Industries, Inc., or approved equivalent.
2. Hub and spigot cast iron with ½-inch trap primer connection; “No. 2697C” by J.R. Smith, or approved equivalent.

PART 3 – EXECUTION

3.01 APPLICATIONS

A. No Hub Couplings:

1. Provide low-torque no-hub couplings on waste and sanitary piping 4 inches and smaller.
2. Provide low-torque no-hub couplings on vent piping.
3. Provide high-torque no-hub couplings on storm piping from area drains, roof drains and overflow drains.
4. Provide high-torque no-hub couplings on sanitary piping 5 inches and larger.

B. Auxiliary Tailpiece with Tapped Inlet: Provide auxiliary tailpiece with tapped inlet for installation on drain body outlet piping, where trap primer is required and drain body and “P” trap is provided without trap primer connection.

3.02 INSTALLATION

A. Piping:

1. Make screwed joints with Teflon sealing tape and with a minimum of three screw threads left visible.
2. Nipples: Provide nipples of weight corresponding to piping. Use only shoulder nipples unless otherwise directed.
3. Pitch drainage piping, unless otherwise indicated, at a minimum rate of 2 percent in direction of flow for drainage system.
4. Provide capped and/or plugged connections in soil, waste and vent piping as required and where indicated on the Drawings (e.g., tenant retail spaces) for future extension to equipment and fixtures provided under other sections of the work.
5. Connections and Change in Direction:

    a. Make changes in direction with long sweep or bends or with ⅛ and/or $^{1}/_{16}$ bends at cleanouts, combination “Y” and ⅛ bend branches at base of roof leader and drainage stacks and vertical piping rising to fixture waste rough-ins.
    b. Make connections of branches to mains with “Y” fittings and ⅛ or $^{1}/_{16}$ bends.
    c. Double sanitary tees may be used when barrel of the fitting is at least two pipe sizes larger than the largest inlet.
    d. Do not change direction of flow more than 90 degrees.
    e. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    f. Reducing size of drainage piping in direction of flow is prohibited.

6. Buried Piping: Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer’s written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

B. Caulked Cast Iron Bell and Spigot Joints:

1. Make joints with lead and tarred oakum.

    a. Use joint runner so that after pouring lead shall finish flush with bell.
    b. Provide 1-inch minimum depth lead seal.

C. Trap Primers: Refer to Section 22 11 00 – Domestic Water Systems, for additional related trap primer product selection, installation and coordination required for trap primer installations.

D. Supports:

1. All horizontal cast iron no-hub pipe shall be supported every 10 feet maximum, and within 6 inches at each side of each joint. When a concentration of fittings occurs, additional support shall be installed, consistent with good trade practices. All horizontal cast iron soil piping shall be supported at each horizontal branch connection.
2. Supports for vertical piping shall be double bolt riser clamps, with each end having equal bearing on the building structure. Supports to be provided as follows:

    a. Cast iron pipe/plastic pipe at every floor and at its base.
    b. All auxiliary steel and supports required for pipe supports shall be provided under this Section.
    c. Make piping rigid in piping chases using support systems to resist push or pull movement at fixture waste rough-ins.
    d. Make piping rigid in piping chases using supports system directly attached to piping to resist push or pull movement at fixture waste rough-ins.

E. No-Hub Cast Iron Soil Pipe:

1. Where components are suspended in excess of 18 inches by means of non-rigid hangers, brace against horizontal movement (sway brace).
2. 6 inches and larger: Brace to prevent horizontal movement at every branch opening and change of direction by securing to building structure.
3. In seismic zones 3 and 4, provide support on both sides of the no-hub coupling on piping 5-inch and larger routing over public, high-traffic areas, lobbies, and egress pathways.

F. Flashing Fittings: Provide vents and all other pipes passing through roofs with a flashing fitting set at a suitable level above the roof to terminate the flashing. Arrange piping passing through roofs to be a minimum of 12 inches from walls or other obstructions so as to permit proper flashing.

G. Drains:

1. Provide floor drains and floor sinks with trap primer connections on body drain or by providing auxiliary tailpiece with tapped inlet.
2. Reset drain rims to suit final construction elevations.
3. Floor Drains:

    a. Set drain rims flush and level with finished floor in areas subject to foot traffic.
    b. Set drain rims minus ⅛ inch to ¼ inch from finish floor elevation, so as to provide positive drainage, where drain is not subject to foot traffic.

4. Make installations water-tight.

H. Traps:

1. Refer to Section 22 11 00 – Domestic Water Systems, for plumbing fixture traps.

2. Provide deep seal “P” traps for all floor drain and floor sink installation with trap primers. Should building conditions prevent use of a deep seal “P” trap, notify Architect (on a case-by-case basis) for direction.
3. Set traps level with regard to their water line.
4. Traps shall be same size as connecting drain outlets.
5. Provide adaptor coupling where required to connect dissimilar waste piping materials as recommended by waste piping manufacturers.

I. Cleanouts:

1. Provide cleanouts in drainage systems in accordance with the Reference Standards and where indicated.
2. Provide cleanouts in indirect waste lines at every change in direction.

    a. Buried Piping:

        (1) Provide cleanouts at ends of horizontal branches and mains, at base of riser conductor lines, at changes in direction greater than 45 degrees, in main drains where mains leave building, and where necessary to remove obstructions.
        (2) Locate cleanouts so that developed length is not more than 50 feet apart on lines 4 inches and smaller and not more than 100 feet apart on lines 5 inches through 15 inches.

3. Cleanouts at the base of all drainage stacks with tapped tees capable of receiving a rough brass countersunk head.
4. Provide brass cleanout plugs and thoroughly coat threads on removable parts with graphite.
5. Provide a full size “Y” branch cleanout in sanitary house drains within 2 feet of the foundation wall.
6. Provide cleanouts and related covers full size for pipes up to 4 inches inclusive, not less than 4 inches for pipes up to 6 inches, not less than 6 inches for pipes up to 8 inches and 10 inches, and not less than 8 inches for pipes up to 12 inches and 15 inches.
7. Install cleanouts on 3-inch or larger pipes at location to maintain minimum clearance of 18 inches.
8. Install cleanouts on 1.5-inch and 2-inch pipes at location to maintain minimum clearance of 12 inches.
9. Provide 18-inch by 18-inch by 6-inch thick concrete pad for exterior grade cleanout installed in asphalt and non-paved areas. Center exterior grade cleanout in concrete pad.

J. Vent Piping:

1. Provide vents shown on the Drawings, as required by Plumbing Code, and as necessary to prevent siphonage or back-pressure on trap seals and to maintain air circulation and atmospheric pressure throughout drainage system.
2. Do not locate outlets of vent piping through the roof less than 25--feet, 0-inches from any air intake duct and vent shaft louver.

3. Do not terminate vent outlet less than ten (10) feet from any openable window, door opening, air intake vent shaft, nor less than three (3) feet in every direction from any lot line; alley and street excepted.
4. Vent lines shall be extended separately or combined, of full required size, not less than six (6) inches above the roof or fire wall.
5. Flag poling of vents is prohibited, except where roof is used for purposes other than weather protection.
6. All vents within ten (10) feet of any part of the roof that is used for such other purposes shall extend not less than seven (7) feet above such roof and shall be securely stayed.
7. Vent pipes installed at grade level shall be extended ten (10)` above the surrounding ground and shall be securely stayed.
8. Grade vents to discharge water of condensation, where possible and do not allow reverse grade to trap water.
9. Make offsets at 45-degree angle wherever possible. Connect upper ends of drainage lines to vent system or extend through roof without decreasing size of vent stacks.
10. Arrange vents and related connections, except wet vent, to not carry drainage.
11. Connect bottom of vent risers to drains in an arrangement where the drainage will wash out rust and scale from the vent riser.
12. Extend portions of vents above floor line upwards to points not less than six (6) inches above flood rim of highest fixture before running horizontally.
13. Run portions below floor line vertically wherever possible.
14. Do not connect main vents into soil or waste stacks lower than six (6) inches above flood rim of highest fixture on stack.

K. Roof and Overflow Drains:

1. Provide style of drains compatible with the roof structure and roofing materials.
2. Provide roof drains with outlets size same as roof drain leader pipes indicated on the Drawings.
3. Provide water-proof caulking and gasket between reversible collar and body.
4. Install drain body, sump receiver, under-deck clamps, before installation of roof membrane system. Set drain flange tight to roof deck. Secure drain to roof deck with approved under-deck clamp bolted to underside of drain body. Protect roofing ballast from entering drain body or leader pipe during roofing installation. Rod-clean each roof drain, each roof overflow drain, each area drain and each leader removing all soil, refuse, and other foreign material.
5. Test flow of each drain with appropriate water flow in the presence of the Owner’s Representative.

3.03 TESTING AND ADJUSTMENTS

A. Provide testing of all installed drainage and vent systems during the progress of the work, including sanitary, storm drainage and vent systems, and fixture roughing-in sections, as directed to permit general construction and building-in of rough work to proceed. Such tests shall be made in the presence of the Owner’s Representative, Building Department Inspectors and all other Authorities Having

Jurisdiction. A minimum of 48-hours' notice shall be given to all parties prior to any testing.

B. Take all due precautions to prevent damage to the building or its contents that may be incurred by such tests as the Contractor will be required to repair and make good, at own expense, any damage caused.

C. Any defects or deficiencies discovered as a result of tests shall be immediately repaired and tests shall be repeated until all test requirements are fully met.

D. No caulking of pipe joints to remedy leaks will be permitted except for hub and spigot joints where lead and oakum joints are used.

E. Each section of drainage and vent rough-in piping tested shall have all openings tightly closed with screw plugs, or equal device, and stand without loss of level for a period of 4 hours when filled with water which produces at least a 10-foot head at the highest point of the section tested.

F. Each section of roof and overflow drainage piping shall be tested corresponding to the full head of water attainable in each portion of the system.

G. The drainage and vent systems shall again be tested and made tight after all plumbing fixtures are connected in place and with water seals in traps by means of standard smoke or chemical test as required by the Plumbing Inspector.

H. Submit to the Architect copies of all test reports witnessed by Plumbing Inspector(s) and Owner's Representative.

END OF SECTION

SECTION 22 33 00
DOMESTIC WATER HEATING SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Domestic water heaters

B. Miscellaneous water heating system accessories

C. Water testing kits

1.02 RELATED DOCUMENTS

A. Section 22 05 01 – Plumbing General Provisions

B. Section 22 05 19 – Meters, Gauges and Thermometers for Plumbing

C. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing

D. Section 22 07 19 – Insulation for Plumbing

E. Section 22 11 00 – Domestic Water Systems

F. Section 22 11 10 – Plumbing Piping and Accessories

G. Section 22 11 23 – Plumbing Pumps

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

A. AGA – American Gas Association

B. ANSI – American National Standards Institute

1. ANSI Z21.10.1 – 2013: Gas Water Heaters – Volume I, Storage Water Heaters with Input Ratings of 75,000 BTU per Hour or Less
2. ANSI Z21.10.3 a&b – 2013: Gas Water Heaters – Volume III, Storage Water Heaters with Input Ratings Above 75,000 BTU per Hour, Circulating and Instantaneous (includes Addenda 1 and 2)
3. ANSI Z21.13 a&b – 2010: Gas-Fired Low Pressure Steam and Hot Water Boilers (includes Addenda 1 and 2)
4. ANSI Z21.22b – 1999 Revised 2008: Relief Valves for Hot Water Supply Systems

C. ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE Standard 90.1 – 2013: Energy Standards for Buildings except Low-Rise Residential Buildings

D. ASME – American Society of Mechanical Engineers

1. ASME Standard for Boiler and Pressure Vessel Code – 2013

a. ASME BPVC – I through XII

2. ASME B16.10 – 2009: Face-to-Face and End-to-End Dimensions of Valves
3. ASME B16.34 – 2013: Valves – Flanged, Threaded and Welding End
4. ASME B31.1 – 2012: Power Piping
5. ASME B31.9 – 2011: Building Services Piping

E. ASTM – American Society for Testing and Materials

1. ASTM B733 – 2004 Revised 2009: Standard Specification for Autocatalytic (Electroless) Nickel-Phosphorus Coatings on Metal
2. ASTM C109 / C 109M – 2013: Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens)
3. ASTM D5162 – 2008: Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates

F. AWWA – American Water Works Association

G. CSA – Canadian Standards Association

1. CSA 4.1 – 2013: Gas Water Heaters – Volume I, Storage Water Heaters with Input Ratings of 75,000 BTU per Hour or Less
2. CSA 4.3 – 2013: Gas Water Heaters – Volume III, Storage Water Heaters with Input Ratings Above 75,000 BTU per Hour, Circulating and Instantaneous (includes Addenda 1 and 2)
3. CSA 4.4 – 1999 Revised 2008: Relief Valves for Hot Water Supply Systems
4. CSA 4.9 – 2010: Gas-Fired Low Pressure Steam and Hot Water Boilers (includes Addenda 1 and 2)

H. ETL – ETL SEMKO (formerly Edison Testing Laboratory)

I. FM – Factory Mutual Approvals LLC

J. ISO – International Organization for Standardization

1. Reference ISO 9001 – 2008 revised 2009: Quality Management Systems – Requirements

K. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry

1. MSS SP-70-2011: Gray Iron Gate Valves, Flanged and Threaded Ends
2. MSS SP-80-2013: Bronze Gate, Globe, Angle and Check Valves

L. NFPA 70, Edition 08 – The NEC: National Electrical Code

M. NSF – National Sanitation Foundation

1. NSF 5-2012: Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
2. NSF/ANSI 61-2013: Drinking Water System Components – Health Effects

N. UL – Underwriters Laboratories Inc.

1. UL 795 – 2011: Commercial-Industrial Gas Heating Equipment
2. UL 1453 – 2004 Revised 2009: Electric Booster and Commercial Storage Tank Water Heaters

O. Local Codes and Code Amendments

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 and the requirements of the listed Related Documents.

B. Water Heaters Storage Tank Insulation: Comply with applicable requirements of ASHRAE Standard 90.1.

C. Gas-Fired Equipment: Certified by the American Gas Association.

D. Electric Water Heaters: Listed by UL in conformance with UL 1453 Electric Booster and Commercial Storage Tank Water Heaters.

E. Storage Tanks / Pressure Vessels: Shall have the seal of American Society of Mechanical Engineers for compliance with ASME Code – Section VIII.

F. Storage Type Water Heaters: Shall have an independent laboratory listing for standards UL 795 and/or ANSI Z21.10.3b.

G. Storage Type Water Heaters: Manufacturer shall be ISO 9001 registered.

H. Valve construction shall be suitable for the pressure, temperature, and fluid quality of the service in which they are to be used.

I. All valves shall be manufactured in accordance with ANSI, AWWA, ASTM, and MSS-SP-70 & 80 (Manufacturers Standardization Society of the Valve and Fittings Industry) standards and specifications.

J. ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.

K. ASME B16.10 and ASME B16.34 for valve dimension and design criteria.

L. NSF Compliance: NSF 61 for valve materials for potable-water service.

M. Minimum test pressure for all valves shall be 1.5 times maximum system working pressure unless noted otherwise.

1.05 SUBMITTALS

A. Comply with requirements of Section 01 33 00 – Submittal Procedures, and as modified in Section 22 05 01 – Plumbing General Provisions.

B. Product Data: Submit manufacturer's latest product literature, including material specifications, construction details, rated capacity data, operating characteristics, installation data and other information required to demonstrate compliance with specified requirements for following items:

1. Water heaters
2. Pressure and temperature relief valves
3. Drain valves
4. Aquastats
5. Expansion tanks

C. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiate between manufacturer-installed and field-installed wiring, and location and size of all required field connections.

D. Submit manufacturer's installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories and maintenance data.

E. Submit warranties, complete warranty and service policies, including all exclusions and conditions.

F. Submit Operational and Maintenance (O&M) manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal, shall have same quality, finish, free area, material construction, etc., as those specified under base specification.

B. Approved Manufacturers:

1. Electric Water Heaters: A.O. Smith, Bradford White, Lochinvar, PVI Industries, Rheem, Rudd.

2.02 ELECTRIC WATER HEATERS

A. Comply with Energy Conservation Standards, UL Listed, ASME tank construction. Refer to schedule on the Drawings for capacities, recovery rates and electrical characteristics.

B. Water Heater: Internal fusing glass-lined storage tank, 125 pounds per square inch working pressure for 65- through 120-gallon capacity and 150 pounds per square inch working pressure for 5- through 50-gallon capacity, equipped with multi-anode system consisting of magnesium or aluminum anode and European style power anode, jacketed and insulated to meet ASHRAE 90.1 standards, 3-

years' warranty; similar to "Model DSE" by A.O. Smith, or approved specified equivalent by Bradford White, Lochinvar, or Rheem-Rudd.

C. Immersion Heaters: Medium watt density elements in each immersion heater with Incoloy sheathing and ceramic terminal block. KW capacities and voltages shall be as scheduled on the Drawings.

D. Tank Features:

1. Construction: Manufactured and stamped in accordance with ASME Code Section IV, hydrostatically tested at 225 psi minimum, and National Board Registered for 125 psi working pressure.
2. Tank shall be cathodically protected with powered anodes.
3. Liner: Glass, with an alkaline borosilicate composition fused to steel at 1,600 degrees F.
4. Hand-hole clean-out.

E. Insulation: Factory-installed foam insulation with heat loss not to exceed ASHRAE Standard 90.1 and steel enclosure cover with factory-baked enamel finish over bonderized undercoat.

F. Accessories:

1. Anodic protection.
2. Factory-installed AGA/ASME rated temperature and pressure relief valve set at relief pressure of 125 psi.
3. Low water cut-off probe to prevent energizing elements in the event of low water condition.

2.03 MISCELLANEOUS HEATING SYSTEM ACCESSORIES

A. Aquastat: Remote bulb direct immersion type, UL Listed, device for high and low limiting temperature of liquids in storage tanks with temperature control range of 100 to 240 degrees F, adjustable midscale differential of 5 to 30 degrees F, 120 volt rated micro-switch snap acting switch, bulb, capillary; "Tradeline Model L4008A1015" by Honeywell with accessories.

1. Accessories:

a. ¾-inch NPT copper immersion well with clamp; select for applicable insulation thickness.
b. Single-pole double-throw switch.
c. Field-addable setpoint lock.

B. Relief Valves:

1. Pressure and Temperature Relief Valve: Bronze body and spring and diaphragm combination pressure and temperature type relief valves with test lever and automatically reseating type thermostatic element. Tested under ANSI Z21.22b with ratings as certified and listed by AGA and rated relief capacities greater than water heater's BTU-per-hour input rating; by Watts.

2. Vacuum Relief Valve: Conformance with ANSI Z21.22b, CSA certified. Brass body and include a protective cap; “Model N36-M1” by Watts. Number “40L” by Watts for higher BTU-per-hour input ratings.

C. Thermal Expansion Tank:

1. Vertical steel expansion tank constructed and designed per ASME Code Section VIII, 125 psi working pressure, steel outer shell, rigid polypropylene liner, heavy-duty butyl rubber diaphragm and non-ferrous system connection tapping, suitable for potable hot water. Refer to schedule on the Drawings for size; by Amtrol, or Bell and Gossett.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Pipe relief drain full size to spill over floor receptor or to other safe location.

B. Install water heater and accessories in full compliance with manufacturer’s instructions and recommendations.

C. Install draft regulators in full compliance with manufacturer’s instructions and recommendations.

D. Install seismic restraints on all water heaters per all applicable local and state codes. The use of solid non-flexible supply materials in lieu of seismic restraints is not acceptable.

E. Pressure and Temperature Relief Valves:

1. Provide adjustable bronze spring and diaphragm combination pressure and temperature type relief valves with test lever and automatically reseating type thermostatic element.
2. Pipe drain to spill over floor drain or to other safe location.
3. Locate on storage tank water heaters.

3.02 TESTING AND ADJUSTMENTS

A. Provide factory-authorized technician for system inspection and start-up, and verify proper installation of all water heaters.

END OF SECTION

SECTION 22 63 13
NATURAL GAS SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. General: Provide gas systems in accordance with the Contract Documents.

1.02 REFERENCE STANDARDS

A. Comply with applicable provisions and recommendations of the following Codes:

1. California Code of Regulations, Title 24 – 2013
2. California Plumbing Code – 2013
3. Local Code and Amendments
4. NFPA 54-99, National Fuel Gas Code

B. Provide gas systems in accordance with the intent of the Contract Documents. Install all gas services meter rigs, regulators, etc., in accordance with the provisions of gas serving company and obtain all necessary approvals.

C. Make arrangements to provide gas service into the building. Ascertain what materials and/or labor will be provided by the local utility company and/or other City authority and pay any fee in conjunction therewith.

D. Gas service contract limit line as indicated on the Drawings.

1.03 RELATED DOCUMENTS

A. Section 22 05 01: Plumbing General Provisions

B. Section 23 09 00: Building Management System (BMS)

PART 2 – PRODUCTS

2.01 BELOW GRADE PIPING AND FITTINGS

A. Piping: Polyethylene piping, with heat fusion weld joints, Type II, ASTM D2513, ASTM D2683, ASTM D3261, PE 2406, where approved by local gas company standards.

1.	1 inch NTS	SDR 12.5
2.	1.25 inch NTS	SDR 13.9
3.	1.25 inch IPS	SDR 10
4.	2 inches IPS	SDR 11
5.	3 inches IPS	SDR 11.5
6.	4 inches IPS	SDR 11.5
7.	6 inches IPS	SDR 11.5
8.	8 inches IPS	SDR 11.5
9.	10 inches IPS	SDR 11.0

B. Transition Fittings: Steel to polyethylene pipe transition couplings and risers shall conform to ASTM D2513 & D2683 and ANSI B31.8 and DOT 192.121, ANSI B1.20, where applicable and meet design, material and construction standards of gas service company. Provide all accessories and fittings required for complete installation at building gas riser location available from Perfection Corporation, or Continental Industries.

C. Tracer Wire: Single conductor with green coating and minimum size No. 12 AWG stranded copper.

D. Buried Pipe Tape: 2 inches wide, safety yellow color code, heavy gauge 0.035-inch, detectable aluminum film including following text: “CAUTION Gas line buried below”.

1. Acceptable manufacturers/products include:

a. Seton Name Plate Company
b. EMED Co., Inc., Buffalo, New York
c. Enterprises, Inc., Waterloo, Michigan
d. “Magnetec” by Thor Enterprises, Inc., Waterloo, Michigan

E. Underground at Service Entrance: Same as Above-ground covered with a flexible polymer film with coal tar and synthetic elastomeric coating of 36-mil thickness or extruded high-density polyethylene factory applied coating of 30 mil thickness. Wrap fittings with 10-mil polyethylene tape, ANSI A21.5, double layer, half-lapped. Minimum dielectric strength exceeding 12kV. Use compatible primer below polymer film or polyethylene tape.

2.02 ABOVE GRADE PIPING AND FITTING MATERIALS

A. General Characteristics for Threaded Pipe and Fittings:

1. Field Pipe Threading: Comply with National Fuel Gas Code “Table I Specifications for Threading Metallic Pipe” for length of threaded portion of pipe and number of threads to be cut.
2. Metallic Pipe and Fittings Threads: Taper pipe threads complying with Standard for Pipe Threads, General Purpose, ANSI/ASME B1.20.1.
3. Thread Compounds: Resistant to action of chemical constituents of gases to be conducted through piping systems and labeled by manufacturer accordingly.

B. Above Grade Interior Piping: ASTM A106 Gr B, or A-53 B seamless, Schedule 40, carbon steel pipe.

C. Above Grade Exterior Piping: ASTM A106 Gr B, or A-53 B seamless, Schedule 40, carbon steel pipe, hot dipped galvanized coating.

D. Fittings:

1. Pipe sizes 2.5 inches and smaller:

a. Interior 150# black malleable iron screwed fittings.
b. Exterior 150# black malleable iron screwed fittings with hot dipped galvanized coating.

2. Pipe Sizes 3 inches and larger:

   a. Interior: Cast iron flanges, and vee-butt welded joints.
   b. Exterior: Cast iron flanges, and vee-butt welded joints, primed coated and 2 coats of exterior grade paint.

3. Joints: Red or white lead and oil or approved pipe compound.

2.03 VALVES

A. Lubricated Plug Valves: UL Listed valves, ASTM-A-126 Grade B steel body and plug material, suitable for natural gas service and pressures up to 200 psi, with close tolerance between the plug and body sealing surfaces, reinforced Teflon stem seal, leak-proof spring loaded ball and lubricant sealed check valve; and combination lubricant screw and button head fitting to prevent foreign matter from being forced into lubricant system. Valve plugs are to be floated on low-friction Teflon surfaces for extra ease of turning – the lower surface to also act as a means of minimizing torsional stress in the spring – and are to have port area equal to 100 percent of the area of standard pipe. Valves are to be so constructed that lubricant system has sufficient pressure to force lubricant over all seating surfaces. Extruded Lubricant around stem is to be positive indication that lubricant system is full, and that there had been a minimum contamination of line fluids. Lubricant shall be suitable for hydrocarbons, L.P.G. and natural gas. Similar to the following:

   1. Interior manual gas valves (½-inch to 2.5-inch size): Screwed ends, lever actuation, and lever handle; “Series 601” by Homestead Valve Division of Olson Technologies.
   2. Interior manual gas valves (3-inch to 6-inch size): Flanged ends, lever actuation, and lever handle; “Series 602 and 622” by Homestead Valve Division of Olson Technologies.
   3. Exterior manual gas valves (3-inch to 6-inch size): Permanently lubricated plug valve, lever actuation, and lever handle; “Roots Style 350” by DMD/Dresser.

B. Ball Valves (½-inch to 2-inch size): Bronze ball valve with B16 chrome plated brass ball and threaded ends; vinyl-coated steel handle; factory-tested under water with air pressure in open and closed positions. Listed by Underwriters Laboratories as natural gas shut-off valve and labeled accordingly; “Series 80-100” by Apollo.

C. Check Valves: Bronze swing check valve with soft resilient disc, suitable for natural gas service; “B-320BC, Class 125, threaded ends, with BUNA-N Disc” by Stockham.

D. Earthquake Valve: Earthquake ball type actuated automatic gas shut off valve, listed by UL and Certified by California State Architect in accordance with ASCE 25-97, sized for minimum pressure drop of 0.1-inch water column at total connected gas load; “Koso/California Series 300” by Pacific Seismic Products.

2.04 PRESSURE REGULATING VALVES

A. ¾-Inch Pipe Size:

1. Lower Diaphragm Case: Die cast aluminum with an exclusive 7-step advance conversion coating, single coat polyester and High Polyurethane Top Coat
2. Top Assembly: Die cast aluminum with an exclusive 7-step advanced conversion coating, single coat polyester primer and High Solid Polyurethane Top Coat
3. Pressure Spring: Steel, zinc plated and yellow chromate treated. Color coded for identification
4. Diaphragm Plate: Steel, plated
5. Seat Disc: Buna-N
6. Orifice: High strength, corrosion resistance, aluminum
7. Lever: Stamped aluminum
8. Seal Plug: Ultraviolet stabilized, mineral filled nylon
9. ¾-inch pipe size
10. 5-inch w.c. to 7.5-inch w.c. outlet pressure regulation
11. Removable weather and bug-proof stainless steel screened ¾ inch NPT vent to resist freeze-ups and to exclude foreign matter
12. Design Conditions: Inlet pressure 5 psi outlet pressure 7 inch w.c. with minimum capacity: 32 scfh
13. "S-253" by Fisher; or "CR-4000-180" by American Meter

B. 2-inch pipe size, flanged connections, spring color Green for 6 inch w.c. to 14-inch w.c. outlet pressure regulation, die cast aluminum alloy diaphragm case and cast iron body, diaphragm type regulator valve, internal control tube for pressure control, straight body with flow horizontal and vent outlet pointing downward. Provide regulator meeting following design conditions: inlet pressure 5 psi, outlet pressure 8 inch w.c. Capacity: 4241 scfh; "Model 122-12" by Equimeter.

C. 2-inch pipe size, flanged connections, spring color Green for 6 inch w.c. to 14-inch w.c. outlet pressure regulation, die cast aluminum alloy diaphragm case and cast iron body, diaphragm type regulator valve, internal control tube for pressure control, straight body with flow horizontal and vent outlet pointing downward. Provide regulator meeting following design conditions: inlet pressure 1 psi, outlet pressure 14-inch w.c. Capacity: 7834 scfh; "Model 122-12" by Equimeter.

D. 1.5-inch pipe size, threaded connections, spring color Blue for 5 inch w.c. to 8.5-inch w.c. outlet pressure regulation, diaphragm type regulator valve, straight body with internal relief vent. Inlet pressure 14 inches w.c., outlet pressure 8 inches w.c. Capacity: 634 scfh; "Model 243-12 –1" by Equimeter.

2.05 MASTER GAS CONTROL VALVE AND PUSH BUTTON STATION

A. Valve shall close by push button switch located where shown on the Drawings and by a solenoid valve in the gas piping.

B. Solenoid valve shall be explosion proof, 2-way, packless, for normally closed operation. Valve shall be constructed of forged brass body with BUNA "N" seat, shall operate on 120 volt, single phase, with continuous duty molded Class "A" coil and shall be sized to pass the total design volume of cubic feet per hour of gas. Valve shall have manual reset.

C. Valve shall be Model 8031B83 as manufactured by Automatic Switch Company.

D. Provide a push button switch to activate the solenoid valve for installation by the electrical trade. All wiring shall be done by the electrical trade.

2.06 GAS METER

A. Gas Meter: Positive displacement rotary type meter, conforming to ANSI/ASC-B109.3 and ANSI C12.1, with local readout and solid state pulser, generating low frequency pulses representing volumetric information, mounted directly to digit non-compensated index registers displacing volume in actual cubic feet (ACF), and drive rate of 10 cubic feet per revolution; “ROOTS Series B Series 3 Solid State Pulsar” by DMD/Dresser.

1. Solid-state pulsar shall be compatible with the Johnson Controls (JCI) Metasys N2 system, Campus Energy Management System (EMS) Pulsar connector(s) shall be single or dual with Amphenol or conduit type connectors as directed by Campus.
2. Meter size shall be based upon inlet gas pressure and 85 percent of total connected load.

    a. Total gas load: 4,241 CFH
    b. Gas pressure: 5 psi

B. Gas Meter: Diaphragm type meter, conforming to ANSI/ASC-B109.3 and ANSI C12.1, with local readout and automatic pulse generating unit representing volumetric information, mounted directly to digit non-compensated index registers displacing volume in actual cubic feet (ACF); “Model AR-250-RVP-FI” by American Meter.

1. Pulsar shall deliver 4 ma pulse for each cubic feet of gas.
2. Switch shall be rated for 24 volt and 100 ma max signal.
3. Pulsar connector(s) shall be single or dual with Amphenol or conduit type connectors as directed by Campus.
4. Meter size shall be based upon inlet gas pressure and 100 percent of total connected load:

    a. Total gas load: 32,000 BTU/HR
    b. Gas pressure: 5 psi

5. Provide wiring to Building Management System (BMS)

2.07 MISCELLANEOUS

A. Vent Cap:

1. ¾-inch to 1-inch pipe size: Aluminum body, built-in drip edge for rain and painter protection, full size venting sized to compensate for effective screen opening, stainless steel screen; similar to “Blo-Vent” by UPSCO.
2. 2-inch pipe size: 180-degree return bend steel end with 0.23 gauge stainless steel 12-inch by 12-inch mesh screen on outlet; “2-inch Return Bend” by UPSCO.
3. 1.25-inch to 4-inch pipe size: Iron body, 90-degree elbow with standard pipe thread with 12-inch by 12-inch mesh stainless steel screen on outlet; “Gas Vent” by UPSCO.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install piping without pockets, with drips at low points, and with valves at each outlet.

B. Use right and left nipples. Do not use bushings, unions and compression couplings.

C. Gas piping within the building below grade is to be run in casings or conduits and to be properly vented at both ends.

D. Gas piping run in plenum spaces, regardless of size to be welded and shall be run in a two-hour enclosure. No valves shall be installed in plenum spaces.

E. Provide dielectric union between buried steel gas piping using listed isolation fitting.

3.02 APPLICATION

A. Manual shut-off valves used on piping systems shall be as indicated for pipe sizes in PART 2.

B. Over-Pressurization Relief Valve: Provide capacity in valve for full relief capacity when pressure regulator fails in widest position and include vent pipe rising 7 feet-0 inches above grade.

C. Provide earthquake valve before gas line enters building and downstream of service exterior shut-off valve. Installation shall be in compliance with utility guidelines and not installed upstream of the gas meter or regulator unless approved by local utility company.

3.03 TESTING AND ADJUSTMENTS

A. Test the gas piping system by means of an air pump and mercury gauge to a pressure equal to the maintenance of a column of mercury 12 inches high for a period of 10 minutes. Conduct the test in the presence of all required inspectors.

B. Test under air pressure to 60 to 80 pounds per square inch for minimum one hour duration. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System shall not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

C. Submit all test reports, witnessed by City Inspectors, to the Project Manager.

END OF SECTION

SECTION 23 00 00
MECHANICAL TABLE OF CONTENTS

Section No.	Title
23 00 00	Mechanical Table of Contents
23 05 01	HVAC General Provisions
23 05 05	HVAC Scope of Work
23 05 13	Electric Motors for HVAC Equipment
23 05 14	Variable Frequency Drives for HVAC
23 05 16	Expansion Fittings and Loops for HVAC Piping
23 05 19	Meters, Gauges and Thermometers for HVAC
23 05 23	General-Duty Valves for HVAC Piping
23 05 29	Hangers and Supports for HVAC
23 05 50	Access Doors in General Construction for HVAC
23 05 53	Systems Identification for HVAC
23 05 93	Testing, Adjusting and Balancing for HVAC
23 07 00	Insulation for HVAC
23 08 00	Commissioning of HVAC
23 09 23	Direct Digital Control System for HVAC
23 21 13	Piping
23 21 16	Hydronic Piping Specialties
23 21 23	Hydronic Pumps
23 25 00	HVAC Water Treatment
23 31 00	HVAC Ducts and Casings
23 33 13	Dampers
23 33 19	Acoustics
23 34 00	HVAC Fans
23 36 00	Air Terminal Units
23 37 00	Air Outlets and Inlets
23 51 00	Breechings, Chimneys and Stacks
23 52 16	Condensing Boilers
23 74 13	Commercial Packaged Rooftop Air Conditioning Units
23 82 05	Space Terminal Heating Units
23 82 16	Air Coils

END OF SECTION

SECTION 23 05 01
HVAC GENERAL PROVISIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. The General and Supplementary Conditions and Division 1 are a part of the requirements for the work under this Division of the Specification.

B. Before submittal of bid, examine all drawings, specifications, addenda, alternates, special conditions and all other bidding documents of all divisions of this project, verify all governing conditions at the site, and become fully informed as to the extent and character of the work required, as well as its relation to other work in the building. Submittal of a bid is an agreement to all requirements of the Construction Documents, and no consideration shall be granted for any claimed misunderstanding thereof.

C. Submittal of a bid is deemed a representation by the Bidder that it is qualified in all respects to properly perform the work for which it is bidding and has experience with similar work. Bidders are deemed to be aware of materials and methods which maybe required in the discharge of their responsibilities, even though unspecified.

D. Indemnify the Owner and the Architect/Engineer against loss, liability, damage or expense, including attorneys' fees, in connection with any claim resulting from damage which may be asserted by any third party.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 WORK INCLUDED

A. Provide labor and materials required to install, test and place into operation the heating, ventilating, air conditioning systems as called for in the Contract Documents and according to all applicable laws, codes, rules, ordinances, and regulations.

B. Provide labor, materials and accessories required to provide complete operating mechanical systems as described or which may be reasonably implied as essential for a complete operating system.

C. Fully indemnify the Owner and the Architect/Engineer against loss, liability, damage, or expense, including attorneys' fees, in connection with any claim resulting from damage which may be asserted by any third party.

D. This Contractor shall accept delivery of the pre-purchased equipment at the site, retain responsibility and warranty for the equipment; inspect the equipment upon delivery for damage; and install the equipment for a complete functioning system. This shall be provided regardless of who purchased the equipment.

1.04 QUALITY ASSURANCE

A. Comply with current governing laws, codes, rules, ordinances and regulations of the Authority or Authorities Having Jurisdiction over any part of the work and secure all necessary permits. Comply with the regulations and requirements of the Owner's insurance underwriter as well as those of the utility companies serving the project.

B. Where Contract Document requirements are in excess of rules, regulations and Code requirements, and are permitted under the Code, the Construction Documents shall govern. In the event of a conflict between the Construction Documents and the applicable laws, rules, regulations, codes and ordinances of federal, state and local Authorities Having Jurisdiction, the latter shall govern.

C. Multiple codes or standards are referenced, the current enforced edition and applicable portions apply, unless noted otherwise.

D. Drawings, specifications, codes and standards are minimum project requirements. Where requirements differ, apply the most stringent as part of the base bid.

E. Should any change in drawings or specifications be required to comply with any governing regulations, notify the Architect and Engineer prior to submitting bid.

F. Execute work in strict accordance with the best practices of the trades in a thorough, substantial, skillful and well-executed manner by competent workers. Provide a competent, experienced full-time Superintendent who is authorized to make decisions on behalf of the Contractor.

G. Equipment shall be certified for use in the State of the project and shall meet the State and City Energy Codes

H. The Architect or Architect's Representative may conduct unannounced field reviews of any work completed or in progress during the Contractor's working hours. A field report will be issued to the Contractor if the field review of the mechanical systems construction has revealed elements of the work, which are inconsistent with the Contract Documents. All items in the report shall be addressed in writing by the Contractor within two (2) weeks and corrections in the field shall be made as directed.

1.05 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

1.	AABC	American Associated Air Balance Council
2.	ABMA	American Bearing Manufacturers Association
3.	ADA	Americans with Disabilities Act

4.	ADC	Air Diffusion Council
5.	AGA	American Gas Association
6.	AHJ	Authority Having Jurisdiction
7.	AHRI	Air Conditioning and Refrigeration Institute
8.	AMCA	Air Movement and Control Association
9.	ANSI	American National Standards Institute
10.	ASA	Acoustical Society of America
11.	ASCE	American Society of Civil Engineers
12.	ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
13.	ASME	American Society of Mechanical Engineers
14.	ASPE	American Society of Plumbing Engineers
15.	ASSE	American Society of Sanitary Engineers
16.	ASTM	American Society for Testing and Materials
17.	AWS	American Welding Society
18.	AWWA	American Water Works Association
19.	CTI	Cooling Tower Institute
20.	DEP	Department of Environmental Protection
21.	ECCCNYS	Energy Conservation Construction Code of NY State
22.	EPA	Environmental Protection Agency
23.	ETL	ETL SEMKO
24.	FM	Factory Mutual
25.	IEEE	Institute of Electrical and Electronic Engineers
26.	ISO	International Organization for Standardization
27.	LEED	Leadership in Energy and Environmental Design
28.	MSDS	Material Safety Data Sheet
29.	MSS	Manufacturers Standardization Society
30.	NAAMM	National Association of Architectural Metal Manufacturers
31.	NEBB	National Environmental Balancing Bureau
32.	NEMA	National Electrical Manufacturers Association
33.	NFPA	National Fire Protection Association
34.	NIOSH	National Institute for Occupational Safety and Health
35.	NUSIG	National Uniform Seismic Installation Guidelines
36.	NSF	National Sanitation Foundation
37.	OSHA	Occupational Safety and Health Administration
38.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
39.	UL	Underwriters Laboratories Inc.
40.	USGBC	United States Green Building Council

B. Definitions:

1. Where it is stated in the specifications to submit to Architect or Engineer for review, refer to Architectural General and Special Conditions for proper procedures.

2. “AS DIRECTED” is defined as directed by the Architect, or the Architect’s Representative.

3. “COMMISSIONING AUTHORITY”: The entity identified by the Owner as responsible for implementing the Commissioning Process.

4. “CONCEALED” is defined as embedded in masonry or other construction, installed behind wall furring or within double partitions, or installed within hung ceilings.

5. “CONSTRUCTION DOCUMENTS”: All documents associated with the project, including all drawings and specifications of all trades.

6. "CONTROL OR ACTUATING DEVICE": automatic sensing and switching devices such as thermostats, pressure, float, flow, operation of equipment.

7. “FINISHED SPACES”: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

8. “FURNISH” is defined as to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.

9. "INDICATED," "SHOWN," or "NOTED": as indicated, shown, or noted on drawings or specifications.

10. “INSTALL” is defined as to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation.

11. “MOTOR CONTROLLERS": manual or magnetic starters with or without switches, individual pushbuttons or hand-off-automatic (HOA) switches controlling the operation of motors.

12. “PIPING”: Includes pipe, tube, fittings, flanges, valves, controls, strainer, hangers, supports, unions, traps, drains, insulation and all related accessories.

13. PROGRESS INSPECTIONS: Inspections that are made during the progress of work to verify substantial compliance with the code and with approved Construction Documents.

14. “PROVIDE” is defined as to “Furnish” and “Install”.

15. "SIMILAR" or "EQUAL": of base bid manufacture, equal in quality materials, weight, size, performance, design, and efficiency of specified product, conforming to "Base Bid Manufacturers."

16. “SUBMIT” is defined as to submit to the Architect for review.

17. “WIRING”: Includes raceway, fittings, wire, boxes and all related accessories.

18. “WORK”: Includes labor, materials, equipment, services and all related accessories necessary for the proper and complete installation of complete systems.

1.06 GUARANTEE

A. Submit a single guarantee stating that all portions of the work are in accordance with Contract Documents. Guarantee work against faulty and improper material, fabrication, installation, start-up and commissioning for a period of two (2) year from date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are specified herein, the longer term shall apply. Correct any deficiencies, which occur during the guarantee period, within 24 hours of notification, at no additional cost to the Owner, to the satisfaction of the Owner. Obtain similar guarantees from subcontractors, manufacturers, suppliers and sub-trade specialists.

B. Guarantee that the materials and workmanship supplied under this division will be the best quality currently available, that the apparatus will be erected in a practical manner and in accordance with best industry practices, that it will be complete in operation, nothing being omitted in the way of labor and material required to make this so, although not specifically shown or mentioned herein, and that it will be delivered in proper working order, complete and perfect in all respects with additional cost, whether or not shown in detail on the Contract Drawings or described in detail in the specifications.

1.07 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

A. Upon request, the Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of digital data files (in the available format used for the project) of the architectural and engineering design drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings.

B. The Contractor acknowledges and agrees that the electronic files are the sole property of the Engineer. Except for use as electronic files for the drawings on this project, the files may not be duplicated, may not use the files on any other projects or allow them to be used by other persons. Use of these files is granted only for the preparation of drawing submittals by your firm on the subject project. The Engineer is acknowledged as the Author, retaining all common law, statutory and other reserved rights, including the copyright.

C. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media files. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the A/E from and against all claims, damages, losses and expenses including attorney's fees, directly or indirectly arising out of, or alleged to arise out of, or resulting from the use of the computer files, including but not limited to all claims, damages, losses or expenses which may be attributable to bodily injury, sickness, or death, or to injury to or destruction of tangible property.

PART 2 – PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Provide products and materials that are new, clean, free of defects and free of damage and corrosion. Provide products and materials as specified within the

Contract Documents. Provide premium, first-class products and materials if not specifically specified herein. Any work or products which are provided that are less than the specified quality, the respective materials and work shall be replaced at no additional cost to the Owner, as directed by the Architect/Engineer.

B. Products and materials shall not contain asbestos, PCBs or any other material that is considered hazardous by the Environmental Protection Agency or any other Authority Having Jurisdiction. Should the Contractor encounter any hazardous materials during the project, this Contractor shall halt work and notify the Owner of such.

C. Statically and dynamically balance rotating equipment for minimum vibration and lowest operating noise level.

D. Provide name/data plates on all major components of equipment with manufacturer's name, model number, serial number, capacity data and electrical characteristics attached in a conspicuous place.

E. Only Qualified Trades People shall install materials and equipment on this project.

F. The Contractor shall maintain standardization of manufacturers for equipment used in similar applications and sizes throughout the project.

G. Applicable equipment and materials to be listed by Underwriters Laboratories and manufactured in accordance with ASME, AWWA, or ANSI standards, and as approved by Authorities Having Jurisdiction.

H. Energy consuming equipment shall be certified for use in the State of the project and shall meet the State Energy Code and local energy ordinances.

I. Fully lubricate equipment prior to operation where required in accordance with the manufacturer's requirements.

J. Follow the manufacturer's instructions for installing, connecting and adjusting all equipment. Provide a copy of such instructions during the equipment installation and in the O+M documents.

K. Do not operate air or vacuum systems until ductwork is complete, temporary filters are in place and construction debris is removed. Provide 1-inch thick fiberglass filter media across the face of each return air opening prior to start of each air system during temporary system operation and system clean-out.

L. Do not operate water or steam systems until piping has been cleaned and start-up strainers are in place.

M. Install floor-mounted equipment on a minimum 4-inch high concrete pad. Concrete work shall be provided by another trade. Coordinate size and location with actual equipment used and accepted layout shop drawings.

N. Secure equipment with bolts, washers and locknuts of ample size to support equipment. Embedded anchor bolts to have bottom plate and pipe sleeves. Grout machinery set in concrete under entire bearing surface. After grout has set, remove wedges, shims and jack bolts and fill space with grout.

O. Locate valves, traps, damper operators, dielectric unions, access doors, etc., to be easily accessible, either in mechanical spaces or through access panels specified. Obtain Architect's approval of access panel locations.

P. Pressure vessels and relief valves shall be selected, built and labeled in accordance with ASME. Obtain a certificate from the City Inspector having jurisdiction showing such acceptance, and mount this certificate in a black frame under glass or laminated plastic adjacent to each pressure vessel and relief valve.

Q. Equipment capabilities, etc., are scheduled or specified for the job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified in the submittals.

2.02 ALTERNATIVE EQUIPMENT AND MATERIALS

A. Contract Documents are based on the materials specified and on the equipment manufacturers indicated. Acceptance of alternative equipment manufacturers does not relieve the Contractor of the responsibility to provide equipment and materials, which meet the quality and performance as stated or implied in the Contract Documents.

B. Equipment manufacturers listed in individual sections are acceptable for this project, subject to requirements of Contract Documents.

C. Submit proposals to supply alternate materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain project schedule. Reimburse Owner for costs associated with the review of the proposed alternative whether alternative is accepted or rejected.

D. Include revisions required to adapt alternatives in such proposals, including revisions by other trades. No increase in the contract price will be considered to accommodate the use of alternative equipment.

E. Wherever quality standards (such as serviceability, longevity and durability) and operating results (such as noise levels and energy efficiency,) are specified or scheduled, or when the manufacturer and size of equipment, for which such operating results are published or determinable, is specified, the substitution being proposed must conform substantially to the quality and quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system..

F. When making an alternative equipment or material request, the Contractor:

1. Represents that the Contractor has personally examined the Contract Documents and has determined that the proposed substitution is appropriate for the use intended in the Contract Documents and is equal or superior in all aspects to that specified.
2. Represents that the substitution has received the necessary approvals of the Authorities Having Jurisdiction
3. Will coordinate the installation of the accepted substitution into the work, making such changes as may be required for the work to be complete in all aspects.

G. Proposed changes and substitutions of systems, equipment and manufacturers shall be submitted and include the following information with the proposal:

1. A description of the differences between the existing contract requirements and that proposed, the comparative features of each, and the effect of the change on the final resulting performance. Include the impact of all changes on other Contractors and acknowledge the inclusion of additional costs to other trades. A line-by-line specification review indicating compliance of the proposed substitution with the project specifications. All deviations and exceptions from the project specifications shall be clearly indicated.
2. Schematic drawings and details to supplement the description. If accepted, the Contractor shall be responsible for the full complete design and resulting impacts of the proposed equipment/system.
3. A list of the contract requirements that must be revised if the change is accepted, including any specification revisions.

H. Complete list of materials and equipment proposed for use in the change.

1. Include a description and estimate of costs the Owner may incur in implementing the change, such as additional space requirements, permits, architectural and aesthetic impact, design costs, tests, permits evaluation, operating and support costs.
2. A projection of any effects the proposed change would have on collateral costs and schedules to the Owner.
3. A statement of the time by which a contract modification accepting the change must be issued, noting any effect on the contract completion time or the delivery schedule.
4. A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.

PART 3 – EXECUTION

3.01 FEES

A. The Contract shall provide and obtain all necessary permits, licenses, and certifications in accordance with all applicable codes, regulations, and Authorities Having Jurisdiction. This shall include the following:

1. Arrange and pay all required fees.
2. Pay royalties or fees in connection with the use of patented devices and systems.
3. Provide controlled or witnessed inspections.
4. Arrange for all final inspections and related fees.

B. Supplementary information in addition to the LRF; the following sustainable building submittal information shall be provided:

1. LFM backup documentation.

2. Product cut sheets.

3. Green seal compliance (adhesives).

4. Verification of prohibited compounds in adhesives, sealants, and sealant primers.

5. Green seal compliance (paints).

6. Certification of composite wood or Agri fiber Resins.

7. Certification of composite wood or agrifiber laminating adhesives.

3.02 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer's data, samples and test reports as specified on the Contract Documents.

B. After receiving notice to proceed from the Owner or Owner's Representative, or after execution of the Owner/Contractor Agreement, the contractor shall provide:

1. Submit a complete list of all mechanical equipment manufacturers and material suppliers for the equipment proposed to be provided on this project as well as names of all subcontractors.

2. A comprehensive list of all submittals for the project. A submittal identification number, a cross-reference to the contract documents, and an item description shall be submitted.

3. Prepare complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment specified herein. All data and details of such materials and equipment for review.

4. Certify that the shop drawings, product data and samples are in compliance with the Contract Documents prior to submission to the Engineer.

5. The Contractor shall be responsible for inspecting all materials and equipment upon their arrival on the job site and verify their complete compliance with the Contract Documents.

6. The Contractor shall be responsible to modify or replace any work, at no cost to the Owner, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

C. Review of submittals is for general compliance with the design concept and Contract Documents. Comments or absence of comments does not relieve the Contractor from compliance with the Contract Documents. The Contractor remains solely responsible for all details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for all construction means and methods, , for performing the work in a safe manner, and for coordinating the work with that of other trades.

D. No part of the work shall be ordered, procured, started in the shop or in the field until the shop drawings and samples for that portion of the work have been submitted, reviewed and returned with either “No Exceptions Noted” or “Exceptions Noted” marked on the submittal.

E. Submittals labeled FOR RECORD or RECORD ONLY shall not be reviewed by the Engineer.

F. The Contractor shall include in the construction schedule a minimum period of ten (10) working days, exclusive of transmittal time, for the Engineer’s review of each submitted shop drawing, product data and/or samples.

G. Submit all required shop drawings and manufacturer’s product submittals in electronic portable document format (PDF) through a file sharing website or as required by the Owner’s Representative or Architect. Review comments will be marked up electronically in the submittals and returned to the Owner’s Representative or Architect. Hard copy paper submittals will not be accepted. Electronic submittals shall be provided with the following information and format:

1. Provide each submittal as a complete indexed file incorporating all requirements of the specific submittal section being submitted for review.

2. Name file with project identifier, submittal number and revision number.

3. Include the following minimum information as metadata in the electronic PDF file:

    a. Date of Submittal

    b. Project Name

    c. Specification Section Number and Title

    d. Drawing/Detail Reference Numbers (as appropriate)

    e. Manufacturer Name

    f. Product Name

4. Each submittal shall include the following, as applicable:

    a. Accurately identify by means of underlining, use of arrow or placing a box around all equipment ratings, model numbers, options, etc. The identification shall be in color to clearly indicate what is included in the submittal.

    b. Any irrelevant information shall be crossed out.

    c. All technical and dimensional data.

    d. Initial installation and service connection requirements.

5. Incomplete or inadequate submittals will not be reviewed by the Engineer and will be returned to the Contractor for their action and resubmission.

6. Provide electronic transmittal form with the following information:

   a. Project Name

   b. Date Initiated and Date Due

   c. Contact Details for Owner, Architect and Engineer

   d. Name of Contractor, Sub-Contractor, Manufacturer and/or Supplier

   e. Type of Submittal

   f. Specification Section Number and Title

   g. Drawing/Detail Reference Numbers (as appropriate)

   h. Indication of Partial or Full Submittal

   i. Stamp Page for Submittal Stamps

H. All submissions will be stamped with the following actions:

Stamp	**Interpretation**
No Exceptions Noted	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents.
Exceptions Noted: - Resubmit for Record - No Resubmission Required	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents and Engineer's notations are complied with. Within this category are two options. A resubmission for our records is required when corrections are necessary. A resubmission is not required if there are only minor comments.
Revise and Resubmit	The submittal does not comply with the Contract Documents; do not proceed with fabrication, manufacture, or construction. The work and shop drawings are not permitted at the job site. Resubmit appropriate shop drawings.

I. Submit materials and equipment by manufacturer, trade name and model number. Include clear, legible copies of applicable brochure or catalog material.

Maintenance and operating manuals are not suitable substitutes for shop drawings.

J. Identify each sheet of printed submittal pages (using arrows, underlining or circling) to show applicable sizes, types, model numbers, ratings, capacities and options actually being proposed. Cross out non-applicable information. Note specified features such as voltages, motor efficiencies, special tank linings, pump seals, materials or paint finishes. Cross out all references to “options”. Cross out statements such as “subject to change without notice” or “not for construction”. Anything not specifically excluded is assumed to be included.

K. Provide dimensional data for roughing in and installation including required maintenance and service access clearances. Include technical data sufficient to verify that equipment meets requirements of the Contract Documents. Include wiring diagrams showing factory installed and field wiring requirements, piping and service connection data, motor sizes complete with voltage ratings, and schedules.

L. The Contractor shall be responsible to maintain on site a complete set of the most current reviewed and stamped shop drawings and product data.

M. Prepare and submit detailed shop drawings for ductwork, piping work and other distribution services in minimum ¼-inch to 1-foot scale, including elevations and locations and sizes of openings in floor decks, walls and roofs. Include on these shop drawings the motor starters, variable frequency drives, and disconnects within mechanical equipment rooms and clearly notate the electrical code required clearances with dashed outline.

N. The work described in shop drawing and product data submittals shall be carefully checked by all trades for clearances (including those required for code compliance, maintenance and servicing), field conditions, maintenance of architectural conditions and proper coordination with other trades on the job. Each submitted shop drawing to include a certification that related field conditions and requirements have been checked by all Contractors and Subcontractors and that conflicts do not exist.

O. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained on submissions or for deviations from requirements in the Contract Documents. The noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data and samples.

P. Inadequate or incomplete shop drawings, product data and/or samples will not be reviewed and will be returned to the Contractor for resubmittal.

Q. Indicate the following in the lower right-hand corner of each shop drawing, and on the front cover of each product data brochure: the submittal identification number; title of the sheet or brochure; name and location of the Project; names of the Architect, Engineer, Contractor, Subcontractor, Manufacturer, Supplier, and Vendor; the date of submittal; and the date of each correction, version and revision. Number all pages and drawings in product data brochures, test reports or submittals consecutively from beginning to end. Unless the above information

is included, the submittal will be returned for resubmission. Resubmittals of shop drawings or product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.

R. Indicate on floor plans the complete path for equipment installation and removal.

3.03 COORDINATION OF WORK

A. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Contract drawings are diagrammatic.

B. The Contract Documents show the general arrangement of equipment, ductwork, piping and accessories. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required to suit field conditions but may not be shown on the Contract Drawings. Investigate the site and review drawings of other trades to determine conditions affecting the work and provide such work and accessories as may be required to accommodate such conditions.

C. Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay .

D. Carefully check space requirements with other trades to ensure that material can be installed in the spaces allotted.

E. Transmit to trades doing work of other divisions all information required for work to be provided under their respective divisions (such as fresh water connections, foundations, electric wiring, access doors, and the like) in ample time for installation.

F. Where, due to union regulations or trade agreements, any of the work shown on the drawings or specified herein is not considered this trade's work, subcontract the work in question, but assume full responsibility for the complete installation. Except for such changes as may be specifically approved by the Architects and Consulting Engineers, in accordance with alternates or options stated hereinafter, all work must be in full accordance with the intent of the plans and specifications, complete in every way and ready for satisfactory and efficient operation when delivered to the Owner.

G. Provide signs required by the Authorities Having Jurisdiction.

H. Where variance occurs between the drawings and specifications, or within either document itself, the Contractor shall request, through the Construction Manager clarification in writing from the Architect and/or Engineer as to which item and manner in the work shall be installed.

I. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that they have the information necessary so that they may properly install the necessary connections and equipment. Identify items (valves, dampers, coils, etc.) requiring access in order that the ceiling and partition contractors can install access doors and panels in the correct locations. All access door quantities and locations shall be reviewed and approved by the

Architect prior to any work. Where requested to consolidate access needs with other Trades, the Contractor shall adjust without any additional cost to the Owner.

J. Consult with other trades regarding equipment so that, wherever possible, motors, motor controls, pumps and valves are of the same manufacturer.

K. Furnish and install sleeves for passage of pipes, ducts and conduits through structural masonry and concrete walls, roofs and floors and elsewhere as will be required for the proper protection of each pipe and duct passing through building surfaces. Sleeves shall extend 2" beyond both sides of the surfaces. The Contractor shall fireproof the penetrations as required.

L. Install firestopping around all pipes, conduits, sleeves, etc., which pass through rated walls, partitions and floors in strict accordance with the manufacturer's published approval listing and rating.

M. Provide detailed information on openings and penetrations required in structural elements and pre-cast panels or components for mechanical work and coordinate with the structural engineer.

N. Prior to installation, coordinate the location of all mechanical equipment motor starters, disconnects and variable frequency drives with the electrical contractor such that the electrical code required clearance is provided for worker safety.

O. Provide required structural or architectural supports and hangers for ductwork, piping and equipment, designed so as not to exceed allowable loadings of structures.

P. Examine and compare the Contract Drawings and Specifications with the drawings and specifications of other trades, report any discrepancies between them to the Architect and obtain written instructions for any necessary changes. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interferences.

Q. Wherever the work is of sufficient complexity, prepare and submit additional detail scaled drawings to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the shop drawings. At completion include a set of these drawings with each set of record drawings.

R. Before commencing work, examine adjoining work on which this work is in any way dependent and report conditions that prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

S. Adjust location of pipes, ducts, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each pipe and duct prior to fabrication.

1. Right-of-Way: Lines which pitch have right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.

2. Provide offsets, transitions and changes in direction of pipes and ducts as required to maintain proper head room and pitch on sloping lines. Provide traps, air vents, drains, etc., as required to effect these offsets, transitions and changes in direction.

T. Install mechanical work to permit removal (without damage to other parts) of hydronic coils, heat exchanger, boiler or chiller tube bundles, heat exchanger plates, controls, fan shafts and wheels, smoke detectors, filters, belt guards, sheaves and drives, and any other parts requiring periodic replacement or maintenance. Arrange pipes, ducts, and equipment to permit access to valves, cocks, traps, starters, motors, and control components, and to clear the openings of swinging doors and access panels.

U. Changes in the cross-sectional dimensions of ductwork are permissible when required to meet job conditions. Maintain at least the same equivalent cross-sectional duct area in accordance with the latest edition of the ASHRAE Guide. Secure the approval of the Architect prior to fabrication of ductwork requiring these changes.

V. Provide access panels in equipment, ducts, etc., as required for inspection and maintenance of concealed or internal equipment, dampers, plenums, smoke detectors, humidifiers, controls, etc.

W. In cases of doubt as to the work intended, or in the event of need for explanation thereof, request supplementary instructions from the Architect.

3.04 CONTRACTOR'S COORDINATION DRAWINGS

A. The Contractor shall coordinate efforts of all trades and shall furnish (in writing, with copies to the Architect) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. The Contractor and all trade Contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment purchased and the exact routing for all lines such as piping, busway, conduit, ductwork, etc., including conduit embedded in concrete floors and walls. The Coordination Drawings shall be submitted complete to the Architect and the Engineer after notice to proceed is given and in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than ¼-inch to 1-foot, shall serve as the base drawings to which all other Contractors shall add their work. Each separate Trade Contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and Coordination Drawings signed off by all trade Contractors. If the Contractor allows one trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.

C. The Contractor's Coordination Drawings shall indicate structural loads at support points for all piping 10-inch and larger, racked piping, racked conduit and busway. Submit to the Structural Engineer for review and approval. The elevation,

location, support points, static, dynamic and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial construction. Penetrations shall be dimensioned for walls, floors and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the Drawings.

D. This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade contractors to make any unauthorized changes to the Contract Documents. Contract document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Architect to change them.

E. Prior to final acceptance of the work, the Contractor shall submit the Coordination Drawings as part of the Record Drawing submittal.

F. All coordination drawings shall be prepared utilizing Revit 3D software.

G. Work installed which interferes with work of any other trade will be corrected at no cost to the project.

H. This Contractor shall not install any work prior to “sign-off” of final coordination drawings by all trades. If work proceeds prior to this sign-off, this Contractor shall be responsible for all costs resulting to correct interferences and conflicts, along with any schedule implications.

3.05 EXAMINATION OF SITE

A. The Contract Documents do not make representations regarding the character or extent of the subsoils, water levels, existing structural, mechanical and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work.

B. Evaluate existing conditions that may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for satisfactory completion of the work.

3.06 CUTTING ,PATCHING AND PAINTING

A. Coordinate all required cutting and patching with other Divisions of these specifications prior to any work.

B. Where cutting, channeling, openings, or drilling of floors, walls, partitions, ceilings or other surfaces is necessary from the proper installation, support or anchorage of ductwork, piping or equipment, lay out the work carefully in advance. Where such work is not provided, the Contractor shall provide accordingly. Repair any damage to the building, piping, equipment or finishes using skilled tradesmen for all required work.

C. Prior to any cutting, chasing, or drilling masonry, tile, etc., obtain written permission from the Architect and perform such work per the Architect's details and direction.

D. Patch all cutting, and openings created to allow the installation of this Contractor's work.

E. Where ductwork, piping or equipment are mounted on a painted finished surface, or a surface to be painted, paint shall match the surface as directed by the Architect.

F. All other uncoated steel items such as boxes, supports, channels, hangers, rods, etc., shall be cold galvanized or have a shop coat of paint applied under these specifications. Shop coats shall be an approved primer containing at least 50 percent rust inhibitive pigment, applied before assembling the different parts.

3.07 PROHIBITED LABELS AND IDENTIFICATIONS

A. In all public areas, tenant areas, storage areas and similar locations within the project, the inclusion or installation of any equipment, fixture or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other source(s) from which such object has been obtained, is prohibited.

B. Exception: Required Underwriters Laboratories labels shall not be removed nor shall identification specifically required under the various technical sections of the Specifications be removed.

3.08 EQUIPMENT PAD AND ANCHOR BOLTS

A. Coordinate all work in this section with the Architect and Structural Engineer. Note any conflicts for resolution prior to bid.

B. Provide concrete pads under all floor-mounted mechanical equipment. This includes electrical components, equipment mounted on legs and pipe support stands. Equipment pads shall conform to the shape of the piece of equipment it serves with a minimum 2-inch margin around the equipment and supports. Pads shall be a minimum of 4-inches high and made of a minimum 28-day, 2,500-psi concrete reinforced with 6-inch by 6-inch 6/6-gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a ¾-inch radius. Use shop drawings stamped "NO EXCEPTIONS NOTED" or "EXCEPTIONS NOTED" for dimensional guidance in sizing pads.

C. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Verify bolts size, number and embed depth recommended by the manufacturer of the equipment with seismic calculations as specified and locate by means of suitable templates. Equipment installed on vibration isolators shall be secured. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation and seismic restraint manufacturer.

D. Provide seismically restrained concrete housekeeping pads where required and coordinate the work with the Structural Engineer.

E. Where equipment is mounted on gypsum board partitions, the mounting screws will pass through the gypsum board and be securely attached to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6-inch square, 16-gauge galvanized metal backplates that are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not acceptable. Submit all loads imposed to the Architect for review.

F. Maintain fire integrity and rating of all walls where equipment is mounted.

3.09 SLEEVES

A. Include on ductwork and piping shop drawings a layout of masonry and concrete floor and wall sleeve locations for pipes and ducts. Include elevations and sleeve sizes.

B. Construct sleeves for pipes passing through walls (other than foundation walls), floors, partitions, hung or furred ceilings, etc., of minimum 18-gauge galvanized steel, flanged on each side of wall, partition, hung or furred ceiling, etc.

C. Provide standard weight galvanized steel pipe sleeves with welded anchor flanges at foundation walls and reinforced concrete or masonry walls.

D. Provide 20-gauge galvanized sheet metal sleeves, the full depth of floor or wall, for round ductwork passing through masonry or concrete and/or steel cellular floor construction. Rectangular ductwork shall be provided with framed openings through floor and wall construction.

E. Provide cast iron or fabricated “wall pipe” equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

F. Mechanical sleeve seals shall be manufactured in an ISO 9001 certified facility.

G. Stack Sleeve Fittings: Provide manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing and underdeck clamping ring with setscrews.

H. Provide mechanical sleeve seals at exterior wall and tank wall penetrations. Seal shall be of the modular sealing element unit type, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel with corrosion-resistant coating. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

I. Install escutcheons at exposed piping through floors, ceilings, walls and partitions in finished areas, within cabinets and millwork, and piping through all fire-rated separations. Provide manufactured wall and ceiling escutcheons and floor plates, with an inside diameter to closely fit around pipe, tube, and insulation of insulated

piping and an outside diameter that completely covers opening. Escutcheons shall be cast iron or cast brass, deep-pattern escutcheons if required to conceal protruding fittings, sleeve hubs or firestopping projections.

J. Provide sleeves for pipe passing through floors, walls or partitions, hung or furred ceilings, of sufficient diameter to accommodate pipe covering where such is required. Locate sleeves secure in place so that an equal space is around the pipe, after the pipe is installed.

K. For sleeves at penetrations of metal deck, nail, screw or weld to the deck prior to the pouring of the deck concrete. Set sleeves in such a manner so that no concrete fills their interior during the concrete pouring and finishing operations.

L. For exposed pipes, caulk floor sleeves with firestop material watertight and project sleeve approximately 2 inches above the finished floor. Finish sleeves with specified flanges flush with the bottom of slab and also with the finished faces of wall.

M. Provide sleeves with an inside diameter at least ½-inch greater than outside of pipe served, including pipe insulation which must be continuous through sleeve.

N. Where piping penetrates walls (other than foundation walls), partitions, floor slabs, etc., pack space between piping and sleeve with mineral wool (for depth of sleeve), or firestop material.

O. Do not support pipes by resting clamps on sleeves. Clamps shall extend beyond sleeve and be supported outboard of sleeve in an approved manner. In no case shall sleeves be cut or slotted to accommodate pipe clamps.

P. Provide escutcheon plates of the proper size for piping in sleeves passing through floors, walls, soffits, furrings, partitions, hung ceilings, etc., throughout the building where exposed. Exposed escutcheons shall be cast brass chromium plated, bell type, with setscrews of sufficient diameter to include any required pipe insulation. Attach escutcheon to building material, not to pipe. Do not penetrate vapor barriers.

1. Split-casting, deep-pattern type cast-brass type with concealed hinge and set screw with polished chrome-plated and rough brass finish.
2. Split-casting, floor-plate type cast brass with concealed hinge and set screw.

Q. Exterior-wall pipe penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install aboveground steel pipe for sleeves smaller than 6 inches.
2. Install aboveground cast-iron “wall pipes” for sleeves 6 inches and larger.
3. Install underground cast-iron “wall pipes” for all sleeves.
4. Mechanical Sleeve Seal Installation:

    a. Select type and number of sealing elements required for pipe material and size.
    b. Position pipe in center of sleeve.

c. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve.
d. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
e. For wall thickness up to 12 inches provide one mechanical sleeve seal at the interior side of sleeve, for wall thickness greater than 12 inches provide two mechanical sleeve seals, one at the interior side of sleeve and one at the exterior side of sleeve.

3.10 FIRESTOPPING

A. REFERENCED STANDARDS:

1. ASTM E119 - Method for Fire Tests of Building Construction and Materials.
2. ASTM E814 - Test Method of Fire Tests of Through-Penetration Firestops
3. UL Standard 1479 Fire Tests of Through-Penetration Firestops
4. UL Fire Resistance Fire Resistance Directory set

a. Through-penetration firestop devices (UL-XHCR)
b. Fire resistance ratings (UL-BXUV)
c. Through-penetration firestop systems (UL-XHEZ)
d. Fill, void, or cavity material (UL-XHHW)

B. Submit product data on through-penetration firestop. Submittal data for firestopping systems shall include the UL System Numbers listed in the UL Building Materials Directory under which the material was tested in accordance with ASTM E814 (UL 1479) for use in a Through-Penetration Firestop System. Where there is a firestop application that has not been tested by UL, obtain from the manufacturer an engineered judgment that the proposed application of the firestop product is suitable. Submit the engineered judgment to the Authority Having Jurisdiction.

1. Product Data: Manufacturer’s specifications and technical data including detailed specification of construction and fabrication, manufacturer’s installation instructions and details of each proposed assembly identifying intended products and applicable UL system number or UL classified devices.
2. Shop Drawings: Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements:

a. Manufacturer or manufacturer’s representative shall provide qualified engineering judgments and drawings relating to non-standard applications as needed.

C. Submit joint sealer guarantee.

D. Fire-Rated Construction: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with

other surfaces or types of construction, and sound or vibration absorption, and at other construction gaps.

E. Smoke Barrier Construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

F. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that it conforms to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free. Mortar systems must be Warnock Hersey approved.

G. Withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

H. All firestopping products must be from a single manufacturer.

I. Firestopping materials shall have been tested to provide fire rating at least equal to that of the construction.

J. Through-penetration smokestopping at smoke partitions: Any system complying with the requirements for through-penetration firestopping in fire-rated construction, as specified, is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded in a non-fire rated smoke barrier.

K. Seal all pipe and duct penetrations through fire-rated construction with factory-built devices or with manufactured fill, void, or cavity materials “Classified” by Underwriters Laboratories Inc. for use as a Through-Penetration Firestop. All firestop devices and systems shall be approved for such use by the Authority Having Jurisdiction. The firesafing system used shall maintain the fire-resistance rating of the building component that is penetrated.

L. All materials shall be non-hardening and non-toxic. The firesafing system used shall accommodate expansion and contraction of the floating mechanical piping systems without damaging the firestop or reducing its effectiveness as a smoke barrier or water seal.

M. Where space for future ducts, pipes and conduits is required, provide sleeves and fill with lightweight concrete or firestop.

N. Provide firestopping and grouting around pipes and ducts penetrating concrete slabs, concrete walls and masonry walls with cement grout in the sleeved opening extending full depth through wall or floor slab. Provide sheet metal cover over the insulation before applying grout. Around pipes and ducts through fire rated gypsum board construction, pack the annular space between the wall sleeve and the insulation sheet metal cover with noncombustible approved firestop material and finish with 20-gauge sheet metal collar on ducts and escutcheons on pipe where duct or pipework is exposed. Attach escutcheons to wall.

O. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

P. Environmental Requirements:

1. Provide adequate ventilation if using solvent.
2. Provide forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

Q. Clean surfaces that will be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

R. Install penetration seal materials in accordance with the UL Fire Resistance Directory in accordance with manufacturer's instruction.

S. Seal holes or voids made by penetrations to ensure an effective smoke barrier.

T. Where large openings are created in walls or floors to permit installation of pipes, ducts or other items, close unused portions of opening with firestopping material tested for the application. See UL Fire Resistance Directory.

U. Install smokestopping as specified for firestopping.

3.11 GROUTING

A. Grout shall be slow-hardening after application, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

B. Provide ASTM C1107/C1107M, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

C. Design Mix: 5,000 psi, 28-day compressive strength from a premixed and factory pre-package.

D. Mix, install and cure grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

E. Clean surfaces that will come into contact with grout. Provide forms as required for placement of grout. Avoid air entrapment during placement of grout.

F. Place grout, completely filling equipment bases.

G. Place grout on concrete bases and provide smooth bearing surface for equipment.

H. Place grout around anchors.

3.12 DELIVERY, DRAYAGE AND HAULING

A. The Contractor shall be responsible for delivering and installing all equipment to match the construction schedule. The Contractor shall provide drayage, hauling, hoisting, shoring and placement of all equipment in the building. If any item of equipment is received prior to the time that it is required, the Contractor shall be fully responsible for any costs and for its proper storage and protection, per the manufacturer's requirements, until the time it is required. The Contractor shall assure all manufacturer's warranties and guarantees are unaffected by early deliveries or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for resulting disassembly, re-assembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc. at no additional cost to the Owner. The Contractor shall assure all manufacturer's warranties and guarantees are unaffected by this work.

3.13 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment and material of other trades from damage by work or workers of this trade, and correct damage caused without additional cost to the Owner.

B. The Contractor shall be responsible for all work, materials and equipment until finally inspected, tested, commissioned and accepted. Protect work against theft, injury or damage; and carefully store material and equipment received on site that is not immediately installed. Close open ends of equipment and materials with temporary covers or plugs during construction to prevent entry of dust, dirt, water or other obstructing material. Cover and protect equipment and materials from damage due to water, moisture, humidity, paint, spray-on fireproofing, construction debris, etc. Store equipment subject to moisture damage, such as insulation or electrical components in dry heated spaces.

C. Provide adequate means for fully protecting finished parts of the materials and equipment against damage from whatever cause during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement or repair. Replace all wet or damp insulation or acoustic lining.

3.14 ELECTRICAL EQUIPMENT AND ELECTRICAL ROOM PRECAUTIONS

A. Do not install piping, equipment or ductwork for heating, ventilation, air conditioning, plumbing or any piping systems not included as part of the electrical work, in the following rooms: switchgear, transformer, generator, elevator equipment, telephone, fire command, security, dimmer or electrical equipment rooms.

B. Do not install piping, equipment or ductwork above switchboards, disconnects, panelboards, dimmers, control panels, VFDs, motor control centers, individual motor controllers, electronics, etc or the code-required service space for these electrical devices.

3.15 EQUIPMENT GUARDS

A. Provide removable expanded metal guards for all hot surfaces, belts, couplings, exposed fan inlets and outlets, and other moving parts of machinery. Provide tachometer openings in the guards at least 2-inches in diameter, for all belt-driven, gear-driven or variable speed machinery. Comply with OSHA requirements for all equipment guards.

3.16 LUBRICATION

A. Provide means for lubricating all bearings and other machine parts. If a part requiring lubrication is concealed or inaccessible, extend a metallic lubrication tube with suitable fitting to an accessible location and identify it with permanent laminated plastic nameplates. Identify this location in the maintenance manual.

B. After installation, properly lubricate all parts requiring lubrication and keep them adequately lubricated with a lubricant recommended by the equipment manufacturer until Owner acceptance.

3.17 DATE OF COMPLETION AND TESTING OF MECHANICAL SYSTEMS

A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing and commissioning prior to occupancy and the Contract closeout. Complete any adjustments and/or alterations that the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual sections for extent of testing required.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when tests and commissioning will be performed. Update this schedule periodically as the project progresses.

3.18 OPERATING INSTRUCTIONS AND OPERATOR TRAINING

A. Provide the services of factory-trained specialists to supervise the operation of all equipment and systems specified and train the Owner’s operating and maintenance personnel for a ten (10) day operating/instruction period. Operating instruction time is defined as straight time working hours and not including nights, weekends or travel time to and from the project. Refer to individual sections for additional training and instruction by manufacturer’s trained specialists.

B. Notify the Owner in writing at least three (3) weeks before the operating/instruction period begins. Do not commence until the Owner has issued written acceptance of the starting time and schedule.

C. In addition to the operating/instruction period, organize and conduct a seminar to instruct the Owner’s Representatives in the operation and general preventative maintenance of equipment and systems provided at the completion of the project.

D. Instruct Owner’s operating personnel in the basis of design, available project documentation, proper starting sequences, operation, shut-down, and maintenance procedures. Instruction for both normal and emergency operations procedures shall be provided and documented.

E. Make arrangements to give instructions by system and not by building areas. Organize training session and the video recording to present segments for equipment types, and overall systems following the Table of Contents of the Operating and Maintenance manuals.

F. Provide services of qualified personnel, including each sub-trade, each major equipment supplier to attend seminar and instruct on respective equipment or systems. Seminar shall be conducted by the Contractor and shall be professionally videotaped with lighting and narration. The seminars may be attended by the Architect or Architect's Representative.

G. Submit seminar agenda, schedule and list of representatives to the Owner for review thirty (30) days prior to seminar. Confirm attendance at seminar by written notification to participants.

H. At seminar, submit final copies of record drawings and operating and maintenance manuals to Owner.

I. Submit a written record of the seminar, complete with an attendance list to the Owner. Provide two copies of the recorded training video on USB flash drives.

3.19 OPERATING AND MAINTENANCE MANUALS

A. Provide operating instructions and maintenance manuals for all equipment and materials furnished under this Division. Manuals shall be available at the operations training seminar.

B. Submit a draft copy of operating and maintenance manuals in PDF format for review at least ten (10) weeks before the completion date. Assemble data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item.

C. After the Architect's and Engineer's review, and any required Contractor revisions, the operating and maintenance manuals shall be delivered to the Owner as three (3) hard paper copies in a binder as described below and separately on electronic media in PDF format.

D. Heavy-duty, three-ring, vinyl-covered, post-type binders, in thickness necessary to accommodate contents, sized to hold 8.5-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

1. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Supplementary Text: Prepared on 8.5-by-11-inch white bond paper.

4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

E. Manual Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system.

F. Maintenance information shall include complete lubrication, cleaning, and servicing data compiled in clearly and easily understandable format. Show model and serial number of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

G. Provide the following equipment operating and maintenance information where applicable:

1. Identifying equipment manufacturer, product name, model number and number

2. Locations (where several similar items are used, provide a list)

3. Systems and equipment controls including description of the sequence of operations and control diagrams.

4. Performance curves and data

5. Wiring diagrams

6. Lubrication charts

7. Manufacturers' recommended operating and maintenance instructions, with all non-applicable information deleted

8. List of spare parts recommended for normal service requirements

9. Assembly and disassembly instructions with exploded view Drawings, where necessary

10. Start-up procedures

11. Routine and normal operating instructions

12. Normal and emergency shutdown instructions

13. Trouble shooting diagnostic instructions, where applicable

3.20 RECORD DRAWINGS

A. The Contractor shall maintain on a daily basis at the project site a complete set of Record Drawings. The Record Drawings shall initially consist of a set of prints or AutoCAD files of the Contractor's Coordination Drawings. The prints shall be marked, or the AutoCAD files electronically updated to show the precise location of all buried or concealed work and equipment, including embedded piping and valves, and all changes and deviations in the mechanical work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite written instructions from the Architect or Engineer. The updated Coordination Drawings shall be used to produce the final Record Drawings that shall be delivered to the Owner in AutoCAD electronic format media upon project completion.

B. Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two (2) dimensions to permanent structures. Provide record drawings of the following items as a minimum:

1. Dimensional changes to Drawings.
2. Revisions to details shown on Drawings.
3. Locations and depths of underground utilities.
4. Revisions to routing of piping and conduits.
5. Actual equipment locations.
6. Duct size and routing.
7. Locations of concealed internal utilities.
8. Changes made by Change Order.
9. Field records for concealed conditions.
10. Record information on the Work that is shown only schematically in the contract documents.

C. The Contractor and subcontractor shall mark all in-progress Record Drawings on the front lower right-hand corner with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING

To be used for recording Field Deviations and Dimensional Data Only

D. Upon completion of the work, the Contractor and subcontractors shall certify all Record Drawings on the front lower right-hand corner adjacent to the above

marking with a rubber stamp impression or an AutoCAD image similar to the following:

RECORD DRAWING
CERTIFIED CORRECT

(Printed Name of General Contractor)

Date:

(Printed Name of Subcontractor)

Date:

E. Prior to final acceptance of the work of this Division, the Contractor shall submit properly certified Record Drawings to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the Record Drawings. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in AutoCAD format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

F. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. After review, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

3. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.

4. Architect will provide data file layer information. Record markups in separate layers

3.21 CERTIFICATION

A. Any certifications required by the Specifications, in addition to those required for shop drawings, product data, equipment and other items, are to be so certified in writing by the Owner, a Partner, or a Corporate Officer of the firm required to provide the Certification, or by another person duly authorized to sign binding agreements for and on behalf of the Owner, Partner or Corporation.

3.22 FINAL REVIEW

A. At a time designated by the Owner, the entire system shall be reviewed for compliance with the Contract Drawings and Specifications. Be available at all times during this review.

B. Demonstrate to the Owner and/or the Architect's personnel prior to the Final Review that systems and equipment have been properly balanced and adjusted and are in compliance with the requirements of the Contract Documents. After these demonstration tests are satisfactorily completed, but prior to the Final Review, submit a written certification that attests to the Contract Document compliance for this project

C. Prior to the final review, the Contractor shall confirm the following items regarding the status of key elements of the work. Negative responses to any of the items indicate that the construction is not substantially complete, and the building is not ready for a final review. The Contractor shall confirm the following in writing:

1. Building air systems (fans, air handling units, etc.) are completely installed, commissioned and operating.

2. Building hydronic systems are completely installed, commissioned, operating and pressure tested.

3. Building management system is installed, commissioned and operating.

4. Building has normal electrical power.

5. Building systems have been cleaned.

6. Seismic restraints have been inspected as specified. Any required special inspections have been completed.

7. Building systems have been balanced and copy of balance report submitted to the Architect.

8. Building fire and life safety systems have been tested and accepted by the local authorities. Any required special inspections have been completed.

9. There are no deviations or non-compliance with the Contract Documents; otherwise, provide a detailed account of any and all deviations or non-compliance.

10. All items on field review reports have been responded to in writing and are resolved to the satisfaction of the Owner.

11. All outstanding items on submittals and shop drawings have been addressed in writing and are resolved to the satisfaction of the Owner.

12. Schedule the final review only after providing written confirmation of all items above. Provide a minimum of ten (10) days' notice.

D. Operate the entire system properly with all systems balanced and all controls adjusted.

E. Certificates and Documents required by the Contract shall be presented to the Architect at least two (2) weeks prior to the Final Review.

F. After the Final Review, any changes or corrections noted as necessary for the work to comply with the Contract Documents shall be accomplished without delay in order to secure final acceptance of the work.

3.23 SYSTEM STARTUP

A. Prior to startup of any permanent system, confirm that the area which the system serves is fully closed off from the environment.

B. Operate the entire system properly with all systems balanced and all controls adjusted.

3.24 CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc., resulting from the installation of his work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean, subject to the Architect/Engineer's instructions, which shall be promptly carried out.

B. Contractor shall clean all light fixtures and equipment at the completion of the project.

C. All panelboards, wireways, cabinets, enclosures, etc. shall be thoroughly vacuumed clean prior to energizing equipment and at the completion of the project. Equipment shall be opened by this contractor for observation by the Architect/Engineer as required

3.25 CONTINUITY OF SERVICE AND SCHEDULING OF WORK

A. Continuity of all services shall be maintained in all areas which will be occupied during the construction period. If any interruption of service becomes necessary, such shall be made only upon consent of the Owner and at a time outside normal working hours (off hours) as the Owner shall designate.

B. Allow time for service interruptions in the overall schedule of the project. The progress of the project shall be neither delayed nor interfered with because of the scheduled service interruptions.

3.26 OPENINGS IN EXTERIOR WALLS

A. Openings in exterior walls and roofs shall be kept properly plugged and caulked at all times, except when being worked on, to preclude the possibility of flooding due to storms or other causes. After completion of the work, openings for which this Contractor is responsible shall be permanently sealed and caulked in a manner approved by the Architect.

3.27 REMOVAL WORK

A. Care shall be taken to avoid creating hazards on the site or causing disruption of service in the adjoining buildings.

B. All existing equipment indicated for removal shall be removed in a neat and workmanlike manner. All existing equipment indicated to be turned over to the Owner shall be presented to the Owner in good condition at a location designated by Owner. All other equipment shall be removed from the premises.

C. Follow state and federal regulations for disposal of any hazardous materials (such as CFC Refrigerant and Glycol).

D. Provide written documentation to the Owner that all hazardous materials have been disposed of properly.

3.28 HAZARDOUS MATERIAL REMOVAL

A. Should this Subcontractor or any of its Sub-Subcontractors encounter any hazardous materials during the performance of its work, this Subcontractor shall stop work immediately and so inform the General Contractor and the Owner of the presence of the hazardous material.

3.29 PROJECT CLOSEOUT

A. At the time of project closeout and prior to the final payment, this Contractor shall provide/submit the following for owner to review and sign off:

1. Review with Owner and confirm that all field issues have been resolved.

2. Submit system testing reports, equipment certificates, and operation manuals as per these specifications.

3. Provide the Owner with required training as per these specifications.

4. Provide spare parts, belts, pulleys, filters, etc., as per these specifications and Owner requirements.

5. Turn over all keys, including door access keys and control panel keys to the Owner with proper tags.

6. Submit construction record as-built sets with A/E review stamp.

7. All proposals and change orders are fully executed and submit a certified statement that no change orders will be submitted after project closeout.

8. Submit copies of the Authority’s inspection and approval letters.

3.30 EARLY OCCUPANCY

A. Be responsible for completing those systems, which are necessary to allow partial occupancy of the building even if systems in the unoccupied areas are incomplete.

B. Verify and comply with requirements for temporary occupancy with the local Building Department.

END OF SECTION

SECTION 23 05 05
HVAC SCOPE OF WORK

PART 1 – GENERAL

1.01 DESCRIPTION

A. The General and Supplementary Conditions and Division 1 are a part of the requirements for the work under this Division of the Specification.

1.02 WORK INCLUDED

A. The Contractors shall provide all labor, materials, tools, scaffolding, machinery, equipment, appliances and services necessary to complete the Heating, Ventilation, Air Conditioning, Plumbing and Fire Protection Work under this Contract. All systems and equipment shall be complete in every respect and all items of material, equipment and labor shall be furnished and installed for a fully operational system. The Contractor shall coordinate their Work with the Work of the other trades so as to resolve conflicts without impeding job progress or the Project construction schedule. Provide notice with the bid proposal of any general construction work required by this Division that is not indicated on the Structural, Architectural, or Mechanical/Electrical Drawings.

B. The Contractors shall examine all the Architectural, Structural, and Electrical Drawings, and other Divisions and Sections of the Specifications in order to determine the extent of Work required to be completed under this Division. Failure to examine all the Contract Documents for this Project will not relieve the Contractor of the responsibility to perform all the Work required for a complete, fully operational and satisfactory installation.

C. Change Orders: Contractor understands that the Contract Documents are not complete design documents.

1. There will be no additive change orders unless the Owner initiates a material change in scope.
2. Where there is a material reduction in scope, a deductive change order shall be provided by the Contractor.

PART 2 – PRODUCTS

2.01 WORK INCLUDED

A. The Work includes but is not limited to the following systems, equipment and services:

1. The hot water system consists of, but is not limited to, all items indicated on the Drawings and specifications and/or specified herein, such as:

a. Heating water pumps
b. Expansion tank
c. Heating water piping, valves, strainers, gauges and hydronic specialties
d. Heat exchangers for swimming pool heating and spa heating

e. Installation of control devices required and modifications to the piping systems required to accommodate these control devices
f. Terminal heating devices
g. Insulation

2. Packaged water-cooled air conditioning or water source heat pump units consisting of all items indicated on the Drawings and/or specified herein, such as:

a. DX cooling coils
b. Hot water heating coils
c. Vibration isolation, insulated housing, blowers, sound attenuators, insulation, drain pans with drains, air filters, etc.

3. Air distribution systems consisting of all items indicated on the Drawings and/or specified herein, such as:

a. Sheet metal ductwork and supports
b. Air terminal devices
c. Duct mounted heating coils
d. Grilles, registers, diffusers, wall, ceiling or floor outlets, duct insulation, manual dampers, backdraft dampers, smoke dampers, combination fire and smoke dampers, fire dampers, etc. All sheet metal damper surfaces visible through architectural louvers, air inlets or outlets shall be painted black under this Division.
e. Sound absorbing sections
f. Insulated sheet metal blank-off behind unused sections of architectural louvers. All visible surfaces of blank-off sections shall be painted black under Architectural Division.
g. Painted sheet metal blank-offs between all active slot diffusers

4. Automatic Temperature Controls and the Building Management System (BMS): Contractor shall install devices such as automatic control dampers, motorized control valves, water flow metering equipment, pipe wells, etc., furnished by Section 23 09 23. Refer to the requirements of each section of mechanical specifications for coordination and installation requirements.

a. Provide interface and summary alarm from the BMS to the Building Security system.
b. Provide interface and summary alarm from the BMS to the Building Fire Alarm system.

5. Ventilating systems consisting of all items indicated on the Drawings or specified herein, such as:

a. Exhaust fans
b. Supply fans
c. Manual dampers, ductwork, grille registers, etc.

6. Provide all supplementary structural steel, anchors, inserts, hangers and miscellaneous supports for mechanical work and equipment.

7. Provide Shop Drawings, Submittal Data, Product Data and Samples.
8. Provide Record Drawings.
9. Provide Contractor Coordination Drawings.
10. Provide balancing and adjusting of mechanical systems as specified.
11. Provide performance and acceptance testing of equipment and systems as specified herein and as required by Authorities Having Jurisdiction. Refer to Section 23 05 93 – Testing, Adjusting and Balancing for HVAC for additional requirements. Participate in and provide labor as required for "off-hour" testing of equipment and systems if required by job conditions or by the Authorities Having Jurisdiction and as required to obtain the "Temporary Certificates of Occupancy (TCO)".
12. Provide Operating and Maintenance manuals.
13. Provide vibration isolation, acoustic treatment, and seismic restraints as required for complete systems as specified or indicated on the Drawings.
14. Provide all systems, equipment, and services specified completely installed, commissioned and ready for use.
15. Provide all excavation and backfill required for Mechanical Work.
16. Provide all sleeves for the Mechanical, Plumbing, and Fire Protection Work complete with seals and firestop as specified herein and as required by the Authority Having Jurisdiction.
17. Provide patching or replacement of all fireproofing if it is damaged or removed during the installation of the Mechanical Work.
18. The Contractor shall participate in and assist in the operation of the fire and life safety ventilation equipment as required during the performance testing, start-up and special inspections of the Division 26 fire detection, alarm and communication systems. Refer to Section 28 30 00, for additional requirements.
19. Provide fuel oil piping, oil storage tanks, controls, accessories, etc.
20. Participate in and provide equipment, materials, and labor as required to construct at the Project site a complete mechanical, plumbing, and fire protection "mock-up", in or out of sequence, of one (1) typical bay and the associated mechanical systems. The field "mock-up" will remain in place for use in the completed building systems. The "mock-up" will be reviewed and will serve as a model for the installation and other similar typical floors.

2.02 PARTIAL LIST OF WORK NOT INCLUDED IN MECHANICAL SPECIFICATIONS

A. Electrical connections for motors and mounting of loose motors.

B. Individual motor controllers except motor controllers furnished as integral parts of pieces of equipment.

C. Pits for sewage ejectors and pumps; the Contractor shall be responsible for correct dimensions, layout, coordination, etc.

D. All concrete work specified or indicated on the Structural, Architectural, and Mechanical/Electrical Drawings.

E. Concrete equipment pads, concrete thrust blocks, and concrete fill for equipment and inertia bases. The Mechanical Subcontractor shall be responsible for providing the General Contractor with the correct dimensions, layout, etc., for all equipment.

F. Metal architectural louvers (except as indicated on the Mechanical Drawings).

G. Painting, except touch-up painting and as otherwise specified herein.

H. Installing access doors in General Construction.

I. Cooling tower supporting structure.

J. Standby-power generator.

K. Subsurface and landscape drainage.

L. Utility mains and piping five (5) feet beyond the foundation walls unless shown otherwise on the Drawings.

END OF SECTION

SECTION 23 05 13
ELECTRIC MOTORS FOR HVAC EQUIPMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Electric Motors

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 14 – Variable Frequency Drives for HVAC

C. Section 23 04 15 – Electric Motor Controllers

D. Section 23 05 48 – Vibration and Seismic Controls for HVAC

E. Section 23 33 19 – Acoustics

F. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

A. New York State and New York City Building Codes (Building, Fire, Electrical, Mechanical, Energy Conservation)

B. Institute of Electrical and Electronic Engineers (IEEE)

1. ANSI/IEEE 112 Standard Test Procedure for Polyphase Induction Motors and Generators

C. National Electrical Manufacturers Association (NEMA)

1. ANSI/NEMA MG-1 Motors and Generators

D. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70 National Electric Code (NEC)

E. Underwriters Laboratories Inc. (UL)

1.04 QUALITY ASSURANCE

A. Review Division 23 Equipment Specification for requirements within those sections

B. Source Limitations: Obtain field-installed motors of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Motors shall conform to applicable requirements of ANSI, IEEE, NEMA, and NEC standards and shall be UL Listed for the service specified.

E. Each submittal shall provide documentation and test reports certifying that all motors are in compliance with the design requirements for this project.

F. Certify that motor selection and performance have been coordinated with the equipment that is being supplied for this project.

G. Coordination

1. Coordinate features of motors, installed units, and accessory devices. Provide motors that are compatible with magnetic controllers, multispeed controllers, reduced-voltage controllers.
2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.
5. Motor compatible with ambient and environmental conditions of motor installation
6. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.
7. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section.

H. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

1.05 SUBMITTALS

A. Submit motors under the sections covering the driven equipment.

B. Submit motor efficiencies at full load, 75 percent full load, and 50 percent full load.

C. Submit certified dimensions, insulation class, NEMA frame size, materials of construction, base details and mounting details.

D. For each motor furnished, submit catalog data, including motor manufacturer, nameplate data, including horsepower, rpm, voltage, phase, frequency, full-load amps, power factor and efficiency standards compliance, electrical ratings and characteristics, mechanical performance data, physical dimensions, weights and support points.

E. Include project-specific wiring diagrams prepared by the Contractor specifically for this work.

F. Include manufacturer's instructions in the operating and maintenance manuals for the specific equipment. Include the following information, if not previously documented on shop drawings: full load power factor, service factor, NEMA design designation, insulation class, frame type.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle motors with lifting lugs provided for this purpose.

B. Maintain the minimum temperatures required to prevent the formation of condensation on motor windings.

1.07 WARRANTY

A. Furnish a three (3) year manufacturer's warranty from final acceptance by Owner for motors, associated accessories and components provided.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Baldor

B. General Electric

C. Marathon

D. Reliance

2.02 GENERAL

A. All motors shall be suitable for the use intended, i.e., with variable speed (variable frequency/voltage) drives cycled start/stop and/or constant speed as scheduled. Motors used in variable speed applications shall be designed to operate under variable torque load (or as specified) from maximum rated speed down to 10% of rated speed. Motors shall be designed to operate continuously at any point in the speed range. Any deviation from this requirement shall be noted and submitted with bid.

B. Coordinate motor with the torque and inertia load of the equipment served, and the inrush characteristics of the motor with the starter selection, so that all items furnished constitute a properly related package. No motor shall operate in the service factor range.

C. Motors shall be of proper power, construction and speed to suit the specified manufacturers of equipment. If other manufacturers of equipment are accepted, the proper adjustment of motor speed, torque and power must be included without additional cost. Submit drawings for review before the equipment is purchased.

D. Match wiring connections with controllers. Starters for motors 1/2 hp to 75 hp shall be magnetic across-the-line type with combination fusible switches. For pump motors over 100 hp, starters shall be part-winding (1/2-1/2) type. All

starters for fan motors 100 hp and over shall be reduced-voltage, autotransformer, closed-transition type.

E. 1/2 horsepower and larger motors shall be rated for 3 phase alternating current (VAC) and suitable for operation on a 208 VAC or 480 VAC (plus or minus 5 percent) – 3-phase – 60 hertz nominal electrical supply system, or as scheduled.

F. 1/3 horsepower and smaller motors shall be rated 120 VAC – single phase – 60 hertz and shall be provided with integral thermal overload protection.

G. Motors 1 hp and larger shall be premium-efficiency, of sizes and types as specified, of the proper power and speed to suit the specified makes of equipment.

H. Motors shall be generally constant speed, squirrel-cage type, open drip-proof or totally enclosed fan cooled (TEFC) design otherwise. Single phase motors shall be high efficiency capacitor start, induction run, or split phase type as approved for the service. Motors 75 horsepower and larger shall be suitable for operation with auto-transformer type motor starters.

I. Motor temperature rise when operating on a variable frequency drive shall not exceed Class F insulation limits at full load, with 115 degrees C allowable winding hot spot temperature, across its nameplate speed and torque envelope. Sine-wave temperature rise shall be Class F or better.

J. Motors shall have minimum Class B insulation for continuous full load duty at 40 degrees C and a maximum altitude of 3,300 feet above sea level. Where normal operating temperatures will exceed the Class B insulation rating, provide Class F insulation. For all motors driven by variable frequency drives, provide Class H insulation.

K. Motors shall be of quiet operating type, guaranteed to fulfill the specified requirements without producing any objectionable sound exceeding room NC levels as specified. All belt-connected motors shall have adjustable bases and set screws to maintain proper belt tension. Provide proper belt guards, in accordance with OSHA Standards.

L. Motors and accessories shall be UL Listed and comply with NEMA standards.

M. Minimum Service Factor:

1. Constant speed applications: 1.15.
2. Variable speed application: Nameplate sine-wave service factor shall be 1.15 or greater.

N. Coordinate the NEMA type of each motor with the torque and inertia load of the equipment served, and the in-rush current characteristics of the motor with the motor starter selection, so that all items furnished constitute a complete motor control and protection package. Motor shall not operate in the 15 percent service factor range.

O. Motors located in ducted air streams or subject to outside air elements shall be totally enclosed fan cooled; others shall be open drip-proof design. Motors one

horsepower or larger shall have encapsulated stator windings of the epoxy or silicone type.

P. Fan motors shall be capable of accelerating their respective fans from zero revolutions per minute to design or synchronous revolutions per minute within a maximum of ten seconds.

Q. All motors ½ horsepower and larger, except two-speed motors, specially wound motors and in-line pump motors frame size 56 and smaller, shall be high efficiency design with full load efficiencies (in percent) which meet or exceed the values listed below when tested in accordance with NEMA MG:

MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED						
Horsepower	1,200 rpm		1,800 rpm		3,600 rpm	
	ODP	TEFC	ODP	TEFC	ODP	TEFC
½ and ¾	80.0	80.4	82.1	82.7	79.1	78.5
1	82.5	82.5	85.5	85.5	80.0	85.5
1.5	86.5	87.5	86.5	86.5	85.5	86.5
2	87.5	88.5	86.5	86.5	86.5	88.5
3	89.5	89.5	89.5	89.5	86.5	89.5
5	89.5	89.5	89.5	89.5	89.5	91.0
7.5	91.7	91.7	91.0	91.7	89.5	91.7
15	92.4	91.7	93.0	91.7	91.0	91.7
20	92.4	92.4	93.0	92.4	92.4	92.4

R. Explosion-proof motors or motors in hazardous locations shall be TEFC motors designed and listed to meet UL and NEC requirements for use in Divisions 1 and 2 hazardous locations as required by local regulatory agencies and insurance companies.

S. Each motor shall be factory-wired to a junction box mounted on the motor or on the driven piece of equipment to facilitate single point of field power connection under Division 26.

2.03 VARIABLE SPEED APPLICATIONS

A. Motors used with variable frequency drives shall be designed specifically for use on AC inverter power and adjustable speed applications, with the following requirements:

1. Frame materials shall be cast iron, aluminum or rolled steel.
2. Motor insulation shall be Class H and designed to meet the voltage spike limits defined by NEMA MG-1, Part 31. Insulation systems shall utilize 200 degree C magnet wire with a Pulse Endurance Index greater than 100. Insulation systems utilizing heavy film wire are not acceptable. Complete insulation of the slot, cell and phase groups is required. The system shall be rated for Class F rise or better.
3. Stator core designs shall be of high rigidity with reinforced end turn construction to minimize mechanical fatigue of the winding, and to reduce resonant noise. Varnished materials shall be double dip, double bake using polyester phenolic Class H varnish. Single dip and bake cycles are not acceptable.

4. Winding thermal protection, utilizing normally closed contacts, shall be sized to match the maximum safe operating temperature of the insulation system. Contacts shall open when winding temperature reaches 155 degrees C. Hazardous location motors shall have winding thermal protection sized as required to meet UL or as auxiliary devices where not required by UL.
5. Low loss electrical steel shall be utilized in the stator and rotor core assemblies.
6. Maximized copper content shall be utilized to achieve high motor efficiency and thermal transfer.
7. Rotor cores and/or assemblies shall be of a low vibration design that meets one-half of the NEMA MG-1 recommended levels for balance.
8. The final motor design shall be evaluated by factory test on inverter power over the full range of speeds.

B. Variable Torque, Variable Speed Motors:

1. Motors shall meet NEMA design “B” performance levels. Design “A” motors are acceptable when higher than normal efficiencies are required.
2. Motors shall be nameplated for 6 to 60 hertz operation. Hazardous location motors may be nameplated 10 to 60 hertz.

C. Constant Torque, Variable Speed Motors:

1. Motors intended for constant torque applications shall be TEFC, TENV or TEBC (Totally Enclosed Fan Cooled, Totally Enclosed Non-Ventilated, or Totally Enclosed Blower Cooled) construction.
2. TEFC motors rated for 3:1 constant torque on “GENERIC” inverter power shall meet NEMA design “B” levels. TENV motors and motors rated for speed ranges greater than 3:1 may be rated as NEMA design “A”. TEBC motors shall meet NEMA design “B” levels.
3. Motors shall meet NEMA criteria for mechanical construction.

D. Nameplates:

1. Performance data for adjustable speed operation shall be stamped on a steel data plate and permanently attached to the motor frame.
2. The minimum amount of adjustable speed nameplate data shall include:

    a. Application Type – Constant Torque, Variable Torque or Constant Horsepower.
    b. Maximum approved continuous torque.
    c. Approved RPM and frequency operating range.
    d. Typical motor full load amps on VFD (inverter) power.

E. Motors used in variable-speed applications shall have the following minimum NEMA nominal efficiency levels nameplated on the motor:

Horse-power	**Open Drip-Proof**			**TEFC**		
	2 Pole	4 Pole	6 Pole	2 Pole	4 Pole	6 Pole
1	—	85.5	80.0	—	85.5	81.5
1.5	82.5	85.5	84.0	84.0	85.5	85.5
2	84.0	85.5	86.5	86.5	85.5	87.5
3	84.0	89.5	88.5	87.5	89.5	90.2

Horse-power	Open Drip-Proof			TEFC		
	2 Pole	4 Pole	6 Pole	2 Pole	4 Pole	6 Pole
5	87.5	89.5	88.5	88.5	90.2	90.2
7.5	87.5	91.0	91.0	91.0	91.0	91.0
10	88.5	91.0	91.0	91.0	91.7	91.0
15	89.5	92.4	91.7	91.0	92.4	91.7
20	91.0	93.0	91.7	91.0	93.0	91.7

F. The above efficiency values represent motor designs rated for 230 VAC or 460 VAC at 1,800 rpm nominal speed. Other base speeds and/or voltages may deviate from the above levels, but the NEMA nominal efficiency must be provided at the time of the bid.

PART 3 – EXECUTION

3.01 INSTALLATION

A. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts. Adjust as necessary so that run-out does not exceed 0.002 inches. Set all direct driven equipment with not more than one-half of the coupling manufacturer's recommended maximum tolerance for parallel and angular variance in alignment.

B. Align all belt-driven equipment to provide minimum wear on belts and drives, with belts properly tensioned.

C. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot for a secure and level installation.

D. When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently re-check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

3.02 START UP

A. Coordinate overload heater requirements with motor starter provider.

B. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

C. Lubricate all motors requiring lubrication. Record lubrication material used and the recommended frequency of lubrication. Include this information in the maintenance manuals.

END OF SECTION

SECTION 23 05 14
VARIABLE FREQUENCY DRIVES FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Variable Frequency Drives (VFD)

1.02 RELATED DOCUMENTS

A. Section 23 05 01 - HVAC General Provisions

B. Section 23 05 13 – Electric Motors for HVAC Equipment

C. Section 23 05 15 - Electric Motor Controllers

D. Section 23 09 23 - Direct Digital Control System for HVAC

E. Section 23 21 23 - Hydronic Pumps

F. Section 23 34 00 - HVAC Fans

G. Section 23 74 13 – Commercial Packaged Rooftop Air Conditioning Units

H. Division 26 - Electrical Specifications

1.03 REFERENCE STANDARDS

A. Institute of Electrical and Electronic Engineers (IEEE)

1. 519-2022 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems

B. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS 7.0 Industrial Control and Systems Adjustable-Speed Drives
2. NEMA ICS 7.1 Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems

C. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code

D. Underwriters Laboratories Inc. (UL)

1. UL 508A – UL Standard for Safety for Industrial Control Panels
2. UL 508C Power Conversion Equipment
3. UL 50 – UL Standard for Safety for Enclosures for Electrical Equipment

1.04 QUALITY ASSURANCE

A. Obtain VFD equipment through one source from a single manufacturer.

B. Manufacturer's Qualifications: Manufacturer shall have produced variable frequency controller for a minimum of 5 years. The manufacturer shall also be ISO 9001 certified.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of switchgear and are based on the specific system indicated.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Qualifications: VFDs and components shall be UL Listed as a complete assembly. VFDs that require field-supplied external fuses for the VFD to be UL Listed are not acceptable.

1.05 SUBMITTALS

A. Product Data as specified, including outline dimensions, weights, power and control wiring schematics, and equipment schedule.

B. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs.

1. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements.
2. Show support locations, type of support, and weight on each support.
3. Indicate field measurements.

C. Operation and Maintenance Data: For VFDs to include in emergency, operation, and maintenance manuals. Include

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
2. Manufacturer's written instructions for setting field-adjustable overload relays.
3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

D. IEEE – Standard 519 compliance calculation and harmonic analysis for this particular installation:

1. Total harmonic voltage distortion and total harmonic current distortion. Provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5 percent.
2. Input line filters shall be sized and provided as required by the manufacturer to ensure compliance with IEEE standard 519. All VFDs shall include a minimum of a 3 percent impedance reactor.

E. Start-up Service Report and Guarantee.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and protect products in accordance with recommended practices listed in manufacturer's Installation and Maintenance Manuals.

B. Deliver each variable frequency motor controllers section in individual shipping splits for ease of handling. Each section shall be mounted on shipping skids and wrapped for protection.

C. Inspect and report concealed damage to carrier within specified time.

D. Store in a clean, dry space. Maintain factory protection or cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic.

E. If stored in areas subject to weather, cover switchgear to provide protection from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside switchgear; install electric heating (250W per section) to prevent condensation.

F. Handle in accordance with manufacturer's written instructions to avoid damaging equipment, installed devices, and finish. Lift only by installed lifting eyes.

1.07 WARRANTY

A. Furnish a three (3) year manufacturer's warranty from final acceptance by Owner for all VFDs, associated accessories, and components provided.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. ABB

B. Yaskawa America

C. Siemens USA

D. Eaton Electrical

2.02 AC VARIABLE FREQUENCY DRIVE

A. Provide completely assembled VFD, factory-tested by the manufacturer. The VFD shall operate from a line overvoltage of 30 percent over nominal. The undervoltage trip level shall be 35 percent under the nominal voltage as a minimum.

B. The alternating current variable speed drive system shall include the microprocessor based variable frequency controller, the required signal logic and control. The electrical drive equipment specified including the variable frequency controller and its associated microprocessor control system shall be of the same manufacturer. Coordinate with driven equipment supplier to ensure compatibility between drive and AC Motors.

C. All equipment shall comply with the applicable requirements of the latest standards of ANSI, IEEE, and NEMA. The electrical equipment, as well as the design, construction, and installation thereof, shall comply with all the applicable provisions of the National Electrical Code and be ETL-SEMKO or UL approved.

D. The variable frequency drive shall be mounted in a NEMA 1 enclosure for drives inside the building, NEMA 12 enclosure for drives in air handling plenum spaces, parking garages (or other public accessible spaces), and NEMA 3R enclosure for drives outside the building. The control circuitry shall be isolated from the power circuitry.

E. The manufacturer shall submit calculated line distortion percentages in accordance with IEEE Standard 519, based upon the total connected horsepower and source kilovolt-amperes of the utility and emergency power distribution system. Request electrical data for calculation from the Division 26 contractor.

F. The speed controller shall respond to a speed adjusting potentiometer from the VFD sequence panel when in the manual mode or shall respond to a milliamp or voltage electrical signal when operating in the automatic mode.

G. The cabinet shall require front access only. The unit shall be suitable for operation in ambient air at 0 degrees C to 40 degrees C and up to 95 percent RH at rated load and switching frequency.

H. The variable frequency controller shall convert 208 or 480 volt (plus or minus 30 percent) 3-phase, 60 hertz (plus or minus 3 percent) utility supplied or standby generator supplied power to variable frequency, variable voltage three-phase AC power for induction motor speed control. The controller shall be selected to have sufficient capacity to provide stepless speed control of the specified horsepower motors throughout a continuous speed range under a variable torque load not exceeding the motor full-load rating.

2.03 SAFETY CONTROLS AND PROTECTIVE COMPONENTS

A. The VFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start). The VFD shall also be capable of DC injection braking at start to stop a reverse spinning motor prior to ramp.

B. The VFD shall be equipped with an automatic extended control power loss ride-through circuit, which shall utilize the inertia of the load to keep the drive powered. Typical control power loss ride-through for a fan load shall be 2 seconds minimum.

C. The overload rating of the drive shall be 110 percent of its normal duty current rating for 1 minute every 10 minutes. The minimum full-load ampere rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.

D. The VFD shall have an integral 3 percent impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients.

E. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable

to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that allow for drive acceleration from zero speed without signaling a false underload condition.

F. Provide surge reduction filter for electrical circuit lengths in excess of 200 feet.

G. The following shall be provided:

1. Motor thermal overload relays at the output for motor protection.
2. Enclosure door interlocked disconnect switch.
3. All coils for relays and contactor shall be suppressed.
4. Automatic Restart: Controller shall automatically attempt to restart five (5) times after a fault. After five (5) restarts, a manual start of the drive equipment is required.
5. The following contacts shall be wired to terminal boards of users control and indication:

    a. Motor running speed
    b. Drive faults
    c. Remote stop-starting

6. A complete factory-wired and -tested bypass system consisting of an output contactor and bypass contactor. Overload protection and single phase protection shall be provided in both drive and bypass modes. Include door-mounted manual by-pass switch with bypass contactor and indicator light. Electronic bypasses are not acceptable.

H. Drive faults shall consist of the following:

1. Motor thermal overload.
2. AC input voltage dips to 60 percent or less of its nominal value.
3. Drive output current exceeds 110 percent of controller full load rating.
4. A fault condition in any of the 3 output power module phases.

2.04 ADJUSTMENTS AND CONTROLS

A. All VFDs shall have the following operator adjustable components:

1. Two (2) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed.
2. PID setpoint controller shall be standard in the drive, allowing a pressure or flow signal to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 milliamp of 24 volts DC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus.
3. Two (2) programmable analog inputs shall accept a current or voltage signal.
4. One (1) programmable analog output.
5. Two (2) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times. Default settings shall be for run and not faulted (fail safe).
6. Seven (7) programmable preset speeds.

7. Two (2) independently adjustable acceleration and deceleration ramps.

B. All VFDs shall have the same interface, including backlit LCD digital display and keypad, regardless of horsepower rating.

1. The keypad shall be used for local control, for setting all parameters, and for stepping through the displays and menus. The keypad shall be removable/lockable to the cabinet, capable of remote mounting, and shall have its own non-volatile memory. The keypad shall allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
2. The keypad shall include Hand-Off-Auto selections. When in “Hand”, the VFD shall be started and the speed will be controlled from the up/down arrows. When in “Off”, the VFD shall be stopped. When in “Auto”, the VFD shall start via an external contact closure and the VFD speed shall be controlled via an external speed reference. Manual pilot devices are not acceptable.
3. Display shall indicate drive frequency, output voltage or output current. Provide an indication of the activation of the drive protection features and/or status in plain English without the use of code abbreviations as follows:

    a. Overcurrent
    b. Overvoltage
    c. Current Limit
    d. Decel Voltage Limit
    e. Ground Fault
    f. Overtemperature
    g. I^2T Protection
    h. Improper Input Voltage Selected
    i. Minimum/Maximum Speed Improperly Adjusted

C. Serial Communications:

1. The VFD shall have an RS-485 port as standard. The standard protocol shall be Modbus. Optional protocols that must be available are: Johnson Controls N2 bus, Profibus and DeviceNet.
2. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. A minimum of 15 field parameters shall be capable of being monitored. The DDC system shall be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. The drive shall have the capability of allowing the DDC to monitor feedback as a minimum, with 5 additional:

    a. Process variable feedback
    b. Output speed/frequency
    c. Current (in amps)
    d. Percent torque
    e. Power (kW)
    f. Kilowatt hours (resettable)
    g. Operating hours (resettable)
    h. Relay outputs

i. Diagnostic warning and fault information
j. Remote VFD fault reset shall be possible

3. The VFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for DO (relay) control and AO (analog) control. This control shall be independent of any VFD function. The outputs can be used for modulating chilled water valves via the analog output, actuate a damper etc. In addition, all drive digital and analog inputs shall be capable of being monitored by the DDC system.

D. The following shall be furnished and mounted by the drive manufacturer and shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL 508 label:

1. Fused VFD only disconnect (service switch). Fast acting semi-conductor fuses exclusive to the VFD to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which do not have fuses, or that, incorporate fuses common to both the VFD and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.
2. The following operators shall be provided:

a. Bypass Hand-Off-Auto
b. Drive mode selector
c. Bypass mode selector
d. Bypass fault reset

3. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

a. Power-on
b. External fault
c. Drive mode selected
d. Bypass mode selected
e. Drive running
f. Bypass running
g. Drive fault
h. Bypass fault
i. Bypass H-O-A mode
j. Automatic transfer to bypass selected

4. The following relay (Form C) outputs from the bypass shall be provided:

a. System started
b. System running
c. Bypass override enabled
d. Drive fault
e. Bypass fault- motor overload or underload due to broken belt
f. Bypass H-O-A position

5. The digital inputs for the system shall accept 24-volt or 115-volt AC (selectable). The bypass shall incorporate internally sourced 24-volt power supply and not require an external control power source.

6. Customer Interlock Terminal Strip: Provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass mode. The remote start/stop contact shall operate in VFD and Bypass modes.
7. Dedicated digital input that will transfer motor from VFD mode to Bypass mode upon dry contact closure for fireman's override. Bypass mode shall force the motor to bypass operation and overrides both the VFD and bypass H-O-A switches and forces the motor to operate across the line.
8. The VFD shall include a "run permissive circuit" that will provide a normally open contact any time a run command is provided (local or remote start command in VFD or Bypass mode). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch). When the VFD system safety interlock (fire detector, freezestat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
9. Class 20 electronic motor overload protection shall be included.
10. There shall be an internal switch to select manual or automatic bypass.
11. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication when in the Bypass mode.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall install the drive and power wiring shall be completed in accordance with the recommendations of the manufacturer as outlined in the installation manual.

B. Start-up Service: Provide certified factory-authorized start-up service for purposes of installation inspection, initial drive equipment setting, energization and adjustment. Start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner.

C. Coordinate with equipment supplier to ensure compatibility between variable frequency drive and the motor supplied with the equipment.

D. Division 26 shall mount and wire the drives in locations as shown on the Drawings.

E. Maintain code required electrical clearance around all VFD cabinets.

END OF SECTION

SECTION 23 05 16
EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Flexible expansion joints
2. Slip type expansion joints
3. Pipe alignment guides and anchors

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 29 – Hangers and Supports for HVAC

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC

D. Section 23 21 13 – Hydronic Piping

1.03 REFERENCE STANDARDS

A. AGA – American Gas Association

B. ANSI – American National Standards Institute

1. ANSI Z223.1 National Fuel Gas Code

C. ASME – American Society of Mechanical Engineers

1. ASME Standard for Boiler and Pressure Vessel Code

a. ASME BPVC – I through XII

2. ASME B18.10 Track Bolts and Nuts
3. ASME B31.9 Building Services Piping

D. ASTM – American Society for Testing and Materials

1. ASTM A53 / A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
2. ASTM A183 Standard Specification for Carbon Steel Track Bolts and Nuts
3. ASTM B650 Standard Specification for Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
4. ASTM F844 Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
5. ASTM F1120 Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Applications
6. ASTM F1123 Standard Specification for Non-Metallic Expansion Joints

E. AWWA – American Water Works Association

1. AWWA C153/A21.53 Ductile-Iron Compact Fittings for Water Service
2. AWWA C210 Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
3. AWWA C213 Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

F. NSF – National Sanitation Foundation

1. NSF Standard 61 Drinking Water System Components – Health Effects

G. UL – Underwriters Laboratories Inc.

1.04 QUALITY ASSURANCE

A. Construct guide and expansion compensators in accordance with ANSI, ASTM and ASM standards.

B. Provide expansion compensators compatible with the pressure and temperature of the system installed.

C. The expansion joint manufacturer must maintain a quality assurance system approved to ASME Code Section VIII.

D. Flexible expansion joints for potable water piping shall be UL classified in accordance with NSF 61.

1.05 SUBMITTALS

A. Product Data: For each type of expansion fitting indicated including maximum pressure and temperature ratings.

B. Shop Drawings: Signed and sealed by a qualified professional engineer indicating layout of piping systems indicating all information as it relates to piping expansion compensation. Shop drawings shall include:

1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops. The calculations must be in accordance with the Standards of the Expansion Joint Manufacturers Association, Inc (10^{th} addition with addenda) and must include thermal movement, force, stress calculations, including pipe length, and pipe materials.
2. Anchor Details: Include both operating and hydrostatic conditions. Detail fabrication of each indicated. Show dimensions and methods of assembly.
3. Alignment Guide Details: Detail field assembly and anchorage.
4. All manufacturer's installation instructions and recommendations.

C. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

1.06 WARRANTY

A. Furnish a five (5) year manufacturer's warranty (from final acceptance by Owner) against defects

B. Furnish a five (5) year warranty (from final acceptance by Owner) against leaks

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Flexible Expansion Joints: Flexonics, MetraFlex, Hyspan

B. Pipe Alignment Guides: MetraFlex, Hyspan, Anvil International

2.02 PERFORMANCE REQUIREMENTS

A. Expansion compensator shall be capable of elongating and compressing to absorb 200 percent of maximum piping expansion between anchors.

B. Pipe alignment guides shall be selected for both upward and downward motion.

C. Compensators are to be based on the following minimum criteria:

1. Initial water temperature: 45 F
2. Maximum chilled water temperature: 85 F
3. Maximum hot water temperature: 210 F
4. Water system pressure: 300 psi
5. Safety factor: 30%

2.03 FLEXIBLE EXPANSION JOINTS

A. Provide flexible expansion loops of size and material noted on the Drawings.

B. Flexible loops shall be designed to not impart thrust loads on the anchors. The loop shall consist of two flexible sections of hose and braid, two (2) 90-degree elbows, and a 180-degree return. Loops shall be installed in a neutral, pre-compressed, or pre-extended condition as required for application.

C. Loops installed hanging down shall have a drain plug. Loops installed straight up may be fitted with an automatic air release valve that purges air from the high point of the loop. Loops installed in any position other than hanging down must have the 180-degree return supported.

D. Joints for copper piping and fittings 2" and smaller with solder-joint end connections:

1. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 degrees F and 340 psig at 450 degrees F minimum pressure ratings.
2. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 degrees F and 500 psig at 450 degrees F minimum pressure ratings

E. Joints for steel piping and carbon-steel fittings 2.5” to 6” with welded end connections:

1. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 degrees F and 145 psig at 600 degrees F minimum pressure ratings.
2. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 degrees F and 200 psig at 600 degrees F minimum pressure ratings.

F. Joints for steel piping and carbon steel fittings 8” to 12” with flanged end connections:

1. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 degrees F and 90 psig at 600 degrees F minimum pressure ratings.
2. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 degrees F and 120 psig at 600 degrees F minimum pressure ratings.

G. Joints for steel piping and carbon steel fittings 14” and larger with flanged end connections:

1. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 degrees F and 120 psig at 600 degrees F minimum pressure ratings.

2.04 METAL EXPANSION JOINTS

A. Bellows Type:

1. Flanged, packless, self-equalizing type constructed of Type 304 stainless steel bellows and carbon steel fittings. Construct control rings of cast steel or nickel iron. Include limit stops and tie rods to prevent over traversing and to constrain pressure thrust forces on the joints. Units shall be rated at 150 psi at 400 degrees F.
2. Include an external sheet metal shroud on all joints that will be insulated. Shroud shall be removable for field inspection of the joint.
3. Include an internal sleeve of Type 304 stainless steel with sufficient clearance between the bellows and the sleeve to permit full rated rotational and lateral movement. Inside diameter of sleeve is not to be less than that of the adjoining pipe.
4. 175 psig minimum pressure rating, with end fittings and external tie rods for limiting maximum travel.
5. Joints for copper piping shall be single- and two-ply, phosphor bronze bellows and brass shroud.
6. Joints for stainless-steel waterway shall be single-ply stainless-steel bellows, stainless-steel pipe end connections, and steel shroud.
7. Joints for steel piping shall be single- and two-ply, stainless-steel bellows and carbon-steel shroud.

B. Slip Type:

1. Provide integral internal and external guides designed for the injection of self-lubricating packing under full line pressure.
2. Provide expansion joints, suitable for use with 150 psig steam of sizes and traverse noted on plans.
3. Traverse chamber and stuffing box shall be ASTM A53, Grade B, seamless steel pipe and concentric reducer of same or greater wall thickness as connected piping system.
4. Slip shall be ASTM A53, Grade B, Type S, black steel pipe. Use Schedule 80 material for sizes through 16-inch and Schedule 60 for sizes 18-inch through 24-inch, but not lighter weight material than used on the connected piping system. Slip shall be ground, polished, and plated with not less than 1 mil of hard chrome applied over 1 mil of crack-free hard chrome, in accordance with ASTM B650.
5. End connections shall be beveled to match connected piping for field welding.
6. Outward limit stops shall be T-303 stainless steel pins welded to slip to prevent disengagement of the slip in the event of anchor failure.
7. Packing/packing cylinder: Injectable packing shall be self-lubricating, asbestos free, flake graphite/Teflon packing suitable for 150 psig at not less than 600 degrees F, injectable under full line pressure, backed by self-lubricating, asbestos free reinforced graphite braided ring packing. The area of the packing in contact with the sliding slip shall be a minimum of 15 times the nominal pipe size of the joint. Provide multiple packing cylinders with integral stainless steel safety valve and internal acme thread and plungers to inject packing into the expansion joint without blowback. Furnish one clean-out tool to loosen impacted packing prior to adding injectable packing. Provide three extra packing plugs for each packing cylinder for each joint.
8. Locate expansion joint with sufficient clearance from wall or other obstruction to allow access to and removal of all packing ram plungers and use of clean-out tool.

2.05 PIPE GUIDES

A. Spider guides:

1. Construct spider guides of carbon steel throughout carbon steel housing and copper spider with Teflon edges.
2. Bother spider and outers housing to be formed as (2) bolted halves.
3. Select size of guides to include insulation when guiding insulated pipe.
4. Spider guides to be pre-insulated with a section of hydrous calcium silicate extending at least 1” beyond each side of spider.
5. For riser guides, provide arms of sufficient length to contact floor slab or other support a minimum of 3” on each side.

B. Slide Guides

1. Construct body and base of slide guides of carbon steel.
2. Slides to be steel with Teflon on Teflon graphite on graphite sliding surfaces.
3. Provide slides with gusset plates on 6” and larger sizes.

C. Radiation Pipe Guides

1. Provide 316" steel "L" brackets slotted on both legs to accommodate maximum adjustment in horizontal and vertical planes.
2. Provide thermal resistant nylon guides surrounding tubing and attached to brackets with ¼" diameter bolts.

2.06 MISCELLANEOUS MATERIALS

A. Bolts and Nuts: ASME B18.10 or ASTM A183, steel, hex head.

B. Washers: ASTM F844, steel, plain, flat washers.

C. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide at least two (2) guides each side of each expansion loop or joint. Size guide cylinder to allow the full insulation thickness to be carried through the guide with ample clearance and without restricting the free movement of the pipe. Size guide cylinder for sufficient length to contain the total movement of the spider. Rigidly anchor pipe guide to building structure.

B. Install expansion fittings according to manufacturer's written instructions in sizes matching pipe size in which they are installed. Align expansion fittings to avoid end-loading and torsional stress.

C. All installations procedures to conform to EJMA Safety Recommendations.

D. Provide expansion loops or joints as shown on the Drawings.

E. Provide minimum of three (3) elbow offsets on branch pipe connections into mains and at each riser takeoff to allow piping flexibility and expansion.

F. Install flexible loop within four (4) pipe diameters, both upstream and downstream, from a pipe guide or anchor.

3.02 EXPANSION JOINT INSTALLATION

A. The bellows element shall be protected from damage. Dents, scores, arc strikes, weld spatter, and other damage can cause the joint to fail. Damaged joints shall not be used.

B. Align joint flange and pipe flange holes. Do not try to compensate for flange or pipe misalignment by putting a torsional, compressive, extension, or offset loads on the expansion joint. Good practice requires that a mating flange in the piping system remain unwelded until the expansion joint has been bolted into position.

C. All anchors, guides, and supports must be installed according to manufacturer's recommendations.

D. Internally pressurized expansion joints shall be installed in the proper orientation with respect to direction of flow.

E. Unit lengths must not be altered during installation except for the application of cold pull.

F. Remove shipping restraints after installation, but before hydrotesting. Test pressure shall not exceed 1.5 times design pressure. Water free of halogens shall be used for hydrotesting.

G. If testing medium is significantly heavier than the product to be carried in the system, care must be taken to support the additional weight.

H. Paints containing low melting point metals or their compounds, particularly aluminum, lead or zinc, must not be allowed to come into contact with the bellows convolutions.

3.03 EXPANSION JOINTS (SLIP TYPE)

A. Verify that the joint has been pre-compressed the proper amount for the application, including the temperature difference between the installation condition and the operating condition.

B. Adjust pre-compression as required.

C. Provide protection for the chrome-plated slip during the entire installation process. Replace packing if it has become imbedded with dirt, gravel, or other foreign material.

D. Install alignment guides as indicated on the Drawings or in accordance with the joint manufacturer's instructions, whichever is more restrictive.

E. For joints furnished with bases, use the proper size bolts in all bolt holes to obtain the maximum anchor strength.

F. Install a drip trap or drain plug, in accordance with the project details, on joints furnished with a drain connection.

G. On lines specified to be insulated, install the insulation blanket, furnished by the expansion joint supplier, in accordance with the manufacturer's instructions. Provide a reusable, removable insulation blanket utilizing T-304 stainless steel wire twist fasteners for the body and silicon fiberglass belting with stainless buckles for the sliding slip, designed to allow access to the packing cylinder plungers for repacking without removal of the blanket. Thermal resistance shall be equal to the insulation covering the adjoining piping.

END OF SECTION

SECTION 23 05 19
METERS, GAUGES AND THERMOMETERS FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Flow meters
2. BTU meters
3. Pressure gauges
4. Static pressure and filter gauges
5. Pressure/temperature test ports
6. Thermometers

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 09 23 – Direct Digital Control System for HVAC

C. Section 23 21 13 – Hydronic Piping

D. Section 23 82 16 – Air Coils

1.03 REFERENCE STANDARDS

A. ASME – American Society of Mechanical Engineers

1. ASME B40.100 Pressure Gauges and Gauge Attachments
2. ASME B40.200 Thermometers, Direct Reading and Remote Reading

1.04 QUALITY ASSURANCE

A. Instruments shall be factory-calibrated for the temperature and pressure of the systems in which they are installed.

B. Instruments to be industrial quality.

C. Pressure gauges shall be manufactured in accordance with ASME Standard B40.100.

D. Thermometers shall be manufactured in accordance with ASME Standard B40.200 and ANSI Specification B40.3.

1.05 SUBMITTALS

A. Submit an overall schedule of instruments to be utilized for the project indicating service and instrument model number.

B. Submit a line-by-line statement of compliance, meeting the intent, non-compliance or not, available for each clause of this specification.

C. Submit list indicating use, operating range, total range and location.

D. Submit manufacturer's data for instrument types, materials, accessories and installation.

1.06 DELIVERY, STORAGE, AND HANDLING

A. All products shall be shipped, stored, and handled per the manufacturer's recommendations.

B. Any products that become damaged may be rejected and shall be replaced by the Contractor at no additional expense to the Owner..

1.07 WARRANTY

A. All products shall be furnished with a two (2) year manufacturer's warranty from final acceptance by Owner.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Thermometers: Weiss, Trerice, Weksler, Taylor, Ashcroft

B. Pressure Gauges: Weiss, Trerice, Weksler, Taylor, Ashcroft

C. Filter Gauges: Dwyer, Trerice, Orange Research

D. Pressure/Temperature Test Ports: Peterson Engineering, Trerice, Weksler

2.02 BTU METER

A. Thermal energy meter shall be provided for measurement of the thermal cooling energy used by the building and its systems.

B. The BTU meter shall have matched RTD or thermistor temperature sensor with differential temperature accuracy of ±0.08 degrees C (0.15 degrees F). Flow meter shall have accuracy within ±1 percent at calibrated typical flow rate for the system and does not exceed ±2 percent of actual reading over an extended 50:1 turndown range. Unit accuracy of ±1 percent factor calibrated, traceable to NIST with certification. NEMA 13 enclosure, panel mounted display, UL listed, isolated 4-20 mA signal for energy rate and supply/return temperatures and flow.

C. Locate meter and display in an accessible location, wall mounted.

D. Unit shall provide BACnet IP communication of the following points:

1. Total energy rate
2. Energy
3. Total flow
4. Flow rate
5. Supply temperature
6. Return temperature

7. Differential temperature

2.03 PRESSURE GAUGES

A. Process type in an impact resistant phenolic case, 4.5-inch diameter glycerine-filled phosphor-bronze bourdon tube rated to 600 pounds per square inch. Stainless steel movement, ½-inch brass socket and 1-percent mid-scale accuracy, black figures on white background. Provide brass needle valve and snubber. Weiss Instrument Model LF4UGY1, or equal. Where fluid temperature exceeds 150 degrees F, provide non-liquid filled gauge Weiss Instrument Model NF4UGY1, or equal.

2.04 FILTER GAUGES

A. Provide filters with direct reading gauges, 4-inch dial type, diaphragm actuated, in a metal case to monitor both primary and secondary filter banks. Dwyer Magnehelic Series 2000, or approved equal. Accuracy to be 2% over full range.

B. Provide direct reading combination gauge/switch, 4-inch dial type, diaphragm actuated, in a metal case with electrical control contacts to provide high pressure alarm at the BMS. Dwyer Photohelic Series 3000MR, or approved equal. Accuracy to be 2% over full range.

C. Lettering shall be black figures on white background. Provide front recalibration adjustment.

D. Provide gauges with the following differential ranges in inches water gauge:

MERV 7 to 10 filters:	0.0 to 1.0
MERV 11 to 12 filters:	0.0 to 2.0
MERV 13 to 16 filters:	0.0 to 2.0
MERV 17 and above filters:	0.0 to 4.0
Activated carbon filters:	0.0 to 2.0

E. Provide one gauge for each filter bank, suitable for flush- or surface-mounting. Include an air filter gauge accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent valves for each gauge.

2.05 PRESSURE/TEMPERATURE TEST PORTS

A. Provide test ports ½-inch NPT made of brass with Nordel core. In addition, supply three (3) kits consisting of ¼-inch NPT pressure gauge, gauge adapter with ⅛-inch probe and protecting shield, bi-metal thermometer range 25 degrees F to 125 degrees F with 5-inch stem and 1.75-inch diameter dial, bi-metal thermometer range 20 degrees F to 240 degrees F with 5-inch stem and 1.75-inch diameter dial. Each kit to be provided in an impact-resistant carrying case.

2.06 THERMOMETERS

A. Adjustable angle dial face, bi-metal thermometer, with 2 degree F scale division, accurate to plus or minus 1 percent of scale range, Type 304 stainless steel case and bezel, shatter-proof glass window, silicone filled.

B. For pipes up to 2-inch diameter, Weiss Model SF3VBM, or equal.

C. For pipes larger than 2-inch diameter, Weiss Model SF5VBM, or equal.

D. Thermometers shall be installed where shown on the Drawings or as specified. Pressure temperature ratings of each thermometer shall be suitable for the system in which it is installed. Thermometers shall have the following insertion lengths:

1. Up to 5-inch pipe: 2.5 inches
2. 6-inch thru 8-inch pipe: 5 inches
3. 10-inch thru 16-inch pipe: 7 inches
4. Larger than 16-inch pipe: 9 inches

E. Provide Type 304 stainless steel wells for all pipe-mounted thermometers.

F. Provide extended wells and stem length to accommodate insulation thickness for insulated pipe applications.

G. Provide thermometers with ranges as per the following:

1. Duct Systems: 0°F - 160 °F
2. Chilled Water Systems:

   a. Glass: 0°F - 120 °F
   b. Dial: 0°F - 150 °F

3. Condenser Water Systems:

   a. Glass: 0°F - 120 °F
   b. Dial: 0°F - 150 °F

4. Hot Water Systems:

   a. Glass: 30°F - 240 °F
   b. Dial: 50°F - 300 °F

5. High Temperature Hot Water Systems:

   a. Glass: 50°F - 550 °F
   b. Dial: 50°F - 550 °F

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flow meters with manufacturers recommended minimum straight lengths of pipe up and down stream of meter

P. Install flowmeter elements in accessible positions in piping systems.

Q. Install permanent indicators on walls or brackets in accessible and readable positions.

R. Install connection fittings in accessible locations for attachment to portable indicators.

S. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

T. Install differential-pressure type flowmeter elements with at least minimum straight lengths of pipe, upstream and downstream and from element according to manufacturer’s written instruction.

U. Install thermometers in the following locations and as shown on drawings:

1. Inlet and outlet of each hydronic zone.

2. Inlet and outlet of each hydronic boiler.
3. Inlet and outlet of water chillers (condenser water and chilled water).
4. Inlet and outlet of each hydronic coil in air-handling units (including each bank of multiple coil units).
5. Each inlets and each outlet of each hydronic (water to water) heat exchanger.
6. Outside, return, supply, and mixed-air ducts.
7. Inlet and outlet of each cooling tower cell.
8. Inlet and outlet of connections to water risers
9. Return fan inlets.
10. Supply fan discharge.
11. Supply fan inlet.
12. Outside air intake.
13. Other locations as indicated on the Drawings

V. Pressure/Temperature Test Ports:

1. Pumps, inlet and outlet
2. All automatic control valves, inlet and outlet
3. Cooling, heating, and re-heat coils, inlet and outlet (including those of terminal units)
4. Other locations as indicated on the Drawings

W. Install pressure gages in the following locations:

1. Steam pressure reducing stations, inlet and outlet
2. Chilled water plant supply and return piping
3. Inlet and outlet of each water pump. If suction head is below 5PSI, provide a compound gage on the suction side of pump.
4. Secondary chilled water supply and return piping.
5. Inlet and outlet of each hydronic air handling unit coils (including each bank of multiple coil units).
6. Inlet and outlet of each converter and heat exchanger.
7. Inlet and outlet of each water chiller (chilled water and condenser water)
8. On the discharge of each condensate pumps.
9. Boilers, inlet and outlet. For multiple steam boilers, common steam header.
10. Inlet and outlet of each side of a filter bank.
11. Inlet and outlet of connections to water risers
12. Expansion tanks
13. Strainers, inlet and outlet
14. Control valves, inlet and outlet
15. Glycol tanks
16. Charging tanks
17. Storage tanks, inlet and outlet
18. Other locations as indicated on the Drawings

X. Filter Gauges:

1. Locations as indicated on the Drawings and in equipment specifications.

Y. Install flow meters in the following installation and as shown on the drawings:

1. Condenser water return from each refrigeration machine
2. Chilled water supply from each refrigeration machine.
3. Discharge header of each heating hot water pumping zone.
4. Discharge header of each reheat hot water pumping zone.
5. Discharge header of each chilled water pumping zone.

Z. For pipes smaller than 2.5 inches, enlarge pipe for installation of thermometer wells.

END OF SECTION

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to the following valve types:

1. Gate Valves
2. Globe Valves
3. Balancing Valve Y-Pattern Type
4. Check Valves
5. Ball Valves
6. Butterfly Valves
7. High Performance Butterfly Valves
8. Grooved End
9. Automatic Flow Control Valves

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 29 – Hangers and Supports for HVAC

C. Section 23 05 53 – Systems Identification for HVAC

D. Section 23 07 00 – HVAC Insulation

E. Section 23 09 23 – Direct Digital Control System for HVAC

F. Section 23 21 13 – Hydronic Piping

G. Section 23 21 16 – Hydronic Piping Specialties

1.03 REFERENCE STANDARDS

A. American Petroleum Institute

1. API 607: Fire Test for Soft-Seated Quarter Turn Valves.
2. API 608: Metal Ball Valves - Flanged and Welding Ends.
3. API 609: Butterfly Valves: Double-Flanged, Lug and Wafer Type.

B. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.5: Pipe Flanges and Fittings.
2. ASME/ANSI B16.34 – Valves – Flanged, Threaded, and Welding End
3. ASME B31.9 – Standards of Pressure Piping – Building Services Piping

C. American Society for Testing and Materials

1. ASTM A216 Grade WCB – Cast Carbon Steel

D. Manufacturer's Standardization Society of the Valve and Fittings Industry

1. MSS SP-6: Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings.
2. MSS- SP-25: Standard Marking System for Valves, Fittings, Flanges and Unions.
3. MSS SP-53: Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components.
4. MSS SP-61: Pressure Testing Steel of Valves.
5. MSS SP-67: Butterfly Valves.
6. MSS SP-68: High-Pressure Offset Seat Butterfly Valves.
7. MSS SP-70: Cast Iron Gate Valves, Flanged and Threaded Ends.
8. MSS SP-71: Cast Iron Swing Check Valves, Flanged and Threaded Ends.
9. MSS SP-72: Ball Valves with Flanged or Butt-Welding Ends for General Service
10. MSS SP-78: Cast Iron Plug Valves, Flanged and Threaded Ends.
11. MSS SP-80: Bronze Gate, Globe, Angle and Check Valves.
12. MSS SP-82: Valve Pressure Testing Methods.
13. MSS SP-85: Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
14. MSS SP-110: Ball Valves - Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.04 QUALITY ASSURANCE

A. Valves and valve construction shall be suitable for the pressure, temperature, and fluid quality of the service in which they are to be used.

B. All valves shall be manufactured in accordance with ANSI, AWWA, ASTM, MSS-SP-70 & 80 (Manufacturers Standardization Society), standards and specifications.

C. ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.

D. ASME B16.10 and ASME B16.34 for dimension and design criteria.

E. Each submittal shall be provided with documentation certifying that all materials, products, components and test reports are in compliance with the design requirements for this project.

F. For each type of valve specified, provide components by the same manufacturer throughout.

G. Minimum test pressure for all valves shall be 1.5 times maximum system working pressure unless noted otherwise.

H. Butterfly valves shall be suitable for dead end service and constructed of industrial design quality.

1.05 SUBMITTALS

A. Product Data:

1. Manufacturer's latest published data for materials, capacity, performance intended service and installation.
2. Submit manufacturer's certification that the valve's pressure and temperature rating meets the systems working pressure and temperature requirements.

B. A single well-organized schedule for all valves indicating Valve type/model number, System type, Location/floor, Pressure rating, Pipe size, Connection method.

C. For each type of valve indicated, include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; pressure differential range, shipping, installed, and operating weights; furnished specialties; and accessories.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Gate Valves:

1. Bronze: Grinnell, Crane, Cincinnati, NIBCO
2. Cast Iron: Crane /Jenkins, Crane/Stockham, Walworth, NIBCO, Grinnell, Milwaukee

B. Check Valves:

1. Bronze: Hammond, Milwaukee, NIBCO
2. Gray-iron swing check: Hammond, Milwaukee, NIBCO, Victaulic
3. Spring-loaded, lift-disc check valves: Metraflex 900 series or equal by Milwaukee, Mueller Steam, NIBCO, Val-Matic, Victaulic

C. Globe Valves: Hammond, Milwaukee, NIBCO

D. Ball Valves: NIBCO, or equal by Apollo, Hammond, Milwaukee, Stockham.

E. High Performance Ball Valves: NIBCO, Apollo, DeZurik

F. Butterfly Valves:

1. Single- or no-flange: NIBCO, or equal by Crane DeZurik, Keystone
2. Grooved-End, Ductile-Iron: Victaulic 300 and 709 series or equal by Grinnell, NIBCO
3. High-pressure: NIBCO, Crane Flowseal, Jamesbury, Tyco, DeZurik

G. High Performance Butterfly Valves: NIBCO, DeZurik, Flow Seal

H. Grooved End Valves: Victaulic, Grinnell, Gustin Bacon, NIBCO

I. Automatic Flow Control Valves: Griswold, Flow Design

J. Y-Pattern Balancing Valves, Multi-Turn: NIBCO, Armstrong Type CBV, B&G Circuit Setter Plus, Taco Accu-Flo, Tour & Andersson STAS/STAD

K. Self contained control valves: Bell & Gossett, Danfoss, Taco

2.02 GENERAL

A. Provide valves of same manufacturer for the same service. Valve pressure and temperature ratings shall be not less than indicated and as required for system pressures and temperatures.

B. Provide valves with manufacturer's name and pressure rating clearly and permanently marked on the outside of body.

C. Provide valves suitable for connection to adjoining piping as specified for pipe joints.

D. Valves shall be full pipe size unless noted otherwise.

E. Provide valves identified for future connection with lockable handles.

F. Valve seats shall be rated to 240 degrees F minimum without deterioration.

2.03 GLOBE VALVES

A. Provide globe valves for throttling in steam and water systems, and as shown on the Drawings or specified for other systems.

B. Two-inch and smaller valves shall be inside rising stem, screwed bonnet with screwed ends.

C. Two and one-half inch and larger valves shall be rising stem, outside screw and yoke, bolted bonnet and flanged ends.

D. Globe valves shall be suitable for repacking under pressure. Packing shall be asbestos free.

E. Steam Service:

1. Up to 300 psig, 2-inch and smaller: Class 300, bronze body, stainless steel plug disc and seat rings, malleable iron hand wheel.

2. Up to 100 psig, 2.5-inch and larger: Class 125, cast iron body, cast iron handwheel, flanged ends.

3. Up to 250 psig, 2.5-inch and larger: Class 250, ASTM 126-B cast iron body, cast iron disc plug, flanged ends.

2.04 BALANCING VALVE Y-PATTERN TYPE

A. Use for throttling in water service ½" to 12".

B. Balancing valve for water service shall be of the calibrated balance valve type with capped pressure/temperature ports, positive shut-off angle globe type, with adjustable memory stop and indicator. Provide valves with provision for connecting a portable differential pressure meter.

C. Valves 2-inch and smaller: Bronze or copper alloy body with brass ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening. Provide memory stop, drain tapping, threaded or soldered ends, with or without integral unions, P/T or Shraeder type pressure taps with integral check valves and seals and adjustable memory stop. Valves shall be suitable for 175 psig water working pressure at 250 degrees F.

D. Valves 2 ½"-inch and larger: Cast iron body with calibrated 304 Stainless Steel ball, globe or venturi/valve arrangement, integral pointer and calibrated scale to register degree of valve opening. Provide memory stop, drain tapping, threaded or soldered ends, with or without integral unions, P/T or Shraeder type pressure taps with integral check valves and seals and adjustable memory stop. Valves shall be suitable for 200 psig water working pressure at 250 degrees F.

E. Provide a pressure differential meter, hoses and carrying case. The kit shall include a six-inch diameter gauge with 270-degree arc readout. Gauge, with accuracy of plus or minus 1percent of full scale, shall be suitable for the differential pressures of the valves supplied for this project, with over-range protection. Include color-coded hoses ten feet minimum in length with brass connectors suitable for connection to the low- and high-pressure connections on the balance valves. Provide instrument valving so meter can be vented and drained. Pressure and temperature rating shall be equal to that of the valves. Provide meter and all accessories in a durable case with carrying handle. The meter is applied directly across the pressure/temperature ports on the calibrated flow control valves. Provide a calibrated conversion calculator to convert pressure drop to flow in gallons per minute. Barton 247A, Midwest 809 or equal.

F. Valves to be omnidirectional without affecting flow measurement and shall provide precise flow measurement, precision flow balancing, positive shut-off with no drip seat.

G. Construct valves so that 4 full turns of handwheel provide maximum setting with hidden memory feature and tamper proof balancing setting.

2.05 CHECK VALVES

A. Swing Type: Provide for steam services

B. Silent Type: Provide on all hydronic systems, including at all pumps. Valves shall have cast iron body with bronze or stainless steel trim, spring loaded, and to be of the center guide type, with flanged end.

C. Swing Type:

1. Up to 300 psig, 2-inch and smaller: Class 300, bronze body, threaded ends, renewable nickel-alloy or bronze seats and discs, PTFE and 45-degree seating angle for steam applications, threaded cap.

2. Up to 300 psig, 2.5-inch and larger: Class 250, ASTM 126-B cast iron body, flanged ends, renewable bronze seats and discs, 45-degree seating angle, bolted cap, non-asbestos gasket.

D. Silent Type:

1. Up to 150 psig, 2-inch and smaller: Class 250 CWP. bronze body, threaded ends, renewable seats.
2. Up to 150 psig, 2.5-inch and larger: Class 125, ASTM A216-B cast iron body, flanged ends, renewable seat and disc.
3. Up to 300 psig, 2-inch and smaller: Class 300, stainless steel body, threaded ends, renewable seats.
4. Up to 300 psig, 2.5-inch to 12-inch: Class 250, ASTM A216-B cast iron body, stainless steel disc and seat, flanged ends.

2.06 BALL VALVES

A. Provide ball valves for isolation and as drain valves, in water systems up to 200 degrees F and pipe sizes up to 2-inch and as shown on the Drawings or specified for other systems.

B. Provide ball valves of the bronze top-entry body type, having a straight-through full port flow passage. Provide extended neck where used on insulated piping.

C. Provide stainless steel ball; full port.

D. Construct seats and gland packing of glass-filled teflon with a threaded packing gland follower; blowout-proof stem rated at 600 psig WOG.

E. Provide stem extensions when valves are installed in insulated pipe with vapor barrier so valve handles clear insulation. Lever handle shall be vinyl covered.

F. Provide lever for quarter-turn operation; lever to indicate open or closed position.

G. When used as drain valves, provide with hose thread and brass cap with chain. Cap shall be rated for full system pressure.

2.07 BUTTERFLY VALVES

A. Provide 250 psi butterfly valves for isolation in water systems up to 250 degrees F and pipe sizes 2.5-inch and larger and as shown on the Drawings or specified for other systems.

B. Butterfly valves shall have ductile or cast iron lug body, Type 316 blow-out proof stainless steel stem with bronze bushings which isolate stem from body and stainless steel disc.

C. The stem journals shall be a multiple seal design providing for completely independent seals. The stem to disc connection shall be a machined drive mated to a machined socket in the disc. Provide threaded top stem bushing to permit removal of handle or actuator while under full operating pressure. Provide extended neck where used on insulated piping.

D. The valve seats shall be molded in resilient elastomer liner..

E. Valves up to size 6-inch shall be supplied with lockable, multi-position handles; size 8-inch and over shall be supplied with enclosed worm gear operator.

F. Valve body shall be full-lug pattern to comply with MSS-SP-67 and be compatible with ANSI pattern flanges of appropriate pressure rating.

G. Valve shall provide tight shut-off up to valve rating and bi-directional dead-end or isolation service without the use of downstream flanges.

2.08 AUTOMATIC FLOW CONTROL VALVES

A. Provide automatic pressure-compensating flow control valves with extended valve body and dual temperature/pressure test ports. Wafer type body is not acceptable.

B. Automatic flow valve shall be manufactured in one piece and to consist of ground joint union, flow control and pressure/temperature test ports.

C. Valves shall be factory set to control the flow rate within 5 percent of the selected rating over an operating pressure differential of at least 10 times the minimum required for full flow conditions.

D. The control mechanism of the valve shall consist of a self-contained, open-chamber cartridge assembly with unobstructed flow passages that eliminate accumulation of particles and debris. All internal working parts shall be Type 300 stainless steel. No plated materials are acceptable.

E. The stainless steel cartridge assembly shall consist of a spring-loaded cup. The cup shall be guided at two points and shall utilize the full available differential pressure across the valve to actuate the cup and thereby reduce friction and hysteresis and eliminate binding. It shall have a thin orifice plate for self-cleaning of the variable inlet ports over the full control range. Cartridge must be removable in one piece.

F. Cast iron valve bodies shall be provided with inlet and outlet ports suitable for connection of instruments for verification of flow rates, and shall be marked to show direction of flow. Valve bodies shall be rated for use at not less than 150 percent of system designed operating pressures.

G. Provide a metal identification tag, with chain, for each installed valve. The tag shall be marked with zone identification, valve model number and rated flow in gallons per minute.

H. Correct flow shall be verified by establishing that the operating pressure differential across the valve taps is within the range indicated on the submittal data sheet for that model number.

I. The pressure measuring apparatus shall be portable and consist of a pressure gauge with a 4.5-inch diameter dial, instructions, hoses, connections and a carrying case. Automatic flow control valves shall be furnished with fittings suitable for use with the measuring instruments specified.

2.09 SELF-CONTAINED CONTROL VALVES

A. Provide pressure-operated non-electric valves with cast bronze or forged brass body.

B. Actuator shall operate using an integral temperature sensor and an adjustment-spring-balanced bellows. A stainless steel spindle riding against an “O”-ring within the packing gland shall provide throttling service.

C. Provide “O”-ring packing gland construction replaceable while the system is in operation with standard tools and without any need for isolation valves.

D. Valves shall be suitable for 125 psig water working pressure at 240 degrees F.

E. Valves shall return to the open position upon failure of temperature control unit.

2.10 VALVE LIST

A. The following is a listing of representative figure numbers by service, indicative of the product quality required.

TABLE C
GLYCOL / WATER SERVICES

Service	Pressure	Floors	Function	Type	Size	Manufacturer	Model No.	Comments
Hot Water	Up to 150 psi	XXX to YYY	Isolation	Ball	½" to 2"	NIBCO	S-585-70-66 T-585-70-66	Solder ends Threaded Ends
Chilled Water	151 psi to 300 psi	XXX to YYY	Balancing	Ball	½" to 2"	Armstrong	CBV	Maximum 300 psi
					2-1/2" to 12"	Armstrong	CBV	Maximum 300 psi
Hot Water	151 psi to 300 psi	XXX to YYY	Isolation	Ball	½" to 2"	NIBCO	S-585-70-66 T-585-70-66	Solder Ends Threaded Ends
Condenser Water	151 psi to 300 psi	XXX to YYY		High Performance Butterfly	2 ½" to 24"	NIBCO	LCS-7822-5	Lug
			Drain Valves	Ball	½ and ¾"	NIBCO	S-585-70-66 HC T-585-70-66 HC	Solder Ends Threaded Ends
			Backflow Prevention	Check Silent	½" to 2"	Mueller	303 HT	Class 300
					2 ½" – 24"	Mueller	107 MAT	Class 250

Commented [FM1]: Table is designed for projects up to 300 psig. For pressures above this, review selections of valves and model numbers that they can accommodate higher pressures.

2.11 VALVE ACTUATORS

A. Provide chainwheel for attachment to valves, of size and mounting height, as specified. Construct of cast or ductile iron, with adjustable sprocket rims and chain guides. Use galvanized or brass chain and chain closure links to form a continuous loop of chain at each operator.

B. Provide gear drive for quarter-turn valves 8-inch and larger.

C. Provide handwheel for valves other than quarter-turn types.

D. Provide lever handle for quarter-turn valves-6-inch and smaller, except plug valves.

E. For plug valves with square heads, furnish Owner with one wrench for every 10 plug valves, for each size square plug head.

PART 3 – EXECUTION

3.01 PRE-INSTALLATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling. Protect internal parts against rust and corrosion. Protect threads, flange faces, grooves, and weld ends.

B. Set angle, gate, and globe valves closed to prevent rattling. Set ball and plug valves open to minimize exposure of functional surfaces. Set butterfly valves closed or slightly open. Block check valves in either closed or open position. Maintain valve end protection.

C. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

D. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

E. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations. Examine threads on valve and mating pipe for form and cleanliness. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage. Do not attempt to repair defective valves; replace with new valves.

F. Properly align piping before installation of valves in an upright position.

3.02 INSTALLATION

A. Install valves so that they are accessible for repacking. Locate valves for easy access and provide separate support where necessary.

B. Install valves with stem vertical and handle up wherever possible, never with stem below horizontal position.

C. Install valves with operating clearance for handle and stem in position to allow full stem movement.

D. Install all check valves at least 5 pipe diameters from any pump or change in direction to avoid excessive turbulence that could damage the valve.

E. Install swing check valves in horizontal position with hinge pin level. Install dual-plate check valves in horizontal or vertical position, between flanges. Install lift check valves with stem upright and plumb. Provide swing check valves where specified, detailed, and at steam condensate lines where they rise at outlet of traps. In such cases, provide isolation valves to allow repair or replacement of check valve.

F. Install isolation valves on equipment so that valve and piping do not interfere with equipment removal or maintenance. Install unions or flanges on equipment side of valves arranged to allow service, maintenance, and equipment removal without system shutdown.

G. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

H. Provide all gate valves 8 inches and larger having a rating of over 150 lbs. with a 1 inch bypass valve of the same pressure rating.

I. Furnish and install other valves, check valves, cocks, etc, as required for the complete and proper valving of the entire installation.

J. Install butterfly valves in horizontal piping with stem in the horizontal position so that the bottom of the disc lifts in direction of flow. Place butterfly valves in vertical piping at pumps with stem perpendicular to pump shaft.

3.03 VALVE ACCESSORIES

A. Provide valves of a design permitting packing while open and under pressure.

B. Provide 1-inch drain valves with threaded ends for hose connections at drain points, at main shut-off valves, low points of piping systems, bases of vertical risers, and at equipment.

C. Steam/condensate bypass:

1. Install pressure equalization/warm up bypass line with a globe valve around main steam shut-off valves (gate and butterfly) 4-inch and larger. Provide bypass gate valve as specified above to meet requirements of operating pressure and temperature of high-pressure steam line. Provide bypasses sizes according to the following:

   a. Up to 8-inch valve: ¾-inch bypass
   b. 10 to 12-inch valve: 1-inch bypass
   c. 14 to 16-inch valve: 1¼-inch bypass

2. Bypass lines shall be made with weldolet taps at the top centerline of the steam main line on each side of the shut-off valve and with the line completely above the elevation of the top of the main steam shut-off valve. Bypass line piping shall be ASTM Type F extra strong (Schedule 80) black steel pipe with ASTM A126/ANSI B16.4 Class 250 extra heavy cast iron threaded fittings. Union in bypass line to be 2,000 pound WOG forged steel ground joint union.

D. Provide required manual or automatic vent valves at high points of piping systems to facilitate venting of air and to ensure quiet operation. Provide piping from air vents to a drain.

E. Provide renewable bronze seat rings and bronze spindles for cast iron body valves.

F. Provide chain operated sheaves and chains for all valves, 2.5-inch and larger, which are more than 8 feet above the floor in mechanical equipment rooms. Extend chains to within 84 inches above finished floor.

G. Provide an isolation valve in the common supply line and an individual balance valve in the return line from each hydronic coil, heat exchanger, and all heat transfer elements.

H. Provide an isolation valve in each supply riser near main and a balancing valve in each return riser near main.

I. Provide pressure/temperature test port fittings at each side of globe valves.

J. Use plastic and plastic-lined valves with wetted surfaces made of same material as or compatible with piping and compatible with system liquid.

END OF SECTION

SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Pipe, duct and un-isolated equipment hangers, anchors and supports.

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 48 – Vibration and Seismic Controls for HVAC

C. Section 23 07 00 – HVAC Insulation

D. Section 23 21 13 – Piping

E. Section 23 31 00 – HVAC Ducts and Casings

1.03 REFERENCE STANDARDS

A. ACI – American Concrete Institute

1. ACI 318 - Building Code Requirements for Structural Concrete
2. ACI 355.2 - Qualifications of Post-Installed Mechanical Anchors in Concrete & Commentary

B. ANSI – American National Standards Institute

1. ASME B31.1 - Power Piping
2. ASME B31.5 - Refrigeration Piping
3. ASME B31.9 - Building Services Piping

C. ASTM – American Society for Testing and Materials

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A47 - Standard Specification for Ferritic Malleable Iron
3. Castings
4. ASTM A48 - Standard Specification for Gray Iron Castings.
5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
6. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
7. ASTM A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
8. ASTM A536 - Standard Specification for Ductile Iron Castings
9. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades

10. ASTM A668- Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
11. ASTM A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
12. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
13. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
14. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
15. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials
16. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers

D. American Welding Society (AWS)

1. AWS D1.1 - Structural Welding Code - Steel

E. ISO – International Organization for Standardization

1. ISO 9001 Quality Management System Requirements

F. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1. SP-58 Pipe Hangers and Supports – Materials, Design and Manufacturer
2. SP-69 Pipe Hangers and Supports – Selection and Application
3. SP-77 - Guidelines for Pipe Support Contractual Relationships
4. SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
5. SP-90 - Guidelines on Terminology for Pipe Hangers and Supports

G. UL – Underwriters Laboratories Inc.

1. UL Building Materials Building Materials Directory
2. UL Component Listing Test Criteria

H. Local Building Codes

1.04 QUALITY ASSURANCE

A. Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Hangers and supports to be constructed and applied according to the following standards:

1. Power Piping: ASME B31.9 – Standards of Pressure Piping – Building Services Piping
2. Manufacturer's Standardization Society MSS SP-58, SP-69, SP-89
3. Duct Hangers: Provide hangers as required per SMACNA Standards for ductwork pressure classification.
4. All hangers shall be U.L. listed and FM approved.

D. Provide supports, guides and anchors that do not transmit unacceptable heat and vibration to building structure.

E. The support systems shall provide for, and control, the free or intended movement of the piping, including its movement in relation to that of connected equipment.

F. Provide for vertical adjustments after installation of supported material and during commissioning, where feasible, to ensure that pipe is at design elevation and slope.

G. Select hangers and supports to perform under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses being introduced into the piping system and connected equipment.

H. Coordinate with other trades to use common means of support. Submit for approval all pertinent design data relating to the support as well as verification of the responsibility for the support.

I. All hangers and supports for equipment and components located outdoors must be connected to the building structure. Mountings shall be designed to resist wind loading.

J. All bracket, clamp and rod sizes indicated in this specification are minimum sizes only. All structural hanging materials shall have a built-in safety factor of 5.

K. Provide rolled-steel auxiliary pipe supports as required.

L. Anchor points shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions from the anchored points.

M. Guide points shall be located and constructed wherever required or shown on drawings and at each side of an expansion joint or loop, to permit free axial movement only in a piping system.

N. Deliver products in original, unopened packaging with legible manufacturer's identification.

O. Submit written guarantee agreeing to repair or replace joint sealers which fail in joint adhesion, extrusion resistance, migration resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated. The guarantee period shall be one year from date of substantial completion.

1.05 SUBMITTALS

A. Provide shop drawings indicating system layout with location showing dimensions, sizes, pipe hanger and support locations and detail of trapeze hangers.

B. Method of attachment to and load imposed on building structures by hangers, anchors, supports, guides and supplemental steel shall be submitted for review and approved by the project Architect and Structural Engineer.

C. Submit details of hangers, anchors and supports for each pipe size and service, ductwork and individual pieces of equipment.

D. Indicate load-carrying capacity of trapeze, multiple-pipe, and riser support hangers. Indicate calculations used to determine load-carrying capacity of trapeze, multiple-pipe, and riser support hangers. Submit sizing methods and calculations sealed by a Professional Engineer licensed in the project jurisdiction.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pipe Hangers and Supports: Anvil International, Empire Industries, Hilti, Pipe Shields, Cooper B-Line/Eaton, Kindorf. Anvil figure numbers are listed below; equivalent material by specified manufacturers is acceptable.

B. Pipe Wrap Tape: Polycen, Nassua, 3M

2.02 GENERAL

A. Finishes

1. Hangers and clamps for uninsulated copper pipes shall be copper-coated and an additional PVC coating.
2. Hangers, anchors, supports and guides (swivel ring, split ring, roller, wrought pipe clamp, or adjustable wrought clevis-type hangers, roller supports, floor stands, wall brackets, etc.) installed within the building in dry areas shall be electro-galvanized.
3. Strut channels installed indoors shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90.
4. Hangers, anchors, supports, guides and struts located outdoors or in non-dry areas shall be hot-dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot-dip galvanized or stainless steel. Zinc-plated hardware is not acceptable for outdoor or corrosive use.

B. Pipe Hangers

1. Carbon-Steel Pipe Hangers and Supports:

   a. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
   b. Galvanized Metallic Coatings: Electro-galvanized (indoor, dry only), Pre-galvanized or hot dipped.
   c. Nonmetallic Coatings: Plastic coating, jacket, or liner.
   d. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
   e. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2. Copper Pipe Hangers:

   a. Description: MSS SP-58, Types 1 through 58, copper-coated-steel and an additional PVC coating, factory-fabricated components.
   b. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel stainless steel.

3. The below table establishes the minimum level of acceptance for pipe hangers. All piping subject to axial movement to be provided with pipe roll (adjustable steel yoke or pipe roll with sockets)

Service	Hanger Types	Notes
Uninsulated Piping 2" and smaller	Adjustable Clevis	
Uninsulated Piping 2 ½" and larger	Adjustable Clevis Adjustable Steel Yoke Pipe Roll Pipe Roll with Sockets	
Insulated Piping 2" and smaller	Adjustable Clevis Hanger	Provide with sheet metal insulation shield
Insulated Piping 2 ½" and larger	Adjustable Steel Yoke Pipe Roll Pipe Roll with Sockets	Provide with pipe-covering protection saddle spot-welded to the pipe

C. Trapeze Hangers

1. Trapeze hangers shall be constructed of roll-formed similar to Anvil Fig. 46.
2. Uninsulated Pipe: Pipe straps with thermoplastic elastomeric liner sized for the outside diameter of the pipe.

3. Insulated Pipe: Pipe straps sized for the outside diameter of the pipe and insulation using insulation shields.
4. Pipe subject to axial movement due to expansion shall utilize strut-mounted roller supports and/or adjustable roller stands.

D. Wall support shall be welded steel bracket with hanger. All piping subject to axial movement to be provided with pipe roller supports.

Service	Hanger Types	Notes
Uninsulated Piping	Welded Steel Bracket (light/medium/heavy duty as required)	Provide with pipe straps with thermoplastic elastomeric liner sized for the outside diameter of the pipe
Insulated Piping	Welded Steel Bracket (light/medium/heavy duty as required)	Provide with pipe straps and sheet metal insulation shield

E. Floor Supports

1. The below table establishes the minimum level of acceptance for floor supports. All piping subject to axial movement to be provided with strut-mounted pipe roller supports and adjustable roller stands.

Service	Hanger Types	Notes
Piping 4” and under	Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support	For uninsulated piping, provide with pipe straps with thermoplastic elastomeric liner sized for the outside diameter of the pipe For insulated piping, provide with sheetmetal insulation shield
Piping 5” and over	Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support	For uninsulated piping, provide with thermoplastic elastomeric liner sized for the outside

		diameter of the pipe For insulated piping, provide with sheetmetal insulation shield
Base Elbows	Pipe stanchions for support of pipe elbows at base of riser and vertical piping.	Stanchions shall be complete with base plate and vent hole.

2. Pre-insulated shields shall be 180 degree, galvanized sheet metal shield with high-density water-repellant phenolic foam, high-density glass fiber insulation, foam glass or high-density polyisocyanurate inserts, having sufficient compressive strength to support the weight of the piping, with minimum specified insulation thickness to match the outside diameter of the insulated pipe.
3. Insulated shields shall be provided of appropriate length and gauge for the application.

F. Metal Framing Channels:

1. Provide perforated electro-galvanized finish, 12-gauge minimum steel channels securely anchored to wall structure with interlocking, split type, bolt-secured, galvanized pipe/tubing clamps. B-Line type B22, S pattern with B-2000 series clamps, Power-Strut Type PS200 H with PS1200 clamps or equal.
2. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion, or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Power-Strut PS004T – PS106N Series or equal.

G. Support stationary vertical piping with carbon steel double bolt riser clamps attached to the pipe. Weld shear lugs to the pipe. In general, use one clamp for each two floors and one clamp at each floor for copper tubing. Where pipes are in open shafts, provide forged steel bar brackets fixed to wall. Riser clamps shall be copper plated when used with copper pipe. Locate riser clamp immediately under coupling or other fitting. Anvil Figure 261, MSS-SP-69, Type 8 for steel pipe; Anvil Figure CT121, MSS-SP-69, Type 8 for copper pipe.

H. Floor Support for Pipe:

1. Sizes up to 4 inches: Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support. Anvil Figure 264, MSS-SP-69, Type 38.
2. Sizes 5 inches and over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support. Anvil Figure 265, MSS-SP-69, Type 38.

3. Provide pipe stanchions for support of pipe elbows at base of riser and vertical piping. Stanchions shall be complete with base plate and vent hole. Anvil Figures 62 and 63.

I. Select hangers and supports in accordance with the manufacturer's recommended maximum loading. Hangers shall have a safety factor of 5 to 1.

J. Hangers shall not be disengaged by movement of supported pipe.

K. Provide copper-plated or felt-lined hangers for copper piping or provide 10-mil pipe wrap tape on pipe at hangers. Tape shall extend a minimum of 2 inches beyond hanger saddle on both ends and be wrapped around pipe a minimum of 2 turns. Install vinyl-coated hangers for all plastic piping.

L. Steel hanger rods shall be threaded both ends, threaded one end, or continuous threaded, black finish. Provide rods complete with adjusting and lock nuts. Anvil Figures 146, 140 or 253.

M. Pipe Support Recommendations for Rigid Grooved Joint Systems: The maximum hanger spacing in the specification to ANSI/ASME B31.1 as noted and should be used only in conjunction with Victaulic 07 zero-flex rigid couplings. For flexible systems the hanger, support, spacing and location refer to the pipe support recommendations section in the Victaulic "Field Assembly and Installation Pocket Handbook" or equivalent provided by Grooved Joint Manufacturer.

N. Concrete inserts shall be MSS-SP-69 Type 18 wedge type or universal concrete inserts.

1. Wedge type shall be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to ⅞-inch diameter. Wedge design shall allow the insert to be held by concrete in compression to maximize the load carrying capacity. Anvil Figure 281.
2. Universal type shall be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to ⅞-inch diameter. Anvil Figure 282.
3. Use drilled steel shell with plug type inserts when the inserts are placed after the concrete is poured.

O. Drainage Piping: Provide MSS-SP-69 Type 8 or MSS-SP-69 Type 42 riser clamps for vertical piping, and MSS-SP-69 Type 52, spring hangers at the base of vertical piping.

PART 3 – EXECUTION

3.01 HANGERS AND SUPPORTS

A. Deflection of pipes shall not exceed $^{1}/_{240}$th (0.416 percent) of span.

1. Support horizontal steel/copper piping in accordance with the following schedule:

Pipe Size (inches)	Maximum Hanger Spacing (feet)		Hanger Rod Diameter (inches)	
	Steel	Copper	Steel	Copper
up to 1	7	5	⅜	⅜
1.25	9	7	⅜	⅜
1.5 & 2	9	8	⅜	⅜
2.5	12	9	0.5	0.5
3	12	10	0.5	0.5
3½	–	11	⅝	0.5
4	12	12	⅝	0.5
5	12	13	⅝	0.5
6	12	14	0.75	⅝
8 to 12	12	14	⅞	0.75
14 & 16	12	–	1	–
18 & 20	12	–	1.25	–
24	12	–	1.5	–

B. Provide hangers at each change in direction and both sides of valves 4-inch and larger. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item. Provide hanger on both sides of “no-hub” mechanical joints.

C. Support hangers from concrete inserts or beam clamps. Furnish, locate and set inserts. Construct inserts of malleable iron or pressed steel with space for rods of all sizes. Install inserts for pipes 3 inches and larger in size with a reinforcing rod ⅝-inch in diameter run through a slot in the insert specifically provided for this purpose.

D. If piping is required in a space where no inserts have been provided, drill holes in the slab (subject to Structural Engineer’s prior approval) and provide rods and hanger attached to an approved fishplate or install double expansion shields connected by a 2-inch by 2-inch angle, from which the hanger rod is to be suspended. For pipe size 2 inches and under use single shields but the hanger spacing shall be reduced to 5 feet. The carrying capacity and size of each shield shall be calculated on the basis of the spacing indicated above but the minimum size shall be ⅜-inch. Install additional shields of the same size so that the number of hangers is of adequate size to support the loads, which they carry. Shields may be used in concrete slabs only. Obtain from the expansion shield manufacturer an ICBO Evaluation Report for the product and submit to the Architect.

E. Regardless of the type of construction (i.e., concrete, concrete-deck-steel or other variations) take particular care to support main lines and large and heavy pipes in an approved manner, including the provision of supplementary steel, if required. Supplementary steel shall be mill-rolled sections. Submit shop drawings, indicating support methods, point loadings to the building structure and hanger locations for review sufficiently in advance of concrete pouring schedules to permit evaluation, critique and any necessary changes to handling and support methods.

F. Hangers shall be directly bolted to steel beams of building construction, where they occur if approved by the Structural Engineer. Smaller pipes shall be

suspended from crosspieces of pipe or steel angles, which in turn, are securely fastened to building beams or hung from building concrete construction by means of rods and inserts. The intention is to provide supports which shall be amply strong and rigid for the load, but which will not weaken or unduly stress the building construction.

G. All attachments to existing steel shall be reviewed with the structural engineer prior to execution. If required, provide supplementary structural steel connected to structural beams. This contractor shall be responsible for all required supplementary steel.

H. Attachments to existing structure must follow the building standards,

1. Attachments with loads up to 500 pounds shall be accomplished by drilled-in expansion shield type anchors located on the centerline of the concrete-filled ribs.
2. No attachments shall be permitted to new or existing electrified decks. If hanger attachments are not existing, all new attachments shall be supported from supplementary steel.
3. 500-pound load attachments shall be spaced not less than 60 inches apart, and shall be located as close to steel beams as possible.

I. Provide approved roller support, floor stands, wall brackets, etc., for lines running near the floor or near walls, which can be properly supported or suspended by the floors or walls. Pipelines near walls may also be hung by hangers carried from approved wall brackets at a higher level than the pipe.

J. Do not hang piping or ductwork from supports for other services. Installed supports shall accommodate free expansion of the piping and duct system.

K. Wherever hangers using pipe rolls are used, provide approved steel pipe covering protection saddles, spot-welded to the piping at each hanger location.

L. Anchor piping where shown to localize expansion or to prevent undue strain on piping and branches. Anchors shall be entirely separate from hangers and of heavy forged or welded construction of approved design. All anchor designs, when submitted for approval, shall include piping reactions which respective anchors are capable of supporting. Provide indicated expansion loop.

M. Install anchors where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

N. Support copper tubing individually by approved hangers not more than 6feet apart. Hangers for uncovered lines shall be specially designed for copper tubing and of exact outside diameter of tubing. Hangers for covered tubing shall be broad straps fitting outside of covering.

O. Hangers for insulated piping shall support the pipe without piercing the insulation. Refer to Section 23 07 00 – HVAC Insulation for insulation protection shields and pipe inserts.

P. For piping 4 inches and larger, support the elbows of the piping adjacent to pumps with steel supports from the concrete housekeeping pad, or from the inertia base where pump is mounted to prevent loading heavy weights of piping on pump flanges or casing. Where inertia base or spring vibration isolation is not provided, base elbows shall be supported on concrete pad with 1-inch neoprene pad.

Q. Use hangers, which are vertically adjustable 1.5-inch minimum after piping is erected. Install hangers so that ½-inch minimum clearance is maintained between finished covering of pipe and adjacent work.

R. Support riser piping independently of connected horizontal piping.

S. Adjust hangers to obtain pipe slope where specified.

T. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior review.

U. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

V. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123/A123M, 1.5-ounces/square foot of surface, each side. Mechanical galvanize threaded products, ASTM B695 Class 150, 2.0 mil coating. Field cuts and damaged finishes shall be field-covered with zinc-rich paint of comparable thickness to factory coating. Corrosive atmospheres include the following locations:

1. Exterior locations, parking ramps, carwash areas
2. Swimming pool equipment, chemical storage or hazardous waste storage rooms
3. Wet wells, meter pits
4. Sanitary and storm sewer pumping stations
5. Food service/kitchen areas, walk-in coolers/freezers
6. Locker/shower rooms
7. Greenhouses

END OF SECTION

SECTION 23 05 50
ACCESS DOORS IN GENERAL CONSTRUCTION FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Furnishing access doors for installation in general construction and color-coded identification dots.

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 53 – Identification for HVAC

1.03 REFERENCE STANDARDS

A. ASME – American Society of Mechanical Engineers

1. ASME A13.1 Scheme for the Identification of Piping Systems

B. ASTM – American Society for Testing and Materials

1. ASTM A167: Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
2. ASTM A1008: Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy

C. NAAMM – National Association of Architectural Metal Manufacturers

1. AMP 500-06 – Metal Finishes Manual for Architectural and Metal Products

D. UL – Underwriters Laboratories Inc.

1. UL Fire Resistance Fire Resistance Directory set

1.04 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain doors for the entire project from a single manufacturer.

B. Fire-Resistive Rating: Wherever access doors are required in construction where a fire-resistive classification is indicated, on the Architectural documents, provide access door assembly with panel door, frame, hinge and latch from manufacturer listed in Underwriters Laboratories Inc.'s "Building Materials Directory" for required rating.

1. Provide UL Label on each fire-rated access door.

C. Furnish inserts and anchoring devices that must be built into other work for installation of access doors.

1.05 SUBMITTALS

A. Shop Drawings: Submit access door locations superimposed on piping layout and duct layout shop drawings.

B. Submit manufacturer's data on access doors including size and type.

C. Submit a schedule of access doors and frames indicating size, type, location and access item or purpose.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Non-Secure Locations in Ceilings: Flush door in drywall (FR6 Type – Fiberglass reinforced gypsum):

1. KARP – Type GFRG
2. Williams Brothers – Type GY 3000/GY 3100
3. Elmdor – Type GFG

B. Drywall vertical surfaces and Secure Locations in Ceilings: Recessed Types as follows:

1. Milcor – Type AP
2. Karp – Type RDWPD

C. Recessed door in finished plaster or ceramic tile:

1. Milcor – Type AP
2. Karp – Type KATR
3. Williams Brothers – Type WB-AP
4. Elmdor – Type AP

D. In fire rated construction:

1. Milcor – Type UFR
2. Karp – Type KRP-350 FR
3. Williams Brothers – Type WB-ATR
4. Elmdor – Type FR

E. Color-Coded Identification Buttons: Brady/Seton, Stranco

2.02 ACCESS DOOR CONSTRUCTION

A. Provide concealed type as required to accept matching ceiling tile or drywall, etc.

B. Provide UL-rated doors for fire-rated construction.

C. For steel framed models listed above, provide flush type steel framed panel with concealed continuous piano hinges for masonry or concrete construction.

D. A key lock is required for access doors in public areas. Provide cylinder lock type access doors located in public corridors and washrooms complete with master keys.

E. Provide cam type locking device.

F. Provide insulated doors in insulated or acoustically rated construction.

G. Furnish access doors of proper size for access to concealed equipment. Unless otherwise indicated, minimum size to be 12-inch by 12-inch for hand access and minimum 18-inch by 18-inch for valve and actuator access and 24-inch by 24-inch for equipment access.

H. The following additional schedule is based on Karp Associates Inc.:

1. Non-Rated Masonry, Concrete: Model DSC 214-M
2. Non-Rated Ceramic Tile, Stainless Steel, Satin Finish: Model DSC 214-M
3. Non-Rated Plaster Wall: Model DSC 214-PL
4. Non-Rated Plaster Ceilings: Model DSC 210-PL

I. Provide color-coded dots on access doors and accessible ceiling tiles to indicate type of service.

PART 3 – EXECUTION

3.01 GENERAL

A. Coordinate location of access doors in hung ceilings, furred spaces, walls, etc., to provide access to concealed work items requiring maintenance and/or adjustment. Obtain approval of the Architect for the locations of such access doors.

B. Locate and group equipment requiring access doors. Coordinate location of equipment with other trades to minimize number of access doors in one area.

C. Provide access doors for maintenance or adjustment purposes for mechanical system components, including but not limited to the following:

1. Valves
2. Dampers
3. Concealed equipment
4. Controls, sensors, devices

D. Access doors shall be marked by small color markings at corner of tile or door in accordance with the following color assignments:

END OF SECTION

SECTION 23 05 53
SYSTEMS IDENTIFICATION FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Valves, automatic control valves, dampers (including smoke and combination fire/smoke dampers) and automatic control dampers identification
2. Equipment identification
3. Piping and ductwork identification
4. Signage

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 50 – Access Doors in General Construction for HVAC

C. Section 23 09 23 – Direct Digital Control System for HVAC

1.03 REFERENCE STANDARDS

A. ASME – American Society of Mechanical Engineers

1. ASME A13.1 Scheme for the Identification of Piping Systems

B. ASTM – American Society for Testing and Materials

1. ASTM D709 Standard Specification for Laminated Thermosetting Materials
2. ASTM D 882: Standard Test Method for Tensile Properties of Thin Plastic Sheeting

C. ANSI - American National Standards Institute

1. ANSI Z535: Safety Color Code - Environmental Facility Safety Signs Criteria for Safety Symbols - Product Safety Sign & Labels - Accident Prevention Tags.

D. APWA – American Public Works Association

1. Recommended Guidelines for Underground Utilities

1.04 QUALITY ASSURANCE

A. Above ground piping identification shall comply with ASME Standard A13.1.

B. Underground piping identification shall comply with APWA Recommended Guidelines for Underground Utilities.

C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

D. Coordinate installation of identifying devices with locations of access panels and doors.

E. All devices to be identified before installation of ceiling or other concealments.

1.05 SUBMITTALS

A. Submit the following:

1. Product Data for each product required including manufacturer's installation instructions, indicating special procedures and installation requirements.
2. Provide a sample list of the proposed valve tag numbering system.
3. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
4. Submit a list of wording, symbols, letter sizes and color coding for equipment identification and pipe labeling.
5. Samples: For color, letter style, and graphic representation required for each identification material and device.
6. Automatic control valve identification chart (obtain from the Building Management or Automation System contractor for inclusion with this submittal)
7. Damper identification chart (including smoke and combination fire/smoke dampers)
8. Lists of pipe and equipment to be labeled
9. Color chart

B. Maintenance Manuals: Provide valve and damper tag schedules for inclusion in maintenance manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Seton

B. Brady

C. Brimar

2.02 VALVE AND DAMPER IDENTIFICATION

A. All tagged components shall be in accordance with ASME A13.1.

B. For valves, smoke and combination fire/smoke dampers and automatic control dampers, use metal tags 2-inch minimum diameter, fabricated of 19-gauge polished brass, stainless steel or aluminum.

1. Attach tags with jack chain “S”-hook or split ring of same materials.

2. Provide engraved/stamped tags with black ink-filled ¼-inch high letters for system abbreviation and ½-inch high numbers. Refer to the following for system identification:

   a. Chilled Water: CHW
   b. Condenser Water: CW
   c. Refrigerant: R
   d. Hot Water: HW
   e. Gas: G
   f. Low Pressure Steam (Supply) and Low Pressure Return: LPS and LPR
   g. Medium-Pressure Steam: MPS
   h. High Pressure Steam:HPS
   i. Fuel Oil: FO

3. Provide minimum $^{5}/_{32}$-inch hole for fastener.

2.03 PIPE IDENTIFICATION

A. Pipe markers shall have a minimum 1.25-inch high letters and integral directional flow arrows. Smaller letters may be used only when space does not permit 1.25-inch high lettering. For piping diameters 8”-10”, lettering shall be 2.5” high and all piping larger than 10” shall include lettering that is 3.5” high.

B. For piping up to 5-inch diameter, use pre-formed snap-on markers.

C. For piping 6-inch diameter and up, use pre-formed strap-on markers with nylon straps.

D. Material: Semi-rigid colored vinyl; 15 gauge up to 1-inch pipe, 30 gauge for all other pipe sizes.

E. Seton “Setmark” or equal.

F. Pressure-sensitive tapes are unacceptable.

G. Exterior Underground Pipe Markers:

1. Material shall be detectable tape, nominal 5-mil thick, minimum 3 inches wide with aluminum backing.

2. Tape color, size and depth to be in accordance with APWA standards with black lettering and appropriate warning message.

H. Refrigerant Piping Requirements

1. All refrigerant piping to be provided with proper identification in accordance with ANSI/ASME A13.1. The piping identification shall be located at intervals not exceeding 20 feet on the refrigerant piping or pipe insulation. The minimum height of lettering shall be 0.50 inches. The identification shall indicate the refrigerant designation and safety group classification. For A2L refrigerant, the identification shall also include “WARNINIG – RISK OF FIRE. FLAMMABLE REFRIGERANT”

2.04 DUCT IDENTIFICATION

A. Identify duct systems by means of labels permanently attached to the duct with the following characteristics:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8" thick.
2. Maximum Temperature: Withstand temperatures up to 160°F or higher. Temperature limits shall be suitable for the temperature of the duct it is affixed to.
3. Minimum Label Size: Length and width vary for required label content, but not less than 3 by 2 1/4 inch.
4. Minimum Letter Size: 1.5"
5. Adhesive:Contact-type permanent adhesive, compatible with label and with substrate.
6. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Contract Drawings; also include duct size and an arrow indicating direction of flow.

2.05 EQUIPMENT IDENTIFICATION

A. Mechanical equipment shall be identified by means of nameplates permanently screw-fastened to the equipment. Nameplates shall be black surface, white core laminated bakelite with engraved letters. Plates shall be a minimum of 3-inch long by 1-inch wide with white letters ⅜-inch high.

B. Identification of Automatic Controls: Refer to Section 23 09 23 – Direct Digital Control System for HVAC for identification requirements.

C. Terminal equipment installed in ceiling spaces such as variable volume terminals, fan coil units, heat pumps, etc., shall have identifying number stenciled on bottom of unit so that it is visible from below.

2.06 SIGNAGE

A. Provide engraving stock melamine plastic laminate, complying with ASTM D709, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

1. Thickness: 1/16-inch for signs up to 20 square inches or 8-inch length; ⅛-inch for larger signs.

2. Fasteners: Self-tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate substrate.

PART 3 – EXECUTION

3.01 VALVE AND AUTOMATIC DAMPER IDENTIFICATION

A. Do not identify valves where the use is obvious, such as equipment isolation valves.

B. Provide schedules of all valves showing identification number, size, type and service of each valve. Provide separate list for each separate type of system. Incorporate in maintenance manuals.

C. Tag automatic dampers including smoke and combination fire/smoke dampers with identical letters or numbers as shown on the Drawings.

3.02 EQUIPMENT IDENTIFICATION

A. Identify equipment with identical letter and/or number as used on the Drawings. Where space is available, use full name of equipment. Attach nameplates in a permanent manner in a location that will be clearly visible after installation is complete.

B. Controls identification shall be specified in Section 23 09 23 – Building Management or Automation System for HVAC. Also identify controls not included in Section 23 09 23 such as float switches, alarms, remote push-button switches with ¼-inch high lettering and laminated plastic plates screwed or chained to equipment.

3.03 PIPING IDENTIFICATION

A. Piping identification shall be in conformance with the ASME A13.1.

B. Identify piping systems with color-coded bands, sharply contrasting with background. Locate bands near strategic points, such as valves, items of equipment, changes in direction, wall penetrations, capped stub-out for future connection and every 40 feet of straight runs. If necessary, paint a strip background of black or white to obtain contrast.

C. Apply bands where they can be easily read. Provide bands with backgrounds of different colors.

D. Drain piping serving mechanical equipment items for which the drain discharge is not visible from the equipment shall be marked near the point of discharge indicating the item of equipment served.

3.04 ACCESS IDENTIFICATION

A. Identify service, damper, duct access door, piping and equipment behind all architectural access doors.

B. Removable ceiling tile shall be marked by small color markings at corner of tile or door in accordance with the following color assignments:

HVAC Cooling	–	Green
HVAC Heating	–	Yellow
HVAC Heating/Cooling	–	Yellow/Green
HVAC (other)	–	Blue

3.05 INSTALLATION OF IDENTIFICATION

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces,

install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.06 UNDERGROUND PIPING IDENTIFICATION

A. During backfilling/topsoil of each exterior underground piping system, install continuous detectable underground type plastic line marker, located directly over, buried in accordance with APWA standards.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Pressure testing of new piping and new duct systems.
2. Adjust and balance hydronic systems.
3. Adjust and balance air systems.
4. Verification of required air and water quantities from existing systems, if applicable.
5. Temporary pipe and duct connections, pipe caps, duct caps, tees, valves, dampers, etc. TAB contractor to coordinate with mechanical contractor.
6. Perform acoustic measurements to systems.
7. Perform airflow measurements for smoke control system zones and stair and vestibule pressurization tests.
8. Operation of mechanical systems as required for testing by other trades.

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 23 – General-Duty Valves for HVAC Piping

C. Section 23 09 23 – Direct Digital Control System for HVAC

D. Section 23 21 13 – Piping

E. Section 23 21 23 – Hydronic Pumps

F. Section 23 23 00 – Refrigerant Piping

G. Section 23 33 13 – Dampers

H. Section 23 34 00 – HVAC Fans

I. Section 23 36 00 – Air Terminal Units

J. Section 23 37 00 – Air Outlets and Inlets

1.03 REFERENCE STANDARDS

A. All work shall be in accordance with the Associated Air Balance Council Standards.

1.04 QUALITY ASSURANCE

A. TAB Contractor Qualifications:

1. Each Balancing Contractor providing a bid for this work shall submit the following information with the bid, or the bid shall not be accepted by the Owner:

1. List previous projects of similar scope with dates that projects were executed.

2. Outline organization of Contractor, including names of principals, years of operation, address, and phone number.

3. List instruments owned by Contractor and procedures that will be used on this project.

4. List name of job site supervisor that will execute this work and a résumé of individual's specific work experience.

5. Provide a sample of a balance report on a project of similar scope.

6. The Contractor must be AABC, NEBB or TABB certified.

7. The TAB field supervisor and technician must be employees of the TAB contractor and certified by AABC, NEBB or TABB.

B. Testing

1. SMACNA – 2023 Testing, Adjusting, and Balancing

2. ANSI/ASME B31.9-2020; Chapter VI Part 937

3. ANSI/ASME B31.1 – 2022: Power Piping Code

4. Test required by the Authority Having Jurisdiction

C. Balancing

1. AABC (7th Edition) National Standards For Total System Balance

2. NEBB 2015 Edition of the Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems.

3. SMACNA – 2023 Testing, Adjusting and Balancing

D. The final balancing, testing, and adjustments of the complete mechanical systems shall be the direct responsibility of the Balancing Contractor, including all costs for doing this work and provision of the personnel, materials, tools, and instrumentation to accomplish this work. Meet standards contained in the AABC National Standard Chapter 17 through 26 and other criteria as set forth in these specifications.

1.05 SUBMITTALS

A. Six months prior to the start of the Test and Balance field activities, submit certification of most recent calibration of all instruments to be used on this project.

B. Submit project-specific agenda (outline).

C. Submit sample forms.

D. Submit balancing report

E. Submit duct and pipe pressure test logs.

1.06 PROCEDURES

A. General: Prior to commencement of balancing, review proposed schedule, methods and instruments to be used in balancing with the Engineer. Include descriptive data, procedure data and sample forms.

B. Descriptive Data: Review Contract Documents, shop drawings released for construction, design concepts and general function of each system including associated equipment and operation cycles. Confirm listing of flow and terminal measurements to be performed; selection points for proposed sound measurements.

C. Procedure Data: Outline procedures for taking test measurements to establish compliance with requirements. Specify type of instruments to be used, method of instrument application (by sketch) and correction factors. Verify access to valves, dampers and equipment for test and balancing.

D. Sample Forms: Submit forms showing application of procedures to typical systems. Forms shall be of AABC format.

E. AABC test sheets required are as follows:

1. Air Moving Equipment Test Sheet
2. Exhaust Fan Test Sheet (Supply, Return, Relief Fans)
3. Air Inlet and Outlet Test Sheet
4. Water Balance Element Test Sheet
5. Circulating Water Pump Data Sheet
6. Duct Traverse Zone Totals Sheet
7. Duct Traverse Readings Sheet

1.07 CONTRACTOR COOPERATION

A. The Balancing Contractor shall check and report defects or deficiencies that may affect balancing.

1. Mechanical Contractor shall cooperate with the Balancing Contractor to:

a. Provide sufficient time before final completion date and individual equipment manufacturer's start-up so that balancing can be accomplished.

b. Provide immediate materials, labor and tools to make corrections without delay.

c. Place heating, ventilating and air-conditioning systems and equipment into full operation and continue the operation for each working day of testing and balancing.

d. Provide a complete set of approved mechanical and electrical shop drawings and equipment and product submittals to the balancing contractor.

e. Advise Testing and Balancing Contractor of changes made to the system during construction.

f. Install required test holes or wells complete with removable and replaceable plugs or caps.

g. Make necessary revisions to controls, valves, dampers, fan and pump drives and consult with equipment manufacturers as required to achieve the specified system's performance.

h. Supply and install dampers as specified and shown on the Drawings, and where required to obtain final system balance.

i. Provide lifts, ladders, scaffolds, tools and labor to assist the work of the Balancing Contractor, including removing ceiling tiles, guards, adjusting pulleys, belts; replace when finished.

j. Building Management System Contractor shall cooperate with and work with the Balancing Contractor when setting damper linkages, minimum outside air dampers, and other air volume devices, and shall be available for readjusting of dampers, devices or controls that are not properly calibrated.

k. Set pressure-regulating and pressure reducing valves to operating and code conditions.

l. Check and set relief and safety valves to code requirements.

m. Clean strainers. Check air filters immediately prior to air balancing.

n. Open fire dampers. Provide certification of damper operation as required by Section 23 33 13 – Dampers.

o. Verify return air openings have been provided in full height walls as specified, shown on the Drawings or as required for proper balancing and system operation.

p. Variable pitch sheaves supplied on 20-horsepower motors and larger shall be changed to fixed sheaves after the air balance is completed. Provide such sheaves.

PART 2 – PRODUCTS

2.01 INSTRUMENTS

A. Instruments for testing and balancing of air and hydronic systems shall have been calibrated within a period of 6 months and verified for accuracy prior to start of work.

B. Submit a list of equipment, which will be used for the balancing of systems and test and calibration certification by an independent instrument calibration laboratory indicating date of test, and test results showing accuracy and repeatability are within limitations acceptable to the AABC.

C. Provide ½-inch pressure and temperature test plugs on the entering and leaving piping at all equipment and as indicated on the plans in order to complete the required system balancing. Coordinate with the mechanical contractor during the installation phase.

PART 3 – EXECUTION

3.01 SITE VISITS

A. A review of the installation shall be made prior to commencing balancing work and any additional dampers or valves required for proper balance shall be reviewed with the Architect and the Contractor.

B. The Test and Balance Contractor shall visit the job site a minimum of 3 times during the ductwork, equipment and piping installations prior to the start of balancing procedures to verify that the duct systems have been properly installed complete with all grilles, dampers, ducts, coil, etc. and that the return air path are completely open an unobstructed. The air balancing contractor shall also verify that adequate access to equipment and balancing devices. Site Visit Reports shall be submitted to the Architect listing any deficiencies found. Identify in the Report any additional balancing valves or dampers required. acceptance

C. Mechanical systems shall not be considered ready for final inspection until balancing results acceptable to the Engineer are obtained.

D. If it is found that the specified airflows cannot be achieved on portions of the system, the actual conditions shall be reported to the Engineer for consideration of corrective action before continuing the balance procedure.

E. If measured flow at final inspection shows deviation of 5 percent or more or mean sound-level deviation of 10 decibels or more from the certified report listings for more than 10 percent of selected areas, the Report shall be rejected.

F. If report is rejected, systems shall be rebalanced and a new certified report submitted.

3.02 TESTING

A. General

1. Perform all tests required by Codes, Ordinances, and as specified herein, as well as demonstrations of operation for all equipment. Each final test to be witnessed by the Owner or Owner's designated representative. Provide a minimum of seven (7) days written notice before performing tests.

2. Install all temporary and permanent equipment and instruments required for tests, as well as additional thermometer wells, gauge and instrument connections, at no additional cost to the Owner.

3. Perform preliminary tests and repair all leaks before notifying the Owner of final tests.

4. Repair leaks, damage, or defects discovered during or resulting from tests or replace to a like-new condition. Remove leaky pipe joints, ductwork, etc., and replace with acceptable materials. Retest systems repaired.

5. Maintain a logbook of all tests, preliminary and final, showing dates, personnel, observers' initials, description of test, and test status. Provide updated log to Owner each month throughout the construction period. Initial log submitted to include listing of all anticipated tests.

6. Testing, balancing, and adjusting will not relieve the Contractor of the warranty requirements.

7. Furnish all fuel, water, and electricity required in performing the testing, balancing and adjustment of mechanical systems.

8. Clean all piping before testing. Refer to spec section 23 25 00.

9. Use calibrated test gauges with at least 4½" diameter dial. Gauge range not to be more than three (3) times test pressure.

10. Provide and demonstrate operation of all test equipment and apparatus required for the complete testing and inspection of all systems at such time and locations as may be directed by the Engineer and/or by the authorities having jurisdiction.

11. When freezing is a hazard, take all precautions necessary to prevent damage. Correct any and all damage that results due to freezing at no expense to the Owner.

12. All tests shall be successfully completed and approved prior to the application of insulation and prior to the concealment of any portion of the system being tested.

B. Piping

1. Before covering or enclosing piping of various systems, all piping must be tested for 4 hours. Start and coordinate testing to be completed by 4:30 PM on the day started. The maximum test pressure not to exceed 500 psig (except for refrigerant systems as noted in 23 81 29 Variable Refrigerant Flow Systems). Tests may be witnessed by the Engineer if he/she so desires and pronounced satisfactory before pressure is removed.

2. Equipment must be valved off during the test. Do not pressure test through new equipment if equipment pressure ratings cannot support the test pressure. Drain equipment and piping and protect against freeze-up anytime the ambient temperature is below freezing.

3. Mix water for each hydrostatic test with Nalco 41, or approved equal, to a ratio of fifty (50) gallons of Nalco 41 to 10,000 gallons of water, or a higher concentration if recommended by the chemical manufacturer. At least sixty (60) days prior to the start of hydrostatic leak testing, submit a two (2) foot long length of the typical piping installed on the project to Nalco or another chemical manufacturer acceptable to the Owner, to determine the composition of the internal pipe coating. Provide injection pumps, water meters and coupon racks to control and monitor the concentration. After leak testing and a sufficient time period to allow the interior of the piping to be chemically coated to prevent rust formation, drain the piping system until empty.

4. Test piping within conduit prior to encasement of joints.

5. Hydrostatically test water piping at 1.5 times actual maximum working pressure.

6. Hydrostatically test steam and condensate piping (less than 90 psig) for eight (8) hours at 150 psig.

7. Hydrostatically test steam and condensate piping (over 90 psig) for eight (4) hours at1.5 times maximum working pressure.

8. Compressed Air Piping: Air test at 125% of relief valve setting of compressor but not exceeding 150 psig for four (4) hours.

9. Refrigerant Piping: Air test at 125% of maximum operating pressure but not exceed150 psig for four (4) hours.

C. Ductwork

1. Maximum system leakage shall not exceed 5% of system design capacity. When testing individual segments of a total system, prorate allowable leakage as follows:

Maximum Leakage = (Surface Area of Test Section) x (.05) x (System CFM)
(Surface Area of System

2. Test recording form to include above calculation. When all sections of a system have been tested, submit confirmation that the sum of individual section surface areas is equal to the total system surface area.

3. Pressure tests shall be performed with a test blower. Rig with orifice plate. Test ducts/casings with positive pressure on the discharge side of the system fan and under negative pressure on the suction side of the system fan. Include testing of flexible runouts.

4. During construction, individually test each completed riser, each completed horizontal distribution section and each field erected casing/plenum, as required below.

5. Test ductwork as follows:

   a. Low Pressure Ductwork (From -2 to +2 inches H2O inclusive):

      (1) Exposed or Accessible: Visual and audible check for leaks that can be heard or felt under normal operating conditions.
      (2) Concealed (i.e., within shafts and above sheetrock ceilings): Pressure test at 2 inches H2O (pos. or neg. as required).

   b. Medium Pressure Ductwork (Below -2 inches and above +2 inches H20): Pressure test at system pressure classification.

3.03 GENERAL BALANCING PROCEDURE

A. Balance to maximum measured flow deviation from specified values of 5 percent at terminal device and 5 percent at equipment or mean sound-level deviation of 15 decibels.

B. Permanently mark settings on valves, splitters, dampers and other adjustment devices.

C. Take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer.

E. At the completion of balancing procedures, allow for a minimum of 2 days for the Engineer to witness test procedures and conduct operational tests.

F. Prior to start of air balancing, take traverse readings at all connections to building systems with all downstream dampers and VAV devices in fully open position and report results to Architect/Engineer. Provide assistance if air quantities are below that shown on drawings.

G. Prior to start of water balancing, take ultra-sonic flow readings at all connections to building systems with all downstream valves in full flow position and report results to Architect/Engineer. Provide assistance if water quantities are below that shown on drawings.

H. After the entire installation has been completed, make required adjustments to balance valves, air vents, automatic controls, pumps, air dampers, VAV boxes, air distribution devices, pressure reducing valves, fans, sheaves, etc., until performance requirements are met. Make these adjustments with equipment operating. In addition, repeat these adjustments for each of the remaining three seasons of the year. During such periods of adjustment prior to the date of acceptance of the mechanical systems, operate equipment.

3.04 AIR SYSTEM PROCEDURE

A. Execute air systems balancing for each air system in accordance with AABC or NEBB specifications and as described herein.

B. Before any air balance work is done, test the system for duct leakage, install clean filters, check for correct fan rotation and equipment vibration, check automatic dampers for proper operation, and verify that all fire dampers are open.

C. Make tests with supply, return and exhaust systems operating and doors, windows, closed or in their normal operation condition.

D. Test and adjust fan or blower speed to design requirements.

E. Test and record motor full load amps. Record each installed motor manufacturer and motor efficiency.

F. Traverse main supply air ducts, using a pitot tube and manometer. Calibrate the manometer to read two significant figures in velocity pressure ranges. Take a minimum of 16 readings per traverse. The intent of this operation is to measure by traverse the total air quantity supplied by the fan and to verify the distribution of air to zones. A “main duct” is defined as any of the following:

1. A duct serving 5 or more outlets.
2. A duct serving 2 or more branch ducts.
3. A duct serving a hydronic coil.
4. A zone duct from a fan-powered or VAV terminal unit.
5. A duct emanating from a fan discharge or plenum and terminating at one or more outlets.
6. All supply and exhaust risers.

G. Submit data in support of supply fans deliveries by the following four methods. For return, relief and exhaust fans, methods 1 and 4 are sufficient:

1. By summation of the air quantity readings at inlets or outlets.
2. By duct traverses of main supply ducts.
3. By rotating vane traverse across the filter bank or coil bank.
4. By plotting revolutions per minute and static pressure readings on the fan curve. Air density corrections must be indicated.

H. Test and record required and measured system static pressures; filter differential, coil differential and fan total static pressure.

I. Test and adjust systems for design recirculated airflow rates.

J. Test and adjust system for design outside airflow rates.

K. Test and record entering and leaving air temperatures.

L. Adjust main supply and return ducts to proper design flow rates.

M. Inspect and confirm all fire dampers are open, all smoke dampers and fire/smoke dampers are in their correct position, all duct access doors are closed and fire damper fusible links are accessible.

N. Adjust zones to proper design, supply and return flow rates.

O. Test and adjust each air inlet and air outlet and transfer duct to within 5 percent of design requirements.

P. Identify each air inlet, air outlet, transfer duct and transfer wall opening as to location and area.

Q. Identify and list size, type and manufacturer of diffusers, grilles, registers and testing equipment. Use manufacturer's rating on equipment to make required calculations.

R. In readings and tests of diffusers, grilles and registers, report the required face and neck velocity, test face and neck velocity, and required air pressure drop and flow rate. Test after adjustments.

S. Building Management System Contractor shall set adjustments of automatically operated inlet vanes, cones, plugs and all dampers to operate as indicated in cooperation with Balancing Contractor.

T. Adjust diffusers, grilles and registers to minimize drafts, dumping, and to prevent "short circuiting" between supply and return outlets.

U. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

V. Vary total system airflow rates by adjustment of fan speeds or fan volume-varying devices. Vary branch air quantities by damper regulation.

W. Prepare single line diagrams of duct systems indicating terminal outlets identified by number. List on data sheets all outlets denoted by the same numbers, including the outlet size, "K" factor, location, cubic feet per minute and jet velocity. Submit this data for supply, return and exhaust air systems.

X. Adjust the minimum. maximum, return and exhaust/spill air dampers so that the respective fans deliver the correct cubic feet per minute at all damper positions. Should the observed air quantities be less than 95% or more than 105% of the

specified airflow, change the pulley ratio to make acceptable changes to obtain the scheduled air quantities.

Y. Balance and adjust supply air systems as follows;

1. Systems installed with trunk ducts only, with no air outlets, to be balanced by adding a volume damper at each end of the trunk duct. Make adjustments to the air handling unit as required to deliver the volume of air within 5% of design flow at the static pressure and cold air supply temperature shown on the drawings. Remove the dampers and seal openings after the reports have been accepted by the Owner.

2. Systems installed with main duct capped at wall of fan room shall be balanced by installing an opposed blade damper at each capped connection. Make adjustments as required to deliver the volume of air within 5% of design flow at static pressure and cold air supply temperature shown on the drawings. Remove dampers and cap opening after the reports have been accepted by the Owner.

3. Systems installed partially complete will be balanced by installing a volume damper in the duct allocated for the remaining portion of the system. Make adjustments as required to deliver the volume of air within 5% of the design flow at the static pressure and cold air supply temperature shown on the drawings. Remove damper and cap after reports have been accepted by the Owner.

4. For systems installed in finished areas of the building, balance and adjust as per the following:

   a. Systems installed in accessible ceilings;

      1. After the duct systems have been completely installed inclusive of grilles, diffusers, dampers, ducts, coils, automatic temperature controls, adjust the air handling units and all air outlets as required to deliver the volume of air within 5% of design flow as indicated on the design drawings (for cold supply temperatures). Post occupancy, readjust the air volumes if required, to properly balance the heating/cooling loads.

   b. Systems installed in inaccessible ceilings:

      1. After the duct systems have been completely installed except for the final connections to grilles and air outlets, and prior to the inaccessible ceiling installation, make adjustments as required, to deliver the volume of air at air tap proportionally within 5% of design flow as indicated on the drawings.

      2. After each duct system has been adjusted, securely lock each manual damper, splitter or spin in damper, with sheetmetal screws prior to installation of ceiling.

3. Submit balancing reports to the Engineer for review and comment as specified prior to the installation of the inaccessible ceiling. Do not conceal duct system prior to the receiving an air balance report which has been accepted by the Owner.

5. For balancing air outlets, use a flow hood for the air balance. The instrument to be complete with a flow hood kit including flow hood tops specifically designed to measure the air outlets specified for the project. The flow hood's accuracy and the instrument calibration for measuring the air flow form the air distribution device specified for the project must be verified in an independent testing lab acceptable to the Owner and Engineer.

Z. For fans with two-speed motors, execute the entire air systems procedure at both speeds. This also applies to fans with variable frequency drives when used in normal mode and smoke control modes.

AA. The final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates, under both heating and cooling conditions. For multi-story buildings, test pressure conditions at ground, intermediate and upper levels. Front doors, stair and vestibule doors, exits and elevator shafts shall be checked for airflow so that leakage does not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

BB. Complete balancing to achieve positive building pressure unless otherwise instructed. A positive pressure relative to outside of 0.05-inch water gauge minimum and 0.10-inch water gauge maximum shall be achieved, measure with negligible, outside wind velocity.

CC. Complete balancing of the refrigeration machinery room intake and exhaust air systems to maintain a negative pressure of 0.05-inch water gauge minimum relative to adjacent spaces.

3.05 HYDRONIC SYSTEMS PROCEDURE

A. Preparation of System: The hydronic system shall be prepared for balancing in the following manner:

1. Open valves to full position including coil stop valves; close bypass valves; and return line balance valves.
2. Examine water in system to determine if it has been treated and is clean.
3. Check proper pump rotation.
4. Install clean strainers.
5. Check expansion tanks to ensure that they are not air bound and that the system is full of water.
6. Check air separators and air vents at hydronic coils and high points of water systems to ensure that they are installed properly and are operating freely. Make certain all air is removed from circulating system.
7. Set temperature controls to close all automatic bypass valves and provide full flow through hydronic coils or heat exchangers.
8. Check operation of automatic bypass valves.

9. Check and set operating temperature of heat exchanger, cooling tower, boiler and chiller at design requirements.
10. Execute air balance before water balance is initiated.
11. After piping systems have been installed, tested, cleaned and flushed, complete with all pumps, piping, valves, coils, and other items as herein specified, make adjustments as required to deliver the water volumes at each coil and piece of equipment to within 5% of design flow as shown on the Drawings, or as required to properly balance the load throughout the conditioned areas. During balancing set control for full flow through coils. Set automatic throttling valves in the full-open position. Close the bypass port on automatic 3-way valves. Confirm proper differential pressure settings at system by-pass station.

B. Test and Balance Procedure:

1. Check operation of variable speed pump and record pump data at varying percentages of full flow.
2. Adjust flow through chiller, heat exchanger, cooling towers and boilers.
3. Check and record entering and leaving water temperatures and pressure drop through chillers, boilers, cooling towers and heat exchangers. Reset to design temperatures.
4. Each air handling unit with multiple coils shall have the flow through each coil balanced. Make adjustments to water volumes in a manner satisfactory to the Engineer.
5. Submit detailed balancing procedure and recording forms for the Engineer's review months prior to commencing any water balancing work.
6. Where automatic flow control valves are installed verify that the operating pressure differential across the valve taps is within the range indicated on the submittal data sheet for that model number.
7. Position and mark/lock manual calibrated balance valves for design flow through coils, AC units, heat pumps, convectors and all other items in system requiring circulation of glycol, chilled water, hot water or condenser water.
8. For venturi type, pitot tube, or other flow measuring devices, record the pipe size, manufacturer and size of device, and the direct reading of the differential pressure, and calculated final flow.
9. Upon completion of flow readings and coil adjustments, mark settings and record data.
10. Ensure bypass valves are tightly closed.

C. Test and Balance Procedure:

1. After making adjustments to coils, recheck settings at pumps. Readjust if required.
2. Install pressure gauges on each coil then read pressure drop through coil and set flow rate on call for full flow through coil. Set pressure drop across bypass valve to match coil full flow pressure drop.
3. Balance flow through equipment and coils by means of pressure drop. Obtain curves from the various manufacturers indicating the relationship between flow and pressure drop through the coils and equipment. Take readings on calibrated test gauges.

4. Upon completion of the water balance, reconcile the total heat transfer through coils by recording the entering and leaving water temperatures and the entering and leaving air dry bulb and wet bulb temperatures.
5. Do not perform adjustments until the entire system has been pressure tested, flushed and cleaned.
6. In conjunction with pump manufacturer for multiple pump, pumping systems, construct and submit system curves indicating operating point with one pump operating, two pumps operating, three pumps operating, etc.
7. Upon completion of balancing, adjust differential bypasses for the same pressure drop on full bypass as on full flow.

3.06 BALANCING REPORT

A. Submit a draft copy of reports prior to final acceptance of project. Provide copies of final report for inclusion in Operating and Maintenance Manuals.

B. Include types, serial number and dates of calibration of instruments.

C. Install at each piece of mechanical equipment a “Data Register” showing significant operating temperatures, pressures, amperes, voltage, and brake horsepower. “Data Register” shall be enclosed in a hard, clear plastic holder securely attached to the equipment or to a wall in the adjacent area.

D. Submit with Report, fan and pump curves with operating conditions plotted. Submit grille and diffuser shop drawings and diffusion factors.

E. Report shall be indexed as follows:

1. Air

a. Summary
b. Procedure
c. Instrumentation
d. Drawings
e. Equipment Summary
f. Fan Sheets
g. Fan Curves
h. Fan Profile Data
i. Static Data
j. Air Monitoring Station Data
k. Traverse Data and Schedule
l. Terminal Unit Summary
m. Outlet Data Summary and Schematics (per system)
n. Building Pressurization Data
o. Smoke Exhaust Mode Data
p. Stairway and Stair Vestibule Pressurization Data
q. Smoke Control System Testing (Smoke Control Zone Supply, Relief and Exhaust Capacities)

2. Water

a. Summary
b. Procedure

c. Instrumentation
d. Pump Data
e. Pump Curves
f. Flow Stations
g. Coils
h. Equipment Data
i. Element Data Summary and Schematics (per system)

3. Sound

a. Summary
b. Procedure
c. Instrumentation
d. Drawings
e. Profile
f. Scale Readings

4. Fire Damper Certification
5. Copy of Contractor's Certification

F. Balancing data to be included:

1. Air Handling Equipment Installation Data:

a. Manufacturer, model and size
b. Arrangement, discharge and class
c. Motor type, horsepower, speed, efficiency, voltage, phase, cycles and full load amperes
d. Location and final identification

2. Air Handling Equipment Design Data:

a. Total airflow rate
b. Static pressure across coil, filter, damper, mixing box sections and total
c. Motor horsepower, speed, efficiency, voltage and amperes
d. Fan speed and brake horsepower
e. Hydronic coil inlet and outlet, dry bulb temperatures
f. Initial filter air pressure drop

3. Air Handling Equipment Recorded Data:

a. Total airflow rate
b. Static pressure across coil, filter, damper, mixing box sections and total
c. Fan speed and brake horsepower
d. Motor operating amperes
e. Inlet and outlet, dry bulb temperatures
f. Filter air pressure drop

4. Duct Air Quantities: Mains, Branches, Outside Air and Exhausts (Maximum and Minimum):

a. Duct sizes

b. Number of pressure readings
c. Sum of velocity measurements
d. Average velocity
e. Duct recorded airflow rate
f. Duct design airflow rates

5. Air Inlets and Outlets:

a. Inlet/outlet identification location and designation
b. Manufacturer’s catalogue identification and type
c. Application factors
d. Design and recorded velocities
e. Design and recorded airflow rates
f. Deflector vane or diffuser cone settings

6. Building Pressurization Data:

a. Outside air temperatures and humidity
b. Outside wind velocity
c. Building pressures plotted with respect to systems
d. Supply air, return air and exhaust airflow rates for varying damper positions
e. Locations of pressure measuring points, inside and outside building

7. Pump Installation Data:

a. Manufacturer, model and size
b. Impeller diameter
c. Drive type
d. Motor type, horsepower, efficiency, speed, voltage, phase, cycles and full load motor amperes

8. Pump Design Data:

a. Flow rate and head pressure
b. Pump speed and horsepower
c. Pump efficiency

9. Pump Recorded Data:

a. Discharge and suction pressures (full flow and no flow)
b. Operating pressure and total dynamic head
c. New positive suction head.
d. Operating rate (from pump curves if metering not provided or from variable speed controller)
e. Motor operating amperes
f. Balancing valve setting (full open, 60-percent open etc.)

10. Expansion Tank Installation Data:

a. Manufacturer, size, capacity
b. Pressure reducing valve setting
c. Pressure relief valve setting

11. Heating Equipment Design Data:

    a. Heat transfer rate
    b. Flow rates and pressure drops
    c. Entering and leaving water temperature

12. Heating Equipment Recorded Data:

    a. Element type and identification (location and designation)
    b. Entering and leaving temperatures
    c. Flow rates and pressure drops

13. Air Heating and Cooling Equipment Design Data:

    a. Heat transfer rate
    b. Water pressure drop across coil
    c. Air static pressure drop
    d. Entering and leaving water temperatures
    e. Entering and leaving air dry and wet bulb temperatures

14. Air Heating and Cooling Equipment Recorded Data:

    a. Element type and identification
    b. Entering and leaving air dry and wet bulb temperatures
    c. Entering and leaving water temperatures
    d. Water pressure drop across coil
    e. Water pressure drop across bypass valve
    f. Air static pressure drop
    g. Air and water flow rates
    h. Adjusted temperature rise or drop

15. Water Chiller Installation Data:

    a. Manufacturer and model
    b. Motor type, kilowatts, speed, voltage, cycles, phase and full load amperes
    c. Water flow rates
    d. Water pressure drops
    e. Entering and leaving water temperatures

16. Water Chiller Recorded Data:

    a. Water flow rates
    b. Water pressure drops
    c. Entering and leaving water temperatures
    d. Running load kilowatts

17. Humidifier/Dehumidifier Installation Data:

    a. Manufacturer, model and size
    b. Maximum kilowatts, voltage, phase, cycles

18. Humidifier/Dehumidifier Recorded Data:

a. Running load amperes
b. Entering and leaving air humidity
c. Length of vapor trail in air stream

19. Sound Level Data:

a. Diagram or description of relationship of sound source to measuring instrument
b. Overall decibels (A) level
c. Reading at each octave band frequency from 31.5 Hz to 16 kilohertz
d. Noise criteria (NC) curves plotted and compared to those recommended by ASHRAE or AABC publications

20. Sound Level Recorded Data:

a. Air Inlets and Outlets
b. VAV Terminal Units
c. Air Handling Units
d. Chillers
e. Cooling Towers
f. Boilers
g. VFDs
h. Fans
i. AC Units

G. Final report

1. If the work is completed during the heating season perform the final test of cooling equipment, the following summer, if completed during the summer, perform test on heating system the following winter.
2. After each seasonal adjustment is made, prepare a detailed report and submit to the Engineer for approval.

END OF SECTION

SECTION 23 07 00
INSULATION FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Duct insulation, jackets
2. Piping insulation, jackets
3. Equipment insulation and covering
4. Breeching insulation

1.02 RELATED DOCUMENTS.

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 21 13 – Hydronic Piping

C. Section 23 23 13 – Refrigerant Piping and Accessories

D. Section 23 31 00 – HVAC Ducts and Casings

E. Section 23 33 19 – Acoustics

F. Division 7 – Thermal and Moisture Protection – Section(s) re: Applied Fireproofing

1.03 REFERENCE STANDARDS

A. ASTM – American Society for Testing and Materials

1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
2. ASTM C411 Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
3. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
4. ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
5. ASTM C534/C534M Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
6. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation
7. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
8. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
9. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
10. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials
11. ASTM E136 Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C

12. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems
13. ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials
14. ASTM F1249 Standard Test Method for Water Vapor Transmission Rate

B. NFPA – National Fire Protection Association

1. NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
2. NFPA 225 Model Manufactured Home Installation Standard
3. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

C. UL – Underwriters Laboratories Inc.

1. UL 723 Test for Surface Burning Characteristics of Building Materials

D. Local Code

1.04 QUALITY ASSURANCE

A. All insulation shall be in accordance with the local energy code requirements.

B. Insulation supplier and insulation installer shall have a minimum of 5 years' successful installation experience on projects of similar scope to this project.

C. Fire-rated duct wrap installer shall have demonstrated experience on projects of similar size and complexity.

1.05 SUBMITTALS

A. Product Data: Provide product description, current Product Data Sheets, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.

B. Submit details of sheet metal boxes for pieces of insulated equipment.

C. Samples: Submit selection and verification samples of fire-rated duct wrap.

D. Quality Assurance / Control Submittals:

1. Test Reports: Upon request, provide fire tests from recognized laboratory.
2. Certificates: Submit manufacturer's certificate that product(s) meet or exceed specified requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions during storage and installation of all products required by manufacturers of adhesives, mastics, and insulation cements.

B. Protect insulation from contact with water.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Fiberglass: Johns Manville; Knauf; Owens Corning.

B. Elastomeric: Armacell; Aeroflex.

C. Mastics, Adhesives and Sealers: Ductmate; Foster; IC; Childers.

1. Vapor Barrier Mastic: Foster 30-65, Childers CP-34, IC – 501. Permeance shall be 0.03 perms or less at 45 mils per ASTM E96.
2. Weather Barrier Breather Mastic: Foster 46-50, Childers CP-10/11 or approved equal.
3. Lagging Adhesive/coating: Foster 30-36, Childers CP-50AMV1 or approved equal.
4. Reinforcing Mesh: Foster Mast a Fab, Childers Chil Glas #10.
5. Calcium Silicate Insulation Adhesive: Foster 81-27, Childers CP-97, Vimasco 760.
6. Fiberglass Insulation Adhesive: Foster 85-60, Childers CP-127, or approved equal. Comply with ASTM C916, Type II.
7. Metal Jacketing/Flashing Sealant: Foster 95-44, Childers CP-76 or approved equal.

D. Jackets:

1. Metal: Childers; RPR Products.
2. PVC: Ceel-Co; PIC Plastics.
3. Other: Venture Tape; Polyguard, Foster Vapor Fas 62-05.

E. Pre-Molded Fittings, Valves, Strainers and Equipment Insulation: Insul-Therm International; Extol of Ohio, Inc.; or approved equal.

F. Fire Barrier Duct Wrap: 3M Duct Wrap 615+; Unifrax FyreWrap®; or approved equal.

2.02 GENERAL

A. Conform to application schedule for type and thickness of insulation.

B. Insulation, jacket, facing and adhesives shall be non-combustible material meeting Code requirements and fire and smoke hazard ratings as tested by procedure ASTM E84, National Fire Protection Association 225, and UL 723, not exceeding Flame Spread 25 and Smoke Developed 50.

C. Adhesive, mastic or insulating material shall not contain asbestos.

D. When different types of insulation abut, submit manufacturer approved details for insulation transition.

E. Insulation that has become wet must be removed and replaced. “Drying out” of insulation is not acceptable

F. Vapor jacket permeance shall be 0.02 perms or less.

G. Jacket puncture resistance shall be 50 units (Beach) or greater.

2.03 PIPE INSULATION MATERIALS

A. Maximum Conductivity Allowed per the below table at a minimum but shall be superseded by local codes that are more stringent:

Fluid Operating Temperature Range and Usage (°F)	Insulation Conductivity	
	Conductivity (Btu-in./hr-ft²-°F)	Mean Ratiing Temperature (°F)
>350	0.32	250
251 – 350	0.29	200
201 – 250	0.27	150
141 – 200	0.25	125
105 – 140	0.21	100
40 - 60	0.21	75
<40	0.20	50

B. Glass Fiber: ASTM C547; rigid molded, non-combustible.

1. Installed ‘K’ Value: 0.21 Btu-in./hr-ft²-°F at 75 degrees F, minimum, corrected per Table above.
2. Maximum Service Temperature: 850 degrees F.
3. Vapor Retarder Jacket: White kraft paper, vinyl coated, embossed and reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips.
4. ends on maximum 12-inch centers.

C. Elastomeric Foam: ASTM C534/C534M flexible cellular elastomeric, molded or sheet.

1. Installed ‘K’ Value (1-inch and less): 0.245 Btu-in./hr-ft²-°F at 75 degrees F, minimum, corrected per Table above.
2. Installed ‘K’ Value (1-1/2 inch and 2 inch): 0.28 Btu-in./hr-ft²-°F at 75 degrees F, minimum, corrected per Table above.
3. ESTM 84 25/50 flame/smoke spread up to 2-inch thickness.
4. Water vapor transmission: 0.03 Perms.
5. Maximum Service Temperature: 220 degrees F.
6. Preformed Pipe Insulation with Jacket: Comply with ASTM C552, Type II, Class 2.

D. Field-Applied Jackets:

1. PVC Plastic (PVC): One-piece molded type fitting covers and sheet material, gloss white. Connections shall be pressure-sensitive color-matching vinyl tape.
2. Canvas Jacket (CJ): UL Listed fabric, 6 ounce per square yard, plain weave cotton treated with dilute fire-retardant lagging adhesive.
3. Aluminum Jacket (AL): 0.016-inch thick sheet, stippled finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory-attached protective liner.
4. Stainless Steel Jacket (SSJ): Type 304 stainless steel, 0.010 inch, smooth finish.
5. Vapor Barrier Jacket (VBJ): Five ply, non-bituminous, embossed, aluminum foil/polymer laminated film with permeance rating of 0.0 as tested in accordance with ASTM F1249 . Venture Clad Plus (1579CW) by Venture Tape, Polyguard Zero-Perm (indoors only), Foster Vapor Fas 62-05 or approved equal.

2.04 PIPE INSULATION SCHEDULES

A. Insulation Schedules:

Service	**Temp. Range (°F)**	**Material**	**Insulation Thickness (inches) for Pipe Sizes:**				
			< 1	1 to <1.5	1.5 to 4	4 to <8	8 and up
Hot Water	141 to 200	Glass fiber	1.5	1.5	2.0	2.0	2.0
Hot water and glycol heating	105 to 140	Glass fiber	1.0	1.5	1.5	1.5	1.5
Chilled water, glycol and open condenser water	40-60	Glass Fiber	1.0	1.5	1.5	1.5	1.5
Refrigerant	All	Elastomeric foam	1.0	1.5	1.5	---	----
Condensate drains above hung ceilings	All	Elastomeric foam, glass fiber	0.5	0.5	1	1	1
Additional insulation greater than values shown in this table for piping in spaces that is not heated, exposed to outdoor conditions including parking garages.	All	Glass fiber	2 (in addition to the standard requirements in this table)				

Note 1: External temperature to not exceed 200°F, or as required by local code

B. Fittings, Valves and Flanges:

1. Use factory pre-molded fittings of the same materials and thickness as the adjacent pipe insulation. Such fittings shall be applied to all 90°s, 45°s, Tee's, flanges, and valves.
2. Where pre-molded insulation fittings are not manufactured, insulate fittings, flanges, strainers and valves with mitered segments of the same density as the adjoining pipe covering. Vaporseal for cold (below dew

point) applications using vapor barrier mastic with open weave glass or polyester mesh lay in while wet. Provide a final coat of vapor barrier mastic. Overlap glass mesh and outer coat adjacent covering by a minimum of 2 inches. Vapor barrier mastic shall be IC 501, Childers CP-34 or Foster 30-65. Permeance of mastic shall be 0.03 perms or less at 45 mils as tested by ASTM E96. Reinforcing mesh shall be Foster Mast a Fab, Childers Chil Glas #10 or approved equal.

3. Provide insulation for the removable covers and flanges of pipe strainers on cold services with built-up sections of glass fiber pipe covering, arranged to facilitate servicing of the strainer. Complete applications with vaporseals as specified above. Vapor barriers shall be sealed and continuous through guides, hangers, walls, sleeves, etc. Adhesives and coatings shall be as noted herein.
4. Insulate fittings, flanges, valves, etc. for services where calcium silicate insulation is specified with mineral wool cement of equal thickness to the pipe insulation. Apply evenly and finish with glass cloth.

C. High-Pressure Steam Valves: Provide removable shop-fabricated fiberglass padding rated for 500 degrees F. Line with thin wire mesh and cover with eighteen-ounce high-temperature woven fiberglass cloth with integral Velcro strap fasteners.

D. Jacketing Schedule:

Service	Location	Jacket Type
Heating hot water	Exposed in Plant Rooms	AL
	All other locations	ASJ
Refrigerant piping	Interior locations	None
	Exterior locations	VBJ or painted finish
Condensate	All locations	ASJ or painted finish

2.05 DUCTWORK INSULATION

A. Materials:

1. Flexible Glass Fiber: ASTM C553, formaldehyde-free flexible blanket.

   a. Installed ‘K’ Value: 0.27 Btu-in./hr-ft²-°F at 75 degrees F.
   b. Density: 0.75 pounds per cubic foot.
   c. Vapor Barrier Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with 2-inch wide UL Listed pressure-sensitive tape and outward clinched expanded staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.02 perms.

2. Rigid Glass Fiber: ASTM C612, rigid board.

   a. Installed ‘K’ Value: 0.23 Btu-in./hr-ft²-°F at 75 degrees F.
   b. Density: 6.0 pounds per cubic foot.
   c. Vapor Barrier Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with 2-inch wide UL Listed pressure-sensitive tape and outward clinched expanded staples and vapor barrier mastic as needed.

3. Canvas Jacket: UL Listed fabric, 6 ounces per square yard, plain weave cotton treated with dilute fire-retardant lagging adhesive: Foster 30-36; Childers CP-50AMV1 or approved equal.
4. Covering for Outdoor Ducts:

   a. Aluminum Jacket: 0.016-inch thick sheet, stucco-embossed finish, with longitudinal slip joints and 2-inch laps.
   b. Ultra-violet light-resistant painted polyvinyl chloride covering with joints secured and sealed with adhesive.
   c. Vapor Barrier Jacket (VBJ): Five ply, non-bituminous, embossed, aluminum foil/polyester laminated with permeance rating of 0.0 per as tested in accordance with ASTM F1249. Venture Clad Plus (1579CW) by Venture Tape, Foster Vapor Fas 62-05 or approved equal.

B. Schedule:

Service	**Material**	**Thickness (inches)**
Heated or Cooled Supply Air Ducts, concealed in unconditioned spaces	Flexible Glass Fiber	2.0 minimum (not less than R-6)
Heated or Cooled Supply Air Ducts, concealed, in hung ceilings used as Return Air Plenums and Riser Shafts	Flexible Glass Fiber	2.0 minimum (not less than R-6)
Heated or Cooled Supply Air Ducts, exposed within the conditioned space served (See Note 1)	Glass Fiber Rigid Board	1 (R-4.5)
Heated or Cooled Supply Air Ducts, exposed within unconditioned spaces (See Note 1)	Glass Fiber Rigid Board	2.0 (R-9)
Return & Relief Air Ducts, concealed, from heated or cooled spaces in unconditioned space.	Flexible Glass Fiber	2.0 minimum (not less than R-6)
Return & Relief Air Ducts, exposed, from heated or cooled spaces in unconditioned space.	Glass Fiber Board	2.0 minimum (not less than R-6)
Return air ducts from heated or cooled spaces in exterior or parking garage locations.	Glass Fiber Rigid Board	2.0 minimum (not less than R-6)
Outside Air Intake Ducts & Plenums from intake louver to supply systems.	Glass Fiber Rigid Board	2.0
Unused portion of louvers where blanked off with sheetmetal	Glass Fiber Rigid Board	2.0
Exhaust or Relief Air Ducts from automatic louvered damper to discharge at exterior openings	Glass Fiber Rigid Board	2.0

Note 1: For ductwork in exposed locations, internal lining to be used as a basis unless external insulation is required by the drawings. In cases when acoustical lining is used, the overall R-values must be maintained per the table above.

C. All ductwork exposed to outdoors shall be provided with 2” of glass fiber rigid board, in addition to any acoustical treatment within the ductwork, and covered with an outdoor

cladding material similar to K-FLEX CLAD AL. See HVAC Ducts and Casings Specification for more information.

D. For ducts located indoors only, wherever external duct insulation is specified, and internal acoustic treatment of equivalent insulating effect is also required by the Drawings or Specifications for the same location, the external insulation may be omitted.

2.06 EQUIPMENT INSULATION

A. Materials:

1. Flexible Fiberglass Blanket: ASTM C553.

   a. Installed 'K' Value: 0.24 Btu-in./hr-ft²-°F at 75 degrees F.
   b. Maximum Service Temperature: 450 degrees F.
   c. Density: 6.0 pounds per cubic foot.
   d. Vapor Retarder Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with UL Listed pressure-sensitive tape and outward clinch expanding staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.02 perms.

2. Rigid Fiberglass Board: ASTM C612.

   a. Maximum Service Temperature: 450 degrees F.
   b. Density: 6.0 pounds per cubic foot.
   c. Vapor Retarder Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with UL Listed pressure-sensitive tape and outward clinch expanding staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.5 perms.
   d. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.

3. Rigid Fiberglass Board: ASTM C612, non-combustible.

   a. Installed 'K' Value: 0.23 Btu-in./hr-ft²-°F at 75 degrees F.
   b. Maximum Service Temperature: 850 degrees F.
   c. Density: 3.0 pounds per cubic foot.
   d. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.

4. Elastomeric Foam: ASTM C534, flexible cellular elastomeric, molded or sheet.

   a. Installed 'K' Value (1-inch and less): 0.245 Btu-in./hr-ft²-°F at 75 degrees F.
   b. Installed 'K' Value (1-1/2 and 2 inch): 0.28 Btu-in./hr-ft²-°F at 75 degrees F.
   c. ESTM 84 25/50 flame/smoke spread up to 2-inch thickness.
   d. Water vapor transmission: 0.03 Perms.
   e. Maximum Service Temperature: 220 degrees F.

5. Apply the vaporseal board by mechanical fasteners such as Graham pins and speed washers. Seal joints with an adhesive, as approved and reinforced with a glass cloth membrane over vinyl mastic, or self-sealing matching tape. Cover pinheads with adhesive, as specified. If vaporseal board is wired, use sheet metal edges to protect the corners of the board from the wire. Seal edges and joints.

6. Enclose removable covers or heads for equipment, (such as coolers, strainers, heat exchangers and pumps) in aluminum sheet metal boxes for easy removal with fiberglass board applied to inside of sheet metal boxes of thickness as described above. Provide lifting handles for removal of boxes.

7. Install equipment insulation in accordance with manufacturer's instructions.

B. Mastics, Adhesives, and Sealants:

1. Apply in accordance with the manufacturers written instructions.

C. Equipment Insulation Schedule:

Service	**Material**	**Thickness (inches)**
Chilled water expansion tanks and air separators	Glass fiber board	1
Chiller evaporator	Glass Fiber Board	2
Hot water pumps, feed water Pumps	Custom Fit Cover	2
Steam PRV control valves	Custom Fit Cover	2
Shell and Tube Heat Exchangers	Glass Fiber Board	1.5
Chilled and Condenser (free cooling only) water pumps	Custom Fit Cover	2
Chiller evaporator heads and water boxes, Chilled water plate and frame heat exchanger	Custom Fit Cover	2

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that ductwork has been tested for leakage in accordance with Section 23 05 93 – Testing Adjusting and Balancing before applying insulation materials.

B. Verify that all surfaces are clean, dry and free of dirt, duct, debris, moisture or foreign material.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

B. Verify piping has been pressure-tested as specified in Section 23 05 93 – Testing Adjusting and Balancing before applying insulation materials to pipe joints.

C. Continue insulation and vapor barrier through penetrations.

D. Piping, Valve and Accessories Insulation:

1. Locate insulation and cover seams in least visible locations where exposed.
2. Neatly finish insulation at supports, protrusions, and interruptions.
3. Provide insulated pipes, fittings, valves and accessories conveying fluids below ambient temperature with continuous vapor retarder jackets with self-sealing laps. Insulate complete system and provide molded flexible polyvinyl chloride jacket(s) for all fittings and valves. Vaporseal all below ambient jacket seams with vapor barrier mastic as recommended by the insulation manufacturer.
4. For insulated pipes, fittings, valves and accessories conveying fluids above ambient temperature, secure jackets with self-sealing lap. Bevel and seal ends of insulation at equipment, flanges and unions.
5. Protect pipe insulation at hangers, guides, and rollers with 20-gauge galvanized metal shields, one-third the insulation circumference in width and minimum 10 inches in length up to 2½-inch pipe size, 12 inches in length on pipes 3-inch and larger, on the outside of the insulation and vapor barrier or jacket. Center shield on hanger and hold shield in place by straps or by manufactured centering tabs or channels on the shield itself. Do not pierce the insulation with hangers.
6. Provide insert between support shield and piping. Fabricate of calcium silicate, rigid phenolic or other heavy density non-deforming insulating material suitable for temperature. Length of insulation inserts shall match support shield length as specified.
7. For exterior applications or locations where abrasion or damage may occur, provide weather protection jacket. Insulated pipe, fittings, accessories joints, and valves shall be covered with ultra-violet light-resistant painted polyvinyl chloride, Foster Vapor Fas 62-05 flexible jacketing or aluminum jacket. Jacket seams shall be located on bottom side of horizontal piping.
8. Piping within Mechanical Equipment Rooms: In addition to the insulation and jacket specified, all piping, including fittings, flanges and valves, shall be covered with a 30 mil (0.8 mm) thick thermoplastic jacket.
9. Apply prefabricated sectional insulation for straight pipes neatly fitted around the piping, and sealed with adhesive. Apply adhesive to only one side of each joint and not to pipe surface.
10. Seal all joints with Foster 30-65 or Childers CP-34 fire-resistant vapor barrier mastic. Oversized pipe sections or board type insulation may be used to fabricate and install insulation around pipe specialties. All void spaces shall be firmly filled with flexible insulation to support oversized pipe insulation.
11. Secure sectional insulation with 0.02-inch thick by ½-inch wide aluminum bands manufactured by Childers, or RPR Products nylon ties, on 24-inch centers for pipe sizes 2 inches and larger. Install at least two (2) bands per section of insulation.
12. Insulate [chilled water] [brine] [glycol] [refrigerant] vertical riser support clamps.

13. Insulate and thoroughly vaporseal control valve bodies where the valve actuator penetrates the insulation.
14. Thoroughly vaporseal the ends of all pipe, valve and fitting insulation sections to prevent condensation from wicking between sections.
15. Replace any self-sealing insulation or lap that is found to be not sealing properly. Do not use staples to secure the insulation or coverings.
16. Thermal Insulation for Engine Exhaust Piping:

    a. Insulate the muffler/silencer and precipitator with three layers of 1.5-inch thick hydrous calcium silicate, installed over spacers to allow a 1-inch air space between pipe and insulation. Include all flexible pipe connections.
    b. Stagger joints for the first, second and third layers.
    c. Apply aluminum jacket (ASTM B209) over outer layer of insulation as specified.
    d. Wrap or pack all protrusions through the insulation with refractory fiber. Seal all chips, joints and cracks.
    e. Provide expansion joints in the insulation and aluminum jacket as recommended by the manufacturer to allow for movement of the flexible pipe connections, and differential expansion between the engine exhaust pipe, insulation and jacket.
    f. Refer to Section 23 51 00 “Breechings, Chimneys and Stacks” for exhaust from the silencer/muffler or precipitator to outside the building.

E. Equipment Insulation:

1. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor-retardant cement.
3. Provide cold equipment containing fluids below ambient temperature with vapor-retardant jackets.
4. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.
5. Cover insulation with metal mesh and finish with ½-inch thick insulating cement, or aluminum jacket.
6. Do not insulate over sight glasses, visual level or flow indicators, nameplates or ASME stamps. Bevel and seal insulation around these items.
7. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage to insulation or vapor barrier.
8. Refer to Section 23 51 00 “Breechings, Chimneys and Stacks” for boilers, stacks and breechings.
9. Hot equipment insulation shall be covered with ½-inch thick insulating cement over copper-clad hexagonal wire.
10. Cold equipment insulation shall be covered with ½-inch thick insulating cement over vaporseal mastic and copper-clad hexagonal wire.

F. Ductwork Insulation:

1. Provide insulated ductwork conveying air below ambient temperature with continuous vapor-retardant jacket. Seal all vapor-retardant jacket seams, punctures, tears and penetrations with UL Listed tapes and vapor-barrier mastic.
2. Provide insulated ductwork conveying air above ambient temperature with or without vapor-retardant jacket. Where service access is required, bevel and seal ends of insulation.
3. Continue insulation through non-fire-rated walls, sleeves, hangers, and other duct penetrations.
4. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 inches on center. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.
5. Mechanical Fastening with Pins Only:

    a. Weld insulation pins to the duct in the centers of the overlaps a minimum of 1.5 inches from each edge of the blanket and spaced a maximum of 10.5 inches on center along perimeter overlap, and a maximum of 10.5 inches on center along longitudinal overlaps.
    b. Impale blanket over pins and hold in place by galvanized speed clips.
    c. Insulation pins that extend beyond the blanket wrap shall be turned down to eliminate sharp points.
    d. Install insulated cup-head pins at the same spacing requirements of the insulation pins.

6. Access Door Installation:

    a. Weld four (4) galvanized steel threaded rods, ¼-inch diameter by 4.5 to 5 inches long to the duct at the corners of the door opening.
    b. Place four (4) steel tubes, each 3 inches long, over the rods to act as protection for the fire barrier duct wrap when fastening the door.
    c. Weld four (4) insulation pins to the door panel for installation of the blanket.
    d. Cut one (1) layer of fire barrier duct wrap approximately the same size as the access panel and impale over the insulation pins on the panel, fitting this layer tightly against the wrap surrounding the access door opening with no through openings.
    e. Cut a second layer of fire barrier duct wrap so as to overlap the first layer by a minimum of 1 inch and impale over the pins so that both layers are locked in place with galvanized speed clips.
    f. Turn down pins that extend beyond the outer layer of fire barrier duct wrap to avoid sharp points on the door.
    g. Place insulated door panel over the threaded rods and hold in place with washers and wing nuts.

G. PROTECTION

1. Protect installed work from damage due before and after installation.

END OF SECTION

SECTION 28 08 00
COMMISSIONING OF HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Work under this Contract shall conform to the requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers commissioning of mechanical systems which are part of this project.
2. Furnish labor and material to accomplish complete HVAC commissioning as specified herein.

B. Definitions

1. Commissioning: The process of ensuring that systems are designed, installed, functionally tested and capable of being operated and maintained to perform in conformity with the design intent. The commissioning begins with planning and includes design, construction, start up, acceptance, and training, and can be applied throughout the life of the building.
2. Commissioning Authority: The designated person, company, or agent, retained by the Owner, who implements the overall commissioning process.
3. Commissioning Plan: A document defining the commissioning process, which is developed by the Commissioning Authority in increasing detail as the project progresses through its various phases.
4. Commissioning Report: The document that records the results of the commissioning process, including the as-built performance of the HVAC system and unresolved issues, and documents all sign-offs.
5. Commissioning Specification: The Contract Document that details the objective, scope, and implementation of the construction and acceptance phases of the commissioning process as developed in the design-phase Commissioning Plan.
6. Commissioning Team: Those people responsible for working together in carrying out the commissioning process.
7. Design Intent: A detailed explanation of the ideas, concepts, and criteria that are defined by the Owner to be important. This typically is an expansion of the information provided in the Owner's Program.
8. Design Intent Document: A detailed written document, evolving throughout the commissioning process, clearly defining items and criteria of the design intent.
9. Functional Performance Testing (FPT): The process of determining the ability of the HVAC system to deliver heating, ventilating, and air-conditioning services in accordance with the final design intent.
10. Construction Documents: Design plans and specifications. Also referred to as Contract Documents.
11. Design Professional: The Owner's Architectural, Engineering and Other Consultants who prepared the Construction Documents.

12. Systems Manual: A composite document that expands the scope of the operation manual and maintenance manual by including the additional information gathered by the commissioning process.
13. Verification: That full range of checks and tests carried out to determine if all components, systems, sub-systems, and interfaces between systems operate in accordance with the Contract Documents. In this context, “operate” includes all modes and sequences of control operation, interlocks and conditional control responses, and specified responses to abnormal conditions.

C. Purpose: The commissioning is a process and its purpose is to:

1. Clearly document the design intent.
2. Verify that the systems installation and performance are in accordance with the plans, specifications and design intent.
3. Train the Owner’s operators so that they fully understand the design intent and the operation and maintenance requirements of the equipment.

1.02 SCOPE OF WORK

A. During Pre-design Phase

1. Document the Owner’s requirements as specified in the Owner’s Program; select the Commissioning Authority.
2. Identify and assign responsibilities.
3. Document the initial design intent.
4. Develop Preliminary Commissioning Plan.

B. During Design Phase

1. Document the design intent as it evolves.
2. Continue development of the Commissioning Plan.
3. Develop the commissioning specification.
4. Prepare Contract Documents that clearly reveal, describe, and fulfill the design intent.
5. Review and accept Contract Documents for compliance with design intent.
6. Coordinate other mechanical, electrical, fire safety, and life-safety service requirements with HVAC layout, equipment, and systems.

C. During Construction Phase

1. Review submittals.
2. Finalize details of the Commissioning Plan.
3. Conduct periodic commissioning team meetings.
4. Observe construction, installation, start up, operation, and testing and balancing.
5. Conduct O&M training.

D. During Acceptance Phase

1. Verify the accuracy of the final TAB report.
2. Verify that the system complies with the Contract Documents.

3. Identify and document deficiencies.
4. Remedy deficiencies and verify.
5. Submit verification report to the commissioning team to review.
6. Do functional performance testing.
7. Identify and document deficiencies.
8. Remedy deficiencies and retest.
9. Submit functional performance tests to the commissioning team to review.
10. Establish an as-built record of system performance.
11. Complete the as-built records.
12. Complete the Commissioning Report.
13. Complete the Systems Manual.
14. Turn over the building to Ownership and/or Facility Department.

E. Systems to be Included in Commissioning Process

All HVAC systems, sub-systems, and equipment included in Division 23, and not only limited to the following, shall have commissioning:

1. Hydronic distribution systems
2. Boiler system
3. VAV boxes
4. Rooftop equipment
5. Fan systems
6. Air handling / air distribution systems
7. Heating and cooling systems
8. Air-cooled air conditioning units
9. Variable frequency drives
   Building Management and Automation control systems, Energy Management Systems, hardware, software and documentation

1.03 REFERENCE STANDARDS

A. ASHRAE Guideline 0 The Commissioning Process

B. ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Commissioning Process

C. ASHRAE Guideline 4 Preparation of Operating and Maintenance Documentation for Building Systems

1.04 QUALITY ASSURANCE

Commissioning Authority shall meet the following qualifications:

A. Commissioning Authority shall have a minimum of five (5) years of demonstrated experience in the commissioning of plumbing systems similar in size and complexity to this project.

B. Commissioning Authority shall hold a Certified Commissioning Professional (CCP) designation from the Building Commissioning Association.

1.05 ROLES AND RESPONSIBILITIES

A. Contracting Officer is the Facility Engineering Department.

1. Contracting Officer will advise HVAC Commissioning Authority regarding changes in building occupancy and/or usage.
2. Assign maintenance personnel and schedule them to participate in meetings, training session as follows:

   a. Construction-Phase coordination meeting
   b. Initial Owner training session at initial placement of major equipment
   c. Maintenance orientation and inspection
   d. Piping and ductwork test and flushing verification meetings
   e. Procedures meeting for Testing, Adjusting and Balancing
   f. Owner's training session
   g. Verification demonstrations
   h. Final review at acceptance meeting

3. Provide qualified personnel for video recording and editing of training sessions.
4. Video record construction process, hidden shafts, etc.
5. Provide any utilities required for the commissioning process.
6. Provide detailed program clearly stating the Owner's objectives, parameters, budgets, etc. for this facility.

B. Commissioning Authority

1. Commission Authority must be contracted with Facility Engineering Department directly and not through the General Contractor.
2. Develop the commissioning requirements and all related testing, verification and quality control sections.
3. Prepare the mechanical commissioning program required as part of the Commissioning Specification. Include lists of all contractors for commissioning events by name, firm, and trade specialty.
4. Develop detailed pre-test and final test reports forms, to be used by the Commissioning Authority for data recording purposes throughout the testing process. The Commissioning Authority shall specifically develop these forms for each system and piece of equipment installed on the project. All forms to be submitted for approval a minimum of one hundred and twenty (120) days prior to initial testing.
5. Execute the mechanical commissioning program, through organization of all tests, meetings, demonstrations, training events and performance verifications described in the Contract Documents and the approved HVAC commissioning program. Organizational responsibilities include preparation of agendas, attendance lists, arrangements for facilities and timely notification to participants for each commissioning event. The Commissioning Authority shall act as chairman at all commissioning events and assure the execution of all agenda items. The Commissioning Authority shall prepare minutes of every commissioning event and send copies to all those in attendance and the Owner within five (5) workdays of the event.
6. Review the Construction Documents which define the scope of the commissioning process and the final performance of the HVAC system.

This includes verification that appropriate commissioning guidelines have been followed, and that there are adequate devices included in the design to ensure the ability to properly test, adjust and balance the systems, and to document the performance of each piece of equipment and each system. Any items required but not shown shall be brought to the attention of the mechanical Contractor prior to submittal of shop drawings.

7. Review all approved submittals (e.g. equipment, ductwork, piping, automatic controls, and TAB procedures) for coordination with the commissioning process and the performance testing of the HVAC system.
8. Schedule regular Construction-Phase coordination meetings to include Owner and Contractor and Design Professional. These meetings shall be for the purpose of reviewing the complete mechanical commissioning program and establishing tentative schedules for mechanical system orientation and inspections, O&M submittals, training sessions, system flushing and testing, job completion, test, adjust and balance (TAB) work and verification and functional performance testing.
9. Schedule Owner training sessions so that they will be held at an appropriate timeframe relative to the turnover of the mechanical system to the Owner. These sessions shall be attended by the Owner's O&M personnel, the mechanical Contractor, the Design Professional, and the Commissioning Authority. The Design Professional shall conduct this session giving an overview of the system, the system design goals and the reasoning behind the selection of the equipment.
10. Conduct and record the results of periodic inspections, undertaken by the Commissioning Authority, of work in progress to ensure that all systems are installed according to specifications. The Commissioning Authority shall note in writing any deficiencies discovered. Once the deficiencies have been corrected, as reported by the mechanical Contractor, the Commissioning Authority shall re-inspect the work and report that the corrections have been made.
11. Assist the mechanical Contractor in recommending solutions to minor deficiencies.
12. Conduct the Mechanical system orientation and inspection following the initial training session. Any subsequent Mechanical system orientation and inspection shall be conducted by the mechanical Contractor. The emphasis of this Mechanical system orientation and inspection shall be an observation of the equipment location with respect to accessibility. Prepare minutes of this meeting, with separate summary of deficiency findings by the Owner and Commissioning Authority. Distribute to attendees and the Owner.
13. Adequate accessibility for maintenance and component replacement or repair is the Contractor's responsibility and shall be checked by the Commissioning Authority.
14. Receive and review the Operation and Maintenance (O&M) manuals as submitted by the Contractor (ensuring that they follow the specified outline and format), and as reviewed and approved by the Design Professional. Insert systems description as provided by the Design Professional.
15. Witness equipment and system start-up and testing. Ensure the results are documented (including a summary of deficiencies), and incorporated in the O&M manuals. The Commissioning Authority shall record all test results on pre-test and final test forms for each piece of equipment.

16. Prior to initiating the TAB work, meet with the Owner, mechanical Contractor, Design Professional, and TAB Contractor. The TAB Contractor shall outline TAB procedures and get concurrence from the Design Professional and Commissioning Authority. Ensure that the TAB Contractor has all forms required for the job database and understands their importance and use.
17. Schedule the O&M training sessions. All training sessions shall be on-site, except where otherwise specified. These training sessions are to be attended by the Owner, Commissioning Authority, Design Professional, Contractors and equipment suppliers as necessary. The format shall follow the outline in the O&M manuals. This mechanical system orientation and inspection should include hands-on training. The Commissioning Authority shall be solely responsible for recording all demonstration and training sessions on videotape, or alternative approved media, and furnish two (2) copies of the recording media to the Owner. Each session shall clearly reflect the content of each training session. Video tapes or other approved media and enclosures shall be neatly labeled.
18. Submit detailed verification test procedures and datasheets to the Design Professional for review.
19. Submit detailed FPT procedures to the Design Professional for review and acceptance.
20. Upon receipt of notification from the Design Professional that the mechanical systems have been completed and are operational, the Commissioning Authority shall proceed to verify the TAB report and operation of the control systems in accordance with the Commissioning Specification.
21. Conduct verification tests.
22. Record verification test data, and submit to the Design Professional for review and acceptance.
23. Provide detailed checklists datasheets to document verification tests.
24. Provide and install calibrated test instrumentation to monitor and record data as necessary.
25. Certify that the mechanical systems are ready for functional performance testing.
26. Observe and record functional performance tests.
27. Submit Functional Performance Test report to the Design Professional for review.
28. Re-test if performance deficiencies are found, corrected and additional testing is requested.
29. Review as-built drawings for accuracy with respect to installed systems. Review revisions to achieve accuracy.
30. Ensure that the O&M manuals and all other as-built records have been updated to include all modifications made during the Construction Phase.
31. Observe and record repeated functional performance tests to correct any performance deficiencies. Revise and re-submit the commissioning report.
32. Prepare the final commissioning report.
33. Assemble the final project documentation, which shall include the commissioning report and all as-built records. Submit this documentation to the Design Professional for review and acceptance.
34. The Commissioning Authority shall verify that all O&M manuals, “as-built” documentation, and training manuals and training sessions are complete in every aspect and in accordance with the project specifications. The

Commissioning Authority shall supplement the above documentation, as required, to make them complete.

C. Architect

1. Provide support to the Design Professional who must provide a service as a part of the commissioning process. This shall include providing adequate space for equipment installation and maintenance.
2. Conduct periodic inspections of work in progress to ensure that all systems and equipment are installed according to specifications.
3. Provide data on structure, building materials, interior finishes, and furnishings for their effect on indoor air quality.

D. Mechanical Design Professional

1. Provide documentation of initial design concepts and Design Intent on the Owner's program.
2. Provide mechanical system design parameters and obtain approval of Owner.
3. Prepare Construction Documents incorporating the Commissioning Specification requirements and description of the mechanical system.
4. The Design Professional shall specify and verify adequate maintenance accessibility for each piece of equipment in shop drawings and the actual installation.
5. The Design Professional retains responsibility for the system evaluation, adequacy of the system to meet design intent, capacity of the system, quality control check or any of the other elements of the system design.
6. Participate in O&M personnel orientation and inspection at the final construction stage.
7. Attend initial meeting with TAB representative as scheduled by the Commissioning Authority.
8. Review verification and functional performance testing procedures submitted by the Commissioning Authority, for conformance with the Construction Documents.
9. Review TAB report and verification datasheets for system conformance to the Contract Documents. Issue to the Commissioning Authority a report noting deficiencies requiring correction.
10. Review Functional Performance Testing report for deficiencies in meeting the finalized design intent.
11. Review as-built records as required by the Contract Documents and turn them over to the Commissioning Authority for inclusion in final project documentation.
12. Review and comment on the final commissioning report.

E. Electrical Design Professional

1. Provide documentation for electrical services to be provided for specific mechanical equipment requirements.
2. Provide electrical system information confirming compatibility with electrical service requirements specified by the mechanical design professional for all HVAC equipment and systems. Provide information necessary for the basis of design.

3. Prepare the Contract Documents that coordinate interfaces between life safety systems BMS, and HVAC systems including commissioning specifications.
4. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority.
5. Participate in the start-up of mechanical equipment and systems.
6. Participate in the mechanical training sessions as required.
7. Participate in review of shop drawings for mechanical equipment.
8. Verify that any space requirements for electrical equipment are in accordance with relevant code requirements.
9. Participate in O&M personnel orientation and inspection sessions.

F. General Contractor

1. Include cost for commissioning requirements in the contract price.
2. Coordinate construction progress with the commissioning schedule to assure that the building envelope and systems that affect proper operation and control of mechanical equipment and systems being tested are completed prior to testing.
3. Include commissioning requirements in the Mechanical, Electrical, and Division 23 BMS controls contracts, as well as all other sub-contractors, to ensure cooperation of all parties in the mechanical commissioning program.
4. Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the mechanical commissioning program as described in the Contract Documents.
5. Issue a statement that TAB work has been completed, and submit the final TAB reports for review.
6. Issue a statement that control systems have been tested and calibrated.
7. Remedy deficiencies identified in verification tests.
8. Evaluate any performance deficiencies identified in the FPT report for non-performance with the Contract Documents.
9. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.

G. Mechanical Contractor

1. Include cost of commissioning requirements in the contract price.
2. Include requirements for submittal data, O&M data, and training in each purchase order or sub-contract written.
3. Ensure cooperation and participation of specialty sub-contractors such as sheet metal, piping, refrigeration, water treatment, and TAB.
4. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
5. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority.
6. Assist the Commissioning Authority in all verification and functional performance tests.
7. Prepare preliminary schedule for mechanical system orientations and inspections, O&M manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, TAB and task completion for use by the Commissioning Authority. Update schedule as appropriate throughout the construction period.

8. Attend initial training session.
9. Conduct mechanical system orientation and inspection at the equipment placement completion stage.
10. Update drawings to the record condition to date, and review with the Commissioning Authority.
11. Gather O&M data on all equipment, and assemble in binders as required by the Commissioning Specification and Section 23 05 01 – HVAC General Provisions. Submit to Commissioning Authority prior to the completion of construction.
12. Coordinate with the Commissioning Authority to provide sufficient advanced notice so that the witnessing of equipment and system start-up and testing can begin.
13. Notify the Commissioning Authority a minimum of two weeks in advance of the time for start of the TAB work. Attend the initial TAB meeting for review of the official TAB procedures.
14. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the Commissioning Authority.
15. Provide written notification to the General Contractor and Commissioning Authority that the following work has been completed in accordance with the Contract Documents, and that the equipment, systems, and sub-system(s) are operating as required:

    a. HVAC equipment including all fans, air handling units, ductwork, dampers, terminals, and all Division 23 equipment.
    b. Refrigeration equipment, pumping systems and heat rejection equipment.
    c. Fire stopping in the fire-rated construction, including fire and smoke damper installation, caulking, gasketing and sealing of smoke barriers.
    d. Fire detection and smoke detection devices furnished under other divisions of this Specification as they affect the operation of the smoke control systems.
    e. That building control systems are functioning to control mechanical equipment and smoke control systems.

16. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.
17. Provide a complete set of as-built records to the Commissioning Authority.

H. Test, Adjust, and Balance (TAB) Contractor

1. Include cost for commissioning requirements in the contract price.
2. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
3. Submit the TAB procedures to the Commissioning Authority and Design Professional for review and acceptance.
4. Attend the TAB review meeting scheduled by the Commissioning Authority. Be prepared to discuss the procedures that shall be followed in testing, adjusting, and balancing the HVAC system.
5. Participate in training sessions as scheduled by the Commissioning Authority.

6. At the completion of the TAB work, and the submittal of the final TAB report, notify the Mechanical Contractor and the General Contractor.
7. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB where required by the Commissioning Authority for verification or diagnostic purposes.
8. The equipment supplier shall document the performance of their equipment. Performance testing shall be witnessed by the Commissioning Authority.

I. Automatic Controls and Building Management/Automation/Energy Management System Contractors

1. Include cost for commissioning requirements in the contract price.
2. Review design for controllability with respect to selected manufacturers equipment:

    a. Verify proper hardware specification exists for functional performance required by specification and sequence of operation.
    b. Verify proper safeties and interlocks are included in design.
    c. Verify proper sizing of control valves and actuators based on design pressure drops. Verify control valve authority to control coil properly.
    d. Verify proper sizing of control dampers. Verify damper authority to control air stream. Verify proper damper positioning for mixing to prevent stratification. Verify actuator vs. damper sections for smooth operation.
    e. Verify proper selection of sensor ranges.
    f. Clarify all questions of operation.

3. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
4. Provide the following submittals to the Commissioning Authority:

    a. Hardware and software submittals.
    b. Control panel construction shop drawings.
    c. Narrative description of each control sequence for each piece of equipment controlled.
    d. Diagrams showing all control points, sensor locations, point names, actuators, controllers and, where necessary, points of access superimposed on diagrams of the physical equipment.
    e. Logic diagrams showing the logic flow of the system.
    f. A list of all control points, including analog inputs, analog outputs, digital inputs, and digital outputs. Include the values of all parameters for each system point. Provide a separate list for each stand-alone control unit.
    g. A complete control language program listing including all software routines employed in operating the control system. Also provide a program write-up, organized in the same manner as the control software. This narrative shall describe the logic flow of the software and the functions of each routine and sub-routine. It should explain individual math or logic operations that are not clear from reading the software listing.

h. Hardware operation and maintenance manuals.
i. Application software and project applications code manuals.

5. Verify proper installation and performance of controls/BMS hardware and software provided by others.
6. Integrate installation and programming schedule with construction and commissioning schedules.
7. Provide thorough training of operating professionals on hardware operations and programming, and the application program for the system.
8. Demonstrate system performance to Commissioning Authority including all modes of system operation (e.g. normal, abnormal, emergency).
9. Provide control system technician for use during system verification and functional performance testing.
10. Provide systems modifications as required.
11. Provide support and coordination with TAB contractors on all interfaces between their scopes of work. Provide all devices, such as portable operators terminals, for TAB use in completing TAB procedures.
12. Additional trend logs may be required to facilitate the commissioning process.

J. Equipment Suppliers and Miscellaneous Contractors

1. Include cost for commissioning requirements in the contract price.
2. Provide submittals, and appropriate O&M manual section(s).
3. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
4. Participate in training sessions as scheduled by the Commissioning Authority.
5. Demonstrate performance of equipment as applicable.

K. Electrical Contractor

1. Include costs for commissioning requirements in the contract price.
2. Include requirements for submittal data, O&M data, and O&M training in each purchase order or subcontract written.
3. Enlist the support of the General Contractor to ensure cooperation of other subcontractors such as the automatic controls and building automation systems contractor, fire detection, and security as necessary.
4. Ensure participation of major equipment manufacturers through their representatives.
5. Ensure coordination, installation, and operation interfaces between life safety and HVAC systems.
6. Attend Construction-Phase coordination meeting scheduled by the Commissioning Authority. Prepare necessary preliminary schedule for O&M personnel orientation and inspections, O&M manual submission, training sessions, equipment start-up, testing and adjusting, and job completion for use by the Commissioning Authority. Update schedule appropriate throughout the construction period.
7. Attend initial training sessions and conduct the electrical system orientation and inspection at the equipment placement completion stage. Update drawings to record condition to date, and review the Commissioning Authority.

8. Gather O&M data on all equipment and assemble in binders as required by the commissioning specification. Submit to Commissioning Authority prior to the completion of construction.
9. Notify the Commissioning Authority of the item for each required test.
10. Participate in and schedule equipment suppliers and contractors to participate in the training sessions as set up by the Commissioning Authority.
11. Conduct a maintenance orientation and inspection with hands-on-training. Update drawings to record condition to date and review with the Commissioning Authority prior to the orientation.
12. Provide written certification to the General Contractor and the Commissioning Authority that the work has been completed in accordance with the plans and specifications and that it is functioning as designed. Where the work has been subcontracted, the contractor shall be responsible for the initial certification, with the electrical contractor certifying that they have inspected the work and that it has been completed and is functioning as designed. This certification must be submitted to the Commissioning Authority prior to the final verification.
13. Demonstrate the operation of each piece of equipment to the Commissioning Authority. Schedule subcontractors as they apply to demonstrate the operation of the equipment and systems.
14. Turn over set of record mark-up drawings to the electrical design professional for final incorporation into record documents.

1.06 DOCUMENTATION

The Commissioning Authority shall oversee and maintain the development of commissioning documentation. The commissioning documentation shall be kept in three ring binders, and organized by system and sub-system when practical. All pages shall be numbered, and a table of contents page(s) shall be provided. The commissioning documentation shall include, but not be limited to, the following:

A. A detailed description of the design intent for the project, listing operating parameters, control sequences, occupancy conditions etc.

B. A complete description of how the HVAC system is intended to operate.

C. Approved TAB report for the building being commissioned.

D. All accepted shop drawings of mechanical equipment. Shop drawings shall be full-size sheets folded as required to fit in binders.

E. All pre-functional performance test checklists, signed by indicating personnel, organized by system and sub-system.

F. All verification and functional performance test checklists/results, signed by indicated personnel, organized by system and sub-system.

G. Three copies of the operation and maintenance (O&M) manual(s) specified in other sections of these specifications shall be included with the commissioning documentation. The manuals shall be incorporated in the commissioning documentation prior to commencement of O&M training required in this and other sections of the specification. Preparation of O&M manuals shall be as specified in Paragraph 3.06 of this specification.

PART 2 – PRODUCTS

2.01 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Authority for approval.

B. The Owner shall furnish necessary utilities for the commissioning process.

2.02 TEST EQUIPMENT – PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

PART 3 – EXECUTION

3.01 GENERAL

A. A pre-construction meeting of all commissioning team members shall be held at a time and place designated by the Owner. The purpose shall be to familiarize all parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

B. The Contractor shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc. per the Contract Documents and related directives, clarifications, and change orders.

C. A Commissioning Plan shall be developed by the Commissioning Authority. The Contractor shall assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If contractor-initiated system changes have been made that alter the commissioning process, the Commissioning Authority shall notify the Contracting Officer.

D. Acceptance procedures are normally intended to begin prior to completion of a system and/or sub-systems, and shall be coordinated with the Division 23 Contractor. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems as per the schedule.

E. The Commissioning Authority shall develop a detailed schedule for acceptance procedures and training. The Commissioning Authority shall work in a cooperative manner with the mechanical (Division 23) Contractor to assure that the commissioning process does not interfere with the completion of work in accordance with the overall schedule.

3.02 PARTICIPATION IN ACCEPTANCE PROCEDURES

A. The Contractor shall provide skilled technicians to start up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program. Work schedules, time required for testing, etc. shall be requested by the Commissioning Authority and coordinated by the Contractor. Contractor shall ensure that the qualified technician(s) are available and present during the agreed-upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Authority time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained.

C. The Commissioning Authority reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and a willingness to work with the Commissioning Authority. Contractor shall provide adequate documentation and tools to start up and test the equipment, system, and/or sub-system(s).

3.03 DEFICIENCY RESOLUTION

A. In some systems, improper adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Contracting Officer, with input from the contractor, equipment supplier, and Commissioning Authority. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Contracting Officer shall have final jurisdiction over any additional work done to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority shall notify the Contracting Officer, indicating the nature of the problem, expected steps to be taken, and suggested deadline(s) for completion of activities. If the deadline(s) pass without resolution of the problem, the Contracting Officer reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner shall be the Contractor’s responsibility.

3.04 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The Contractor(s), suppliers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their contractual obligations.

3.05 ACCEPTANCE PROCEDURES

A. Verification Tests

1. Scope

a. Operating tests and checks to verify that all components, equipment, systems, sub-systems, and interfaces between systems operate in accordance with the Contract Documents. These tests are to include all operating modes, interlocks, specified control responses, specific responses to abnormal or emergency conditions and verifications of the proper response of the Building Automation System controllers and sensors.
b. Verify the validity of the TAB report.

2. Participants

The Commissioning Authority shall be responsible for preparing the scope of these tests. The Commissioning Authority shall schedule the tests and assemble the commissioning team members who shall be responsible for the tests. Participating contractors, manufacturers, suppliers, etc. shall include all costs to do the work involved in these tests in their proposals. Following is a list of tasks and supporting information that shall be required:

a. Mechanical Contractor: Provide the services of technician(s) who is (are) familiar with the construction and operation of this system. Provide access to the contract plans, shop drawings, and equipment cutsheets of all installed equipment.
b. Controls Contractor: Provide the services of a controls engineer who is familiar with the details of the project. Provide details of the control system, schematics, and a narrative description of control sequences of operation.
c. Electrical Contractor: Provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces, and interlocks.

3. Documentation and Reporting Requirements

a. Provide checklists for each component, piece of equipment, system, and sub-system, including all interfaces, interlocks, etc. Each item to be tested shall have a different entry line with space provided for comments. Separate checklists shall be prepared for each mode of operation. Provide space to indicate whether the mode under test responded as required or not. Also, provide space for all necessary parties to sign off on each checklist.
b. Data sheets used in verification of the proper operation of the control system shall include each controller to be verified, and its location. For each controller, provide space for recording the readout of the controller, the reading at the controller’s sensor(s), and any comments. Also, provide space for all necessary parties to sign off on each checklist.

c. All test procedures and data sheets shall be submitted to the design professional for review and acceptance.

4. Instrumentation

a. The Commissioning Authority shall furnish all measurement instrumentation for the verification tests. All instruments will have calibrated within the six-month period prior to these tests.

5. Procedures

a. The Commissioning Authority shall direct and witness the verification operating tests and checks for all equipment and systems.

(1) Set the system equipment (i.e., chiller, boiler, pumps, fans, etc.) into the operating mode to be tested, i.e. normal shut down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.
(2) The Commissioning Authority shall inspect and verify the position of each device and interlock identified on the checklist. Each item shall be signed off as acceptable (yes), or failed (no).
(3) This test shall be repeated for each operating cycle that applies to the mechanical system being tested.
(4) Operating checks shall include all safety cutouts, alarms and interlocks with smoke control and life-safety systems during all modes of operation of the mechanical system.
(5) If during a test an operating deficiency is observed, appropriate comments shall be added to the checklist datasheet.
(6) Verification of the interface of the Building Management System and the TAB criteria shall include the following:

(a) Verify supply and return flow rates for VAV and constant volume systems in all modes of operation of the HVAC system.
(b) Verify operation of the terminal units in both heating and cooling cycles.
(c) Verify minimum outdoor air and intake air in all modes of operation and at minimum and maximum total air flow rates.
(d) Verify building pressurization.
(e) Verity total exhaust air flow, and total outdoor air intake.

(7) Verification of the proper responses of Building Management System controllers and sensors shall be as follows:

(a) For each controller or sensor, record the indicated monitoring and control system reading, and the test instrument reading.

(b) If the initial test indicates that the test reading is outside of the control range of the installed device, the calibration of the installed device shall be checked and adjusted as required. The deficient device shall be re-tested and the results recorded on the checklist data sheet.

b. The Commissioning Authority shall direct and witness the field verification of the final TAB report.

(1) The Commissioning Authority shall select, at random, 10 percent of the report data for verifications.
(2) The TAB Contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified. The TAB Contractor must use the same instruments (by model and serial number) that were used when the original data were collected.
(3) Failure of an item is defined as:

(a) For all readings other than sound, a deviation of more than 10 percent.
(b) For sound pressure readings, a deviation of 3 decibels. (*Note: variations in background noise must be considered*).

(4) A failure of more than 10 percent of the selected items shall result in the rejections of the final TAB report.

c. If the deficiencies are identified during verification, the General Contractor must be notified, and action taken to remedy the deficiency. The final tabulated checklist datasheets shall be reviewed by the Design Professional and the Commissioning Authority, to determine if verification is complete, and the operating system is functioning in accordance with the Contract Documents.

B. Functional Performance Testing

1. Scope

a. Functional performance tests shall determine if the HVAC system is providing the required cooling and heating services in accordance with the final design intent. They shall also determine the installed capacity of the cooling and heating plant, and heat transfer components. Following is a list of test examples:

(1) Determine capability of cooling system to deliver cooling at the design supply temperature, and required rate of flow.
(2) Determine capacity of heating system to deliver heating at the design temperature.

(3) Determine the ability of the HVAC unit to deliver the cooling and/or heating services to the distribution system, at the design supply air temperature, required static pressure, and proper outside air ventilation rate.

2. Submittals

a. Detailed procedures for each series of tests shall be submitted to the Commissioning Authority for review and acceptance. The procedures shall include samples of the datasheets that will be part of the reports.

3. Participants

a. Participants in the functional performance tests shall be the same as those listed in the verification tests.

4. Instrumentation

a. In addition to the instrumentation requirements detailed under verification, the Commissioning Authority may need to provide data acquisition equipment to record data for the complete range of testing.

5. Procedures

a. The Commissioning Authority shall supervise and direct all functional performance tests.
b. For each test, the Commissioning Authority shall install the measuring instruments and logging devices to record test data for the required test period. The instrumentation shall monitor and record all operating conditions to allow for complete evaluation of the test results.
c. Measurement will be required to allow for calculation of total capacity of the system for each mode of operation under test.

6. Documentation and Reporting Requirements

a. All measured data, datasheets, and a comprehensive summary, describing the operation of the HVAC system at the time of testing, shall be submitted to the Commissioning Authority.
b. A preliminary Functional Performance Test report shall be prepared by the Commissioning Authority and submitted to the Design Professional for review. Any identified deficiencies need to be evaluated by the Design Professional and Construction Manager to determine if they are part of the Contractor's contractual obligations. Construction deficiencies shall be corrected by the responsible Contractor(s) and the specific functional performance test repeated.
c. If it is determined that the HVAC system is constructed in accordance with the Contract Documents, and the performance deficiencies are not part of the Contract Documents, the Contracting Officer must decide whether any required modifications needed to bring the performance of the HVAC

system up to the finalized design intent shall be implemented, or if the test shall be accepted as submitted. If corrective work is performed, the Contracting Officer shall determine if a portion or all required functional performance tests should be repeated, and a revised report submitted.

3.06 OPERATING AND MAINTENANCE MANUAL

A. The operating and maintenance manual shall consist of a sturdy binder with 8.5-inch by 11-inch sheets containing the following major sections:

1. System Descriptions

a. Each major system shall be described, typewritten, in general terms, including major components, interconnections, theory of operation, theory of controls, unusual features and major safety precautions. This information should correlate with information provided in the manufacturer's instruction book. This Section shall include, but not be limited to, the following data:

(1) Detailed description of each system and each of its components showing piping, valves, controls, and other components, with diagrams and illustrations where applicable
(2) Wiring and control diagrams with data to explain detailed operation and control of each component
(3) Control sequences describing start-up, all modes of operation, and shut-down
(4) Corrected shop drawings
(5) Approved products data including all performance curves and rating data
(6) Copies of approved certifications and laboratory test reports (where applicable)
(7) Copies of warranties

b. System diagrams, described in Clause 3.7.B. following, shall be incorporated in the appropriate systems descriptions. These should be reduced in size or folded to usefully fit into the manual.

2. Operating Instructions

a. Condensed, typewritten, suitable for posting, instructions shall be provided for each major piece of equipment. Where more than one (1) common unit is installed, one instruction is adequate. The instructions shall provide procedures for:

(1) Starting up the equipment/system
(2) Shutting down the equipment/system
(3) Operating the equipment in emergency or unusual conditions
(4) Safety precautions
(5) Troubleshooting suggestions
(6) Other pertinent data applicable to the operation of particular systems or equipment

b. The instructions shall be suitable for posting adjacent to the equipment concerned.
c. The Contractor shall provide instructions for:

(1) Hydronic distribution systems, including pumps
(2) Air handling units and exhaust fans
(3) DX AC units
(4) Heating and cooling plants
(5) DDC control systems
(6) Variable frequency drive

3. Ongoing and Preventive Maintenance

a. Condensed, typewritten procedures for recommended ongoing and preventive maintenance actions shall be provided for each category of equipment/system listed above.
b. This information shall include, but not be limited to, the following:

(1) Maintenance and overhaul instructions
(2) Lubricating schedule including type, grade, temperature, and frequency range
(3) Part list, including source of supply and recommended spare parts
(4) Name, address, and 24-hour telephone number of each sub-contractor who installed equipment and systems, and local representative for each type of system
(5) Other pertinent data applicable to the maintenance of particular systems or equipment

c. These recommended preventive maintenance actions shall be categorized by the following recommended frequencies:

(1) Weekly
(2) Monthly
(3) Quarterly
(4) Semi-Annual
(5) Annual
(6) Other

B. Posted Operating Instructions and Diagrams

1. Operating Instructions

a. Copies of operating instructions provided in the operating manual (cf sub-Clause 3.7.A) shall be posted in the near vicinity of each piece of applicable equipment. The instructions shall be mounted neatly in frames under Plexiglas, where they can be easily read by operating personnel. Instructions mounted outdoors shall be suitably protected from weather.

2. Posted Systems Diagrams

a. Simplified one-line diagrams of the systems listed shall be developed and transcribed on transparent “D” sized erasable

sepia film and posted neatly under Plexiglas in the main or most appropriate equipment room for each reference by operating and maintenance personnel. These drawings shall be done in a professional manner which is acceptable to the Maintenance Division staff. The diagrams shall show each component including all valves installed in the system, with name and identifying number. If space does not permit valve numbers on the diagrams, valve charts shall be provided. Explanatory notes, where needed, shall be provided.

(1) HVAC controls diagram
(2) Hydronic distribution system
(3) Air handling/ventilation system
(4) Other systems as applicable

b. These diagrams shall be suitable for reduction in size and use in the operating manual system descriptions previously covered.

3.07 OPERATING AND MAINTENANCE TRAINING

A. The Mechanical Contractor, and appropriate sub-contractors, shall provide comprehensive operating and maintenance instruction on building systems in accordance with the Contract Documents prior to delivery. The instruction shall include classroom instruction delivered by competent instructors based upon the contents of the operating manual. Emphasis shall be placed upon overall systems diagrams and descriptions, and why systems were designed as they were. The classroom instruction(s) shall also include detailed equipment instruction by qualified manufacturer representatives for all equipment for which operating instructions are provided. The manufacturer representative training shall emphasize operating instructions, and preventive maintenance as described in the operating manual. At a minimum, the training sessions shall cover the following items:

1. Types of installed systems
2. Theory of operation (preferably delivered by the design engineers)

a. Design intent
b. Occupied vs. unoccupied or partial occupancy
c. Seasonal modes of operation
d. Emergency conditions and procedures
e. Comfort conditions
f. Indoor air quality
g. Energy efficiency
h. Other issues important to facility operation

3. System operations
4. Use of control system

a. Sequence of operation
b. Problem indicators
c. Diagnostics
d. Corrective actions

5. Service, maintenance, diagnostics and repair

6. Use of reports and logs
7. Troubleshooting, investigation of malfunctions, and determining reasons for the problems

B. Each classroom training period shall be followed by an inspection, explanation and demonstration of the system concerned by the instructors. All equipment listed in sub-Clause 3.7.A. shall be started up and shut down, with the exception of sprinkler system.

C. The Contractor shall be responsible for organizing, arranging, and delivering in a manner and on a schedule agreeable to the Contracting Officer.

D. The Contractor shall provide, at or before substantial completion, a proposed agenda and schedule of the above training for approval by the Commissioning Authority and the Contracting Officer.

E. Each classroom training session and demonstration shall be recorded on videotape or alternative acceptable media and submitted to the Contracting Officer.

END OF SECTION

SECTION 23 09 23
DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Provide a complete, fully integrated Building Management System (BMS) incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities in accordance with the Contract Documents. The BMS shall be DDC with electric actuation as specified herein.

B. The work under this Section of the Specifications includes all labor, materials, equipment and services to provide a fully operational native BACnet Building Management System (BMS). For terms of this specification, "native BACnet" means that all of the BMS devices, from the front end operator's workstation to the building controllers and down to the unitary controller level, only speak and understand BACnet. The devices may be interconnected using any of the approved BACnet LAN technologies. The BMS shall be a totally native BACnet-based system, including a Microsoft Windows (or approved alternate operating system) operator's workstation, based on a distributed control system in accordance with this Specification. The operator's workstation, all building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ASHRAE Standard 135 and ASHRAE Standard 135.1 BACnet. No gateways shall be used for communication to controllers installed under this Section. Gateways may be used for communication to existing systems or to systems installed under other sections. The work in general consists of, but is not limited to, the following:

1. The native BACnet BMS shall be as specified and consist of a high-speed, peer-to-peer network of DDC controllers and an operator workstation. The operator workstation shall be a personal computer (PC) with color monitor, mouse, keyboard, and printer. The PC shall allow a user to interface with the network via dynamic color graphics. Each HVAC system, lighting system(s), building floor plan, and control device will be depicted by point-and-click graphics.
2. Remote portable operators interface computer units as specified.
3. A dedicated data communications network including electric isolation and protection from electrical interference.
4. A network of stand-alone Direct Digital Control (DDC) controllers and field panels, including sensors, and control devices.
5. Complete electrical installation including wiring, raceways and power wiring, except as noted.
6. Software required to produce a complete and operational native BACnet BMS as specified herein. Include a minimum of two licenses for any proprietary software being provided.
7. Complete operating and maintenance manuals and field training of operators and maintenance personnel.
8. System commissioning and acceptance tests as specified.
9. Full documentation for all software and equipment provided.
10. Project management for managing system installation including, but not limited to: Design, installation, equipment delivery, and coordination with other trades, labor management, commissioning and acceptance testing.

11. Review of fire alarm shop drawing for acceptance by BMS contractor to ensure proper coordination of scope of work, wiring and operating sequences.
12. Provision for interface wiring or network integration to emergency power, lighting, and other Divisions of the specifications.
13. Miscellaneous control wiring including, but not limited to:

    a. Wiring of packaged heat pump unit thermostats
    b. Fuel oil control system
    c. Chiller control panel interface wiring
    d. Boiler control panel interface wiring
    e. Packaged standard or custom equipment control panel interface wiring
    f. Cooling tower control wiring
    g. Cooling tower level controls and filter/separator
    h. Interlock wiring including summary alarm supervision or stand-alone systems
    i. Power wiring from designated Division 26 outlets or circuits to BMS components that require power
    j. Interconnecting wiring between indoor unit and outdoor unit for split systems.

14. Warranty of system including all associated materials, labor, and services for period of one year from the date of final acceptance.
15. Web-based operator access software.
16. Electronic sensors.
17. All actuators for valves and dampers shall be electric. All sensors shall be electric/electronic.
18. All line voltage and low voltage wiring, conduit, panels, and accessories for a complete operational system. All final electrical connections to each standalone DDC Controller.
19. BMS Contractor shall be responsible for all electrical work associated with the BMS and as shown in the contract documents.
20. The BMS contractor shall be responsible for all electrical work associated with any BMS interface to any other systems including but not limited to HVAC and plumbing systems.
21. The BMS contractor shall furnish all wells for water monitoring devices, flow switches, and alarms.
22. The BMS system, as a whole, shall have the capability to be easily expanded through the addition of point modules and/or controllers. No equipment shall be installed which cannot, as installed, accommodate an upgrade the entire system by at least 25%. A 25% system upgrade shall include 25% more points (of each type) either via point modules or controllers and 25% more memory capacity for future connections.
23. Provide appropriate labor jurisdiction to mount, wire and pipe airflow measuring stations in the field. Provide manpower as required to meet project schedule.

C. The BMCS contractor shall fully coordinate his work with the equipment specified and supplied under other specification sections. A review of all equipment schedules located on the contract drawings shall be performed. Coordinate this information with the actual approved equipment cuts/submittals. Provide all additional components which may be required to interface with the equipment as called for in this specification. The BMCS contractor shall detail, layout, and

provide all components required for the BMCS criteria for each piece of equipment. The contractor must pay particularly close attention to areas which call for direct network integration, through the utilization of standard protocols, to devices furnished under other specification sections.

D. Provide all necessary permits, applications, filings and associated fees which may be required to perform the work called for in this specification.

E. Qualification Proposal:

1. Submit complete proposal for review prior to final acceptance of mechanical division bid. The following information shall be submitted:

   a. Schematic of BMS configuration indicating DDC panels, locations, capacity and functions.
   b. List of subcontractor and supplier of components with descriptions of their services or components furnished.
   c. Location and qualification of primary software programming support staff.
   d. Specific detailed list of all areas of the proposed native BACnet BMS that cannot comply with the requirements of the Contract Documents. Reference the specification paragraph where compliance is not possible. Provide additional information to evaluate the impact of the deviation.
   e. Provide all required detailed information for a satisfactory evaluation of the bid. Failure to submit may result in rejection of proposal.

2. Submit written resumes of key personnel proposed on the project.
3. The following minimum qualifications are required from the native BACnet BMS contractor.

   a. Have comprehensive local service and trained support personnel capable of giving instruction and provide emergency maintenance on the system, including all software, firmware and hardware components.
   b. Have access to local supplies of essential expendable and spare parts.
   c. Have a proven record of successful native BACnet installations and maintenance of equivalent native BACnet systems for a minimum period of 5 years.
   d. Have installed two native BACnet systems of similar size and BMS architecture.
   e. Provide all engineering, programming and support by a local office located within 25 miles of the project site.

1.02 RELATED DOCUMENTS

A. Section 22 11 00 – Domestic Water Systems

B. Section 22 11 23 – Plumbing Pumps

C. Section 22 63 00 – Natural Gas Systems

D. Section 23 05 01 – HVAC General Provisions

E. Section 23 05 14 – Variable Frequency Drives for HVAC

F. Section 23 05 19 – Meters, Gauges and Thermometers for HVAC

G. Section 23 05 23 – General-Duty Valves for HVAC Piping

H. Section 23 05 48 – Vibration and Seismic Controls for HVAC

I. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

J. Section 23 08 00 – Commissioning of HVAC

K. Section 23 09 23 – Direct Digital Control System for HVAC

L. Section 23 09 93 – Sequence of Operations for HVAC Controls

M. Section 23 21 13 – Piping

N. Section 23 21 16 – Hydronic Piping Specialties

O. Section 23 33 13 – Dampers

P. Section 23 36 00 – Air Terminal Units

Q. Section 23 40 00 – HVAC Air Cleaning Devices

R. Section 23 52 16 – Condensing Boilers

S. Section 23 74 13 – Commercial Packaged Rooftop Air Conditioning Units

T. Section 23 81 23 – Computer-Room Air-Conditioners

U. Section 23 81 26 – Split-System Air-Conditioners

V. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

A. ANSI – American National Standards Institute

B. ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE Standard 135 A Data Communication Protocol for Building Automation and Control Networks
2. ASHRAE Standard 135.1 Method of Testing for Conformance to BACnet

C. ASME – American Society of Mechanical Engineers

1. ASME Standard for Boiler and Pressure Vessel Code

a. ASME BPVC – I through XII

2. ASME Standard A13.1 Scheme for the Identification of Piping Systems

D. FCC – U.S. Federal Communication Commission

1. Part 15 – Radio Frequency Devices

E. FDDI/ANSI – Fiber Distributed Data Interface (a set of ANSI protocols for sending digital data)

1. FDDI/ANSI Standard X3T9.5 – Implementing FDDI over Copper

F. FM – FM Approvals LLC

G. MIL – Military Standard labeled

1. MIL-STD-810G – Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

H. NEC – National Electric Code

1. NEC Article 770 – Optical Fiber Cables
2. NEC Article 800 – Communications Circuits

I. NEMA – National Electrical Manufacturers Association

1. NEMA ICS 6 Industrial Controls and System Enclosures

J. NFPA – National Fire Protection Association

1. NFPA Standard 70 National Electrical Code

K. UL – Underwriters Laboratories Inc.

1. UL Standard 873 Temperature-Indicating and -Regulating Equipment
2. UL Standard 1449 Surge Protective Devices

L. Local State and City Codes

M. Local Codes

1.04 QUALITY ASSURANCE

A. The Contractor shall provide an experienced full-time Project Manager for this work, responsible for direct supervision of installation and startup of the system.

B. Comply with all current governing codes, ordinances and regulations, as well as with requirements of all other applicable codes.

C. Comply with Standards listed in Paragraph 1.03.

D. Perform work in accordance with NFPA 70.

E. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years of documented experience.

F. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience.

G. The Installer shall have an established working relationship with the Control System Manufacturer.

H. The Installer shall have successfully completed Control System Manufacturer's classes on the control system. The Installer shall present for review the certification of completed training, including the hours of instruction and course outlines upon request.

I. All products used in this installation shall be new, currently under manufacture, and shall be applied in standard off the shelf products. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner in writing. Spare parts shall be available for at least 10 years after completion of this contract.

J. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.05 SUBMITTALS

A. General: Indicate at the beginning of each submittal known substitutions and deviations from requirements of the Contract Documents. Refer to Section 23 05 01 – HVAC General Provisions.

B. Product Data: Provide technical bulletins and catalog data for all equipment and system components. Clearly identify, by use of symbol or tag number, the service of each item. All irrelevant information shall be marked out leaving only pertinent data. For all system elements (building controller(s), application controllers, routers, and repeaters) provide BACnet Protocol Implementation Conformance Statements (PICS) as per ASHRAE Standard 135 and ASHRAE Standard 135.1.

C. Shop Drawings:

1. Shop drawing submittals shall include sufficient data to indicate complete compliance with Contract Documents. Submissions of drawings, brochures, bulletins, catalog data, and narrative descriptions shall include as a minimum:

a. Symbol and abbreviation lists.
b. System block diagram showing quantity and location of PC, operator console equipment, native BACnet DDCs, field equipment panels and major system components.
c. For each system controlled, provide control panel diagram, system flow diagram and sequence of operations:

1) Control panel diagrams: Provide detailed input and output wiring to each controller within panel. Provide detailed Bill of Materials for each component within

panel. Provide detailed panel diagram showing location of each component within panel including transformers, panduit, terminal blocks, etc.

2) System Flow Diagram: A system flow diagram for every controlled or monitored system should be shown. Flow diagram should show location of each control component on flow diagram and associated wiring. Provide detailed bill of materials for each component shown on the flow diagrams.

3) Sequence of operations: For each system controlled or monitored, provide a detailed sequence of operations. Sequence of operations shall not be a copy of the contract documents but should be the contractors interpretation of the sequences presented in the contract documents.

d. Interfaces (software and hardware) with equipment provided in other sections of specifications.

e. Narrative description of operation for each system, enumerating and describing the function of each component. Include alarm and emergency sequences, and equipment interlocks.

f. Description of manual override capabilities.

g. Complete input and output point schedule. Identify network number, control panel (if applicable), points associated controller address, input or output number, point function, signal type and controller or panel location.

h. Spare capacity provisions.

i. Detailed bill of materials.

j. Valve and damper schedule: Provide identification numbers, location, system, dimensions and performance data.

k. Device mounting details: Include as a minimum:

1) Sensing elements in ducts or casings.

2) Sensing elements in piping.

2. Complete full-size drawings, 11-inch by 17-inch minimum using AutoCAD Software.

D. Programming:

1. Point identification code.
2. System advisory messages, printouts, logging formats.
3. System graphics showing monitored points.
4. Software flow charts for application and DDC programs.
5. Graphic User Interface program, include commands, alarm annunciation, logs and programming capabilities.
6. Description of system operation under failure conditions.

E. Samples:

1. Thermostat, humidity sensor and temperature sensor covers.
2. All devices mounted on finished surfaces or exposed.

F. Quality Control Submittals:

1. UL, FM listing compliance certificates.
2. Final calibration, commissioning and testing reports.

G. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.

H. Operation and Maintenance Data:

1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
2. Include keyboard illustrations and systematic procedures indexed for each operator function.
3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

I. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.06 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Installation of the following items furnished under this Section but installed under other sections.

1. Automatic control valves
2. Automatic control dampers
3. Thermowells
4. Airflow measuring stations
5. Liquid flow sensor – transmitters
6. Liquid flow switches
7. VAV and fan coil type terminal unit DDC controllers
8. Packaged air handling equipment DDC controller

B. Designated circuits shall be furnished by the Division 26 Contractor from the distribution panelboards for BMS power. Power wiring from the designated power outlets or circuits shown on Division 26 drawings to BMS components shall be within the work scope of this section (Unless otherwise specified).

C. Supervise and coordinate the installation of equipment, instruments and materials furnished under this Section but installed under other Divisions of the Specifications. All equipment and instruments shall be installed in strict accordance with the manufacturer’s published installation instructions.

1.07 PRODUCTS NOT FURNISHED OR INSTALLED BY THE BUILDING MANAGEMENT SYSTEM SPECIFICATION BUT INTEGRATED WITH THE WORK OF THIS SECTION

A. Boiler Controls

B. Variable Frequency Drives

C. Water Treatment Controls

D. Packaged Air Conditioners

1.08 SYSTEM DESCRIPTION

A. System Configuration:

1. The Building Management System (BMS) shall perform both monitoring and control of mechanical and electrical equipment for building management, energy conservation, and environmental control.
2. The BMS control philosophy shall be direct digital control and be implemented by a distributed digital system.
3. The personal computer (PC) shall provide for overall building data acquisition and transfer, report generation, historical data storage and retrieval, and operator interface.
4. The PC and DDCs shall communicate through dedicated communications network(s). All communications on network shall be by digital signals only. Operator's workstation shall as a minimum support Point-to-Point (PTP) and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device. Operator's terminal shall comply with the requirements of a BACnet conformance Class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:

    a. Clock Functional Group
    b. Event Response Functional Group
    c. Time Master Functional Group
    d. Device Communications

5. The native BACnet Direct Digital Controllers shall perform remote data acquisition and process control. DDC panels shall be locally mounted completely self-contained, field programmable, real-time microprocessor based controllers capable of stand alone operation.
6. Each native BACnet DDC shall be connected to its particular controlled environment through field input/output (I/O) instrumentation.

B. Design and Performance Criteria:

1. Expansion Capability:

    a. System Point Capacity. Main equipment controllers installed shall have 20% or greater spare I/O capacity. In addition, the system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The PC operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.
    b. System shall be modular to allow change of function and operation in the field by plug-in modules, equipment and software changes to expand system capacity without interrupting system operation.

2. System Performance:

a. The system shall conform to the following minimum performance standard:

1) Graphic Display: The system shall display a graphic with 20 dynamic points with all current data within 10 seconds.
2) Graphic Refresh: The system shall update a graphic with 20 dynamic points with all current data within 8 seconds.
3) Object Command: The maximum time between the command of a binary object by the operator and the reaction by the device shall be less than 2 seconds. Analog objects should start to adjust within 2 seconds.
4) Object Scan: All changes of state and change of analog values shall be transmitted over the high-speed network such that any data used or displayed at a controller or workstation has been updated within the previous 60 seconds.
5) Alarm Response Time: The maximum time from when an object goes into alarm to when it is annunciated at the workstation shall not exceed 45 seconds.
6) Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. The Contractor shall be responsible for selecting execution times consistent with the mechanical process under control.
7) Performance: Programmable controllers shall be able to execute DDC PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.
8) Multiple Alarm Annunciations: All workstations on the network shall receive alarms within 5 seconds of each other.
9) Reporting Accuracy: The system shall report all values with an end-to-end accuracy as listed or better than those listed in Table 1.
10) Stability of Control: Control loops shall maintain measured variable at setpoint within the tolerances listed in Table 2 below.

Table 1: BMS System Performance Reporting Accuracy

Edit this Measured Variable	**Reported Accuracy**
Space Temperature	plus or minus 1 degree F
Ducted Air	plus or minus 1 degree F
Outside Air	plus or minus 2 degrees F
Water Temperature	plus or minus 1 degree F
Delta-T	plus or minus 0.25 degree F

Edit this Measured Variable	**Reported Accuracy**
Relative Humidity	plus or minus 2.5 percent RH
Water Flow	plus or minus 5 percent of full scale
Airflow (terminal)	plus or minus 10 percent of full scale (Note 1)
Airflow (measuring stations)	plus or minus 5 percent of full scale
Air Pressure (ducts)	plus or minus 0.1 inches water gauge
Air Pressure (space)	plus or minus 0.01 inches water gauge
Water Pressure	plus or minus 2 percent of full scale (Note 2)
Electrical (A,V,W, Power Factor)	plus or minus 5 percent of reading (Note 3)
Carbon Monoxide (CO)	plus or minus 5 percent of reading
Carbon Dioxide (CO_2)	plus or minus 50 parts per million
Thermal Energy	plus or minus 2 percent of reading
Note 1: 10-100 percent of scale	
Note 2: For both absolute and differential pressure	
Note 3: Not including utility-supplied meters	

Table 2: BMS System Control Stability and Accuracy

Controlled Variable	**Control Accuracy**	**Range of Medium**
Duct Air Pressure	plus or minus 0.2 inches water gauge	0-6 inches water gauge
Space Differential Air Pressure	plus or minus 0.01 inches water gauge	-0.1 to 0.1 inches water gauge
Airflow	plus or minus 10 percent of full scale	
Space Temperature	plus or minus 1.0 degrees F	
Duct Temperature	plus or minus 2.0 degrees F	
Humidity	plus or minus 5 percent RH	
Fluid Pressure	plus or minus 1.5 psi	1-150 psi
	plus or minus 1.0 inches water gauge	0-50 inches water gauge differential

b. Environmental Conditions:

1) The native BACnet DDCs, Field Equipment Panels, and other equipment shall operate under continuous ambient environmental conditions of 35 degrees to 122 degrees F dry bulb and 10 percent to 95 percent relative humidity, non-condensing as a minimum. Sensors and control elements shall operate under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location.
2) Other equipment, such as video screen terminals and printers, shall, unless designated otherwise, operate properly under continuous ambient environmental conditions of 50 degrees to 104 degrees F and a relative humidity of 20 percent to 80 percent.

c. Materials and Equipment:

1) Where multiple units of the same type are required, the units shall be products of a single manufacturer; however, the component parts of the system need not be the products of a single manufacturer. The components shall not require customizing other than setting jumpers and switches and adding firmware. Each major component of equipment shall be labeled with the manufacturer's name, address, model and serial number.
2) All systems and components shall have been thoroughly tested and proven in actual use.

d. Total system shall be immune to internal- and external-generated sources of electrical noise.

1.09 OWNER'S MANUALS

A. General:

1. Submit draft copy of Owner's manuals for review in PDF format. After review by authorized representative, the Contractor shall incorporate review comments and submit final copies in PDF and hard copy format.
2. Update manuals with modifications made to system during guarantee period. Provide replacement pages or supplements in quantity stated above.
3. Assemble Owner's manuals into multi-volume sets as necessary and required by the Owner.
4. Protect each volume with a heavy duty vinyl plastic binder. Volumes to have plastic printed dividers between major sections and have oversized binders to accommodate up to 1/2-inch thick set of additional information.
5. Each binder shall show the project name and volume title on front cover and spine.
6. On the first page of each manual identify the project name, manual title, Owner's name, Engineer's name, Contractor's name, address and service phone number, and person who prepared manual. Provide a detailed table of contents for each volume of the manuals.

7. Provide a digital copy of the manual. Document format shall be Adobe Acrobat Current Version.
8. Embed PDF of the manual within the user interface home screen graphic.

B. Operating manual to serve as training and reference manual for all aspects of day-to-day operation of the system. As a minimum include the following:

1. As-builts of submittal drawings. This should reflect the as-built conditions of the control panels, wiring, flow diagrams and sequence of operations.
2. Sequence of operation for automatic and manual operating modes. The sequences shall cross reference the system point names.
3. Description of manual overrides operation of control points.
4. System manufacturer's complete operating manuals.
5. Troubleshooting sequence, flow diagram and procedures.
6. Provide a digital copy of the manual on flash drive. Document format shall be Adobe Acrobat Current Version.

C. Provide maintenance manual to serve as training and reference manual for all aspects of day-to-day maintenance and major system repairs. As a minimum include the following:

1. Complete as-built installation drawings for each system including locations on plans of all control devices drawn to scale. As-built drawings shall be submitted in AutoCAD format.
2. Overall system electrical power supply scheme indicating source of electrical power for each system component.
3. Indicate which components are on emergency power and indicate all battery backup provisions.
4. Overall system shielding and grounding scheme indicating all major components and ground paths.
5. Photographs and drawings showing installation details and locations of equipment.
6. Routine preventative maintenance procedures, corrective diagnostic troubleshooting procedures, and calibration procedures.
7. Parts lists with manufacturer's catalog numbers and ordering information.
8. Cut sheets of every component listed on the bill of materials. Cut sheets should indicate exact component used.
9. Lists of ordinary and special tools, operating materials, supplies and test equipment recommended for operation and servicing.
10. Manufacturer's operating set-up, maintenance and catalog literature for each piece of equipment.
11. Recommended spare parts.
12. Recommended maintenance frequency.
13. Approximate installation date for each component and recommended replacement frequency.
14. Field test reports.
15. Provide a digital copy of the manual. Document format shall be Adobe Acrobat Current Version.

D. Provide Programming Manual to serve as training and Reference Manual for all aspects of system programming. As a minimum include the following:

1. Complete programming manuals, and reference guides.
2. Details of any special software packages and compilers supplied with system.
3. Information required for independent programming of system.
4. Documentation on application and DDC programs: Flow charts, equations, and parameters.
5. Point schedule; include all points, real and virtual.
6. Software troubleshooting procedures.
7. Provide a digital copy of the manual. Document format shall be Adobe Acrobat Current Version.

1.10 MAINTENANCE

A. Submit an alternate price to perform complete preventative and emergency maintenance of the native BACnet BMS for a period of one (1) year in accordance with the Contractor's recommended standards and schedule. This price shall be itemized to show material costs and labor costs. This price shall be based upon work being executed during normal working hours, but shall include separate emergency callout provisions. Prices submitted should be based upon current price lists and labor rates, details of which shall be included with the bid and should be broken out into three categories.

1. Computer hardware and associated equipment
2. Field equipment including DDCs, sensors and final control elements
3. Software and programming

B. The preventative maintenance contract may be renewed annually, at the option of the Owner, up to a total term of 10 years. The annual price shall be negotiated 3 months in advance of annual contract expiry and shall be at the mutual agreement of both parties. Variation in annual prices shall reflect only changes in material and labor costs as substantiated by Federal Guideline Consumer Price Indexes.

1.11 WARRANTY

A. Labor and materials for the control system specified shall be warranted free from defects for a period of 12 months after final completion and acceptance. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

B. All work shall have a single warranty date, even when the Owner has received beneficial use due to an early system startup. If the work specified is split into multi-phase contract, then each contract or phase shall have a separate warranty start date and period.

C. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to Architect and Owner, then the date of acceptance shall be the start of pre-warranty endurance test.

D. Operator workstation software, project-specific software, graphic software, database software, and firmware updates which resolve known software

deficiencies as identified by the Contractor shall be provided at no charge during the warranty period.

E. After the above acceptance tests are complete and the system is demonstrated to be functioning as specified, a thirty-day endurance test period shall begin. If the system functions as specified throughout the endurance test period requiring only routine maintenance and adjustment, the system shall be accepted. If during the endurance test period the system fails to perform as specified and cannot be corrected within eight hours, the Owner may request that the endurance tests be repeated after problems have been corrected.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. DDC System:

1. Johnson Controls (JCI), METASYS matching the existing campus system. No alternate vendors or systems will be accepted.

B. Immersion Thermowells: BAPI machined thermowells or acceptable equivalent

C. Temperature Sensors: Weksler Model T4, ACI, Weiss Model EN, BAPI or acceptable equivalent

D. Humidity Sensors: General Eastern HumiTRAC, Vaisala or acceptable equivalent

E. Flow Transmitter Assembly – Water (Electromagnetic): Rosemount Model 8711 and Model 8712U transmitter or acceptable equivalent

F. Flow Transmitter Assembly – Water (Ultrasonic): Controlatron, Badger Meter Model TFX Ultra or acceptable equivalent

G. Flow Transmitter Assembly – Water (Turbine Type): Onicon F1211 or acceptable equivalent

H. Flow Measuring Probe – Air (Thermal): Kurz Instruments, Ebtron, Ruskin, Air Monitor or acceptable equivalent

I. Flow Measuring Assembly – Air (Pitot):

1. Acceptable flow sensor manufacturers: Air Monitor Fan E, Brandt DSK-7000 or acceptable equivalent
2. Acceptable velocity pressure transducer manufacturers: Air Monitor, Brandt, Setra or acceptable equivalent

J. Pressure Transmitter Assembly – Air Streams: Brandt, Setra, Air Monitor or acceptable equivalent

K. Building Differential Pressure Transducer: Sentra Model 264, Dwyer, Greystone, or acceptable equivalent.

L. Differential Pressure Transmitter Assembly – Water: Mamac PR-282 or acceptable equivalent

M. Demand Control Ventilation Sensor: Vaisala - GMW Series or acceptable equivalent

N. Carbon Monoxide Gas Detection Sensor: BAPI 420CO or acceptable equivalent

O. Watt Transducer: Scientific Columbus, Ohio Semitronics or acceptable equivalent

P. Current Sensing Switches: Veris or acceptable equivalent

Q. Current Sensing Transducer: Veris or acceptable equivalent

R. Electropneumatic Transducer: Veris Model EP2 or acceptable equivalent

S. Differential Pressure Switch – Liquid: JCI/Penn Model P74, Barksdale EPD1 or acceptable equivalent

T. Differential Pressure Switch – Air: Cleveland Controls Model AFS or acceptable equivalent

U. Differential Pressure Switch – Filters – Indicating: Dwyer Series 3000 or acceptable equivalent

V. Level Switch: McDonnell & Miller, Delta or acceptable equivalent

W. Damper End Switch: Fumas Electric, Allen Bradley, Telemechanique or acceptable equivalent

X. Low Temperature Thermostat: Johnson Controls TF-142 or acceptable equivalent

Y. Liquid Level Analog Sensor: Flowline Cricket Alphasonic Level Transmitter Model LA12 or acceptable equivalent

Z. High-Low Liquid Level Sensors: Gems Model Number 24576 or acceptable equivalent

AA. Photo Cell (for control of lighting zones): Celestial or acceptable equivalent

BB. Automatic Control Dampers: Ruskin, Pottorff, Air Balance, Johnson Controls or acceptable equivalent

CC. Heavy Duty Industrial Automatic Control Dampers: Ruskin Model CD80AF2 or acceptable equivalent

DD. Modulating Airflow Monitor Damper: Ruskin Model IAQ50 damper or acceptable equivalent

EE. Automatic Valves: Belimo Aircontrol, Siemens, Johnson Controls or acceptable equivalent

FF. Automatic Control Damper / Automatic Valve Electric Actuators: Siemens, Belimo Aircontrol, Johnson Controls or acceptable equivalent

GG. Butterfly Valves: Jamesbury, Keystone, Victaulic Series 300 or acceptable equivalent

2.02 NETWORK ARCHITECTURE

A. Owner Intranet Network

1. The BMS contractor shall be responsible for installation of primary and secondary LAN's required to support the complete BMS system. The Operator Workstation for the building shall be located as advised by the Project Manager.

B. BACnet Primary LAN

1. Primary LAN for the building automation system shall consist of a high-speed network utilizing BACnet over Ethernet or BACnet/IP. The Primary LAN shall be used for communications between BACnet B-BC devices, B-AAC devices, B-ASC devices, and the Operator Workstation. The network shall be configured to allow for a redundant communication path from all network level controllers to the server. Managed network switches shall be used for this purpose**.**

C. BACnet Secondary LAN

1. A secondary LAN, separate from the Primary LAN shall be used for communications between B-ASC devices and the B-BC or B-AAC that provides BACnet router services for the device. The Secondary LAN shall utilize BACnet MS/TP for communications. The intent of the separate Primary LAN and Secondary LAN is to isolate traffic between B-BC's or B-AAC's and their associated B-ASC devices from the primary LAN.

2.03 CENTRAL CONSOLE

A. Provide a central operator's console to include as a minimum:

1. Personal computer (OWS)
2. Color graphics display terminals
3. Printer (alarm and logging)
4. Uninterruptible Power Supply (UPS).

B. Assemble console equipment in a console configuration that allows operator access to all console equipment from one position.

C. Provide a central console at the following locations:

1. Engineering Office
2. Central plant.

2.04 OPERATOR'S WORK STATION (OWS)

A. The Operators Work Station (OWS) shall be a US EPA certified Energy Star Personal Computer (PC) together with operator terminals. The following specifications are the minimum requirement. The operator's workstation is to be sized based on the controls manufacturers recommendations for the project size:

1. Tower style case with minimum of two internal drive bays.
2. Processor: Intel Xeon Six Core with minimum speed 3.5 GHZ microprocessor.
3. RAM: 16.0GB DDR4 random access memory.
4. Solid State Drives: One 256 GB SATA SSD drive. Install operating system and application software on the SSD disk.
5. Hard Drive: 2TB 3.5inch Serial ATA (7,200 Rpm) Hard Drive
6. Ports: 8 USB Ports
7. Network Adapter: Gigabit Ethernet.
8. Graphics card: 4.0GB SDRAM NVIDIA® Quadro P1000 or approved equal.
9. Display Adapter: 4096 Megabyte quad monitor.
10. Mouse: Logitech® USB Mouse with 2 buttons and scroll wheel.
11. Keyboard: Logitech® USB Keyboard.
12. Software: Latest compatible Microsoft® Office and Windows© workstation version that has been tested and approved by the BMS software manufacturer as being compatible with their software.
13. Manufacturer: HP, Dell Precision® WorkStation or Equal.

B. Provide color display monitors at each OWS location meeting the following minimum requirements:

1. Flat panel 27-inch LCD displays with EnergyStar Rating.
2. Resolution of 2560 by 1440 pixels.
3. 16 million discrete colors.
4. Monitor stand and 100mm x 100mm VESA mount.
5. Manufacturer: NEC, Viewsonic, Sony or approved equal.

C. Provide a color laser jet printer at each OWS meeting the following minimum requirements:

1. 1200 by 1200 dpi resolution
2. 40 pages per minute in black and color with 550 sheet tray
3. 4-line color display with keypad, 2-sided printing.
4. 3 sets of ink cartridges, power cord and printer cable.
5. All change-of-state reporting, system logs, information summaries, system malfunctions and alarms shall be printed at this terminal.
6. Manufacturer: HP Enterprise M553dn series or approved equal.

D. Uninterruptible Power Supply (UPS): Provide a portable UPS capable of maintaining operation of the PC and all peripherals for 30 minutes in the event of a failure of the normal power supply. UPS shall provide instantaneous backup power during blackouts and brownouts, lightning and surge protection tested to UL 1449, and network-grade line conditioning and two EMI/RFI filters.

2.05 LARGE DISPLAY MONITORS

A. Provide large display monitors at the following location:

1. Three within the Office/Retail Building Engineering Office for 24/7 display of the Chilled Water System, Condenser Water System, and Heating Hot Water System.

B. The large display monitors shall be wall mounted and shall meet, at minimum, the following requirements:

1. 42-inch monitors.
2. Specifically designed for 24/7 usage.
3. Native resolution of 3840 x 2160.
4. Aspect ratio of each module shall be 16:9.
5. Brightness of 400 cd/m2.
6. Contrast ratio shall be 1000:1
7. Two HDMI inputs.
8. Two USB inputs.
9. Large display monitors shall be LG UX340C or approved equal.

C. The Large Display Operator Interface shall connect via three of the video outputs from an OWS.

2.06 LOCAL OPERATOR'S TERMINAL (LOT)

A. Provide touchscreen device portable terminal(s) to allow local programming, control and monitoring at each DDC panel.

B. Provide two (2) portable LOT handheld devices which can be connected to any DDC panel.

C. Provide BMS manufacturer's application software for each LOT.

D. The portable LOT devices shall not be used by the BMS subcontractor for startup or commissioning and shall be delivered new to the Owner after substantial completion.

E. The portable LOT shall meet the following requirements:

1. It shall perform all of the functions applicable to the BMS that can be undertaken from the OWS.
2. LOT shall be portable with maximum weight of 3 pounds.
3. Battery powered with rechargeable batteries. Minimum battery life shall be 8-hours without recharging.
4. Minimum 9-inch LED touchscreen display.
5. Internal 802.11 a/b/g/n antenna.
6. Internal storage of 128 GB.
7. Windows 10 Pro/Enterprise, Windows Server 2016, or Windows Server 2019 operating system.

2.07 NATIVE **BACNET** DIRECT DIGITAL BUILDING CONTROLLER

A. Native BACnet DDC Building Controllers shall be completely self-contained, field programmable, real time 64-bit microprocessor based controllers.

B. DDC application programs shall be resident in the DDC. Once downloaded, a DDC shall not require further communication with the CPU except for data base changes, operator commands, and requests from the CPU for DDC data.

C. The Building Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP network, while using the same Ethernet LAN for non-IP communications to other BACnet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

D. Building Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Global controller shall be a BACnet conformance Class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:

1. Clock Functional Group
2. Files Functional Group
3. Reinitialize Functional Group
4. Device Communications Functional Group
5. Event Initiation Functional Group

E. Provide current and voltage limiting devices at communications network cable connection.

F. Provide power supplies with transient power line surge protection.

G. Supply a minimum of 72 hours of battery backup for the random access memory and real time clock. Provide automatic restart and battery recharging upon restoration of power.

H. Provide floor-mounted or wall-mounted cabinet with full front-hinged door, locking handle with master key and non-glare baked enamel finish. Each DDC shall contain a clear plastic encased control diagram showing associated controls.

I. Provide seismic restraints and attachments to wall or floor using neoprene bushings or pad with steel disc to spread load over the entire neoprene element.

J. Provide the manufacturer’s standard enclosure except if location requires additional protection due to potential vandalism, environmental conditions or any other reason. Take all necessary precautions to protect the DDC and related components, including:

1. NEMA enclosure 1 for normal, indoor areas, and NEMA 4 for outdoor or wet areas.
2. Heavy-duty key locks

K. Capabilities:

1. Stand-Alone Capability: If PC or communications network malfunctions, each DDC shall continue to control, monitor and have the ability to be accessed and programmed via the LOT.
2. Degraded Mode: If failure of a sensor or system component causes information critical to a DDCs program to be lost, default values or subroutines shall automatically be used to approximate critical information to ensure continued control.
3. Networking: Each DDC shall be capable of sharing point information with other DDCs on the same data network.
4. Real time operating system shall be capable of time-of-day scheduling and other time based functions.
5. Unauthorized access to hardware or software programs shall be accomplished by a password or cabinet lock. In the locked or unauthorized position, the operating characteristics of the DDC cannot be changed, although inputs, outputs and setpoint values can be displayed. In the unlocked or authorized position, the ability to change the DDC program shall be unhindered.
6. Alarm processing shall include: Change of state, flow proof, high and low analog limits, and setpoint deviation. Provide at least two levels of alarm priority.
7. The DDC programming language shall be designed for Building Automation and Control applications and shall be capable of performing the following control algorithms: Floating; Proportional (P) direct and reverse acting; Proportional plus Integral (PI); Proportional Integral plus Derivative (PID); Anti-integral wind up; Cascade; programmed interlock logic; deadband switching and control; incremental control.
8. All communication with operator workstation and all application controllers shall be via BACnet. Building controller shall incorporate as a minimum, the functions of a 3-way BACnet router. Controller shall route BACnet messages between the high-speed LAN (Ethernet 10/100MHz), at least 4 master slave token passing (MS/TP) LANs, a point-to-point (PTP – RS-232) connection and an on-board modem.

    a. Each MS/TP LAN shall be software configurable from 9.6 to 76.8Kbps.
    b. The RJ-45 Ethernet connection shall accept either 10Base-T or 100Base-TX BACnet over twisted pair cable (UTP).
    c. The direct access port shall be a female DB-9 connector supporting BACnet temporary PTP connection of a portable BACnet operator terminal at 9.6 to 115.2 Kbps over RS-232 null modem cable.

L. DDC Configuration:

1. Points used in the same control loop or algorithm shall be connected to the same DDC.
2. Spare Capacity: Allow for 10-percent increase of each point type per DDC location, or a minimum of two of each point type per DDC location whichever is greater. Addition of points shall require only programming, control devices and wiring.
3. Programming shall be object-oriented using control function blocks, supporting DDC functions, 1000 Analog Values and 1000 Binary Values.

All flowcharts shall be generated and automatically downloaded to controller. Programming tool shall be resident on workstation and the same tool used for all controllers.

4. Building controller shall be capable of providing global control strategies for the system based on information from any objects in the system regardless if the object is directly monitored by the controller or by another controller. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site or downloaded via remote communications are not acceptable. Changing global strategies via firmware changes is also unacceptable.

2.08 NATIVE **BACNET** CUSTOM APPLICATION CONTROLLLERS (CAC)

A. General: Provide an adequate number of native BACnet Custom Application Controllers to achieve the performance specified in PART 1 of this section on system performance. Each of these controllers shall meet the following requirements.

1. The Custom Application Controller shall be native BACnet and have sufficient memory to support its operating system, database, and programming requirements.
2. Data shall be shared between networked Custom Application Controllers.
3. The operating system of the Controller shall manage the input and output communication signals to allow other distributed controllers to share real and virtual object/point information, and allow central monitoring and alarms.
4. Controllers that perform scheduling shall have a real-time clock.
5. The Custom Application Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall operate under a predetermined failure mode and generate an alarm notification to the BMS network.

B. Environment:

1. Controller hardware shall be suitable for the anticipated ambient conditions.
2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40 degrees F to 150 degrees F.
3. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F.
4. Provide seismic restraints and attachments to wall or floor using neoprene bushings or pad with steel disc to spread load over the entire neoprene element.

C. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

D. Memory: The Custom Application Controller shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

E. Immunity to power and noise: Controller shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shut-down below 80 percent nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hertz and from keyed radios up to 5 watts at 3 feet.

2.09 NATIVE **BACNET** APPLICATION SPECIFIC CONTROLLERS

A. General: Application Specific Controllers (ASCs) are microprocessor-based native BACnet DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. ASCs shall be user-programmable, and customized for operation within the confines of the equipment they are designed to serve. Application Specific Controllers shall communicate with other controllers on the internetwork.

B. Each ASC shall be capable of stand-alone operation and shall continue to provide control functions without being connected to the network.

C. Each ASC shall contain sufficient I/O capacity to control the target system.

D. Communication:

1. The controller must reside on a BACnet network using the MS/TP Data Link/ Physical layer protocol. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include input, output and self-contained logic program as needed for complete control of unit.
2. Each controller shall have compatible connection for a LOT or a portable operator's tool. This connection shall be extended to a space temperature sensor port where shown.

E. Environment:

1. The hardware shall be suitable for the anticipated ambient conditions.
2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40 degrees F to 150 degrees F.
3. Controllers used in conditioned space shall be mounted in dust-proof enclosures, and shall be rated for operation at 32 degrees F to 120 degrees F.
4. Provide seismic restraints and attachments to wall or floor using neoprene bushings or pad with steel disc to spread load over the entire neoprene element.

F. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

G. Memory: The Application Specific Controller shall use non-volatile memory and maintain all BIOS and programming information in the event of a power loss.

H. Immunity to Power and Noise: Controllers shall be able to operate at 90 percent to 110 percent of nominal voltage rating and shall perform an orderly shut-down below 80 percent. Operation shall be protected against electrical noise of 5-120 Hertz and from keyed radios up to 5 watts at 3 feet.

I. Transformer: Power supply for the ASC shall be rated at minimum of 125 percent of ASC power consumption, and shall be fused or current limiting type.

J. Hardwired inputs and outputs shall tie into the system through building, custom application, or application specific controllers.

K. The ASC shall provide the following information either on the PC or the LOT unit.

1. Space temperature/humidity
2. Space temperature setpoint(s) for heating and cooling
3. Minimum primary air setpoint
4. Maximum primary air setpoint
5. Valve and damper positions in percent open
6. Air volume in cubic feet per minute
7. Fan status for fan powered terminal unit (if applicable)
8. Control parameters (deadbands, PID gains, etc.)

2.10 LIGHTING CONTROLS

A. Description:

1. General: Provide an interface to the BMS for the control of lighting zones, relays and circuits as indicated on the electrical drawings and specifications. Refer to electrical drawings for location of relay panels and lighting zone quantities.
2. Related work specified elsewhere:

   a. Provision of switches, controller, lighting relay cabinets and relays (LRC) by Division 26.
   b. Provision of branch circuit wiring from lighting fixtures circuit breakers to relays and from relays to switches by Division 26.
   c. Provision of interface module using Modbus, BACNet or Lonworks communications protocol.

3. Control wiring and wireways from BMS system to lighting control interface module.
4. Provision of necessary controllers, network connections, programming and graphics.

B. Submittals:

1. Provide shop drawing submittals complete with the following information.

   a. Wiring diagrams of each interface module/lighting relay cabinet interconnection.
   b. Description of each device/component, including cut sheets.
   c. Lighting control zoning diagram.

2. Provide a narrative describing the software function of the system.

C. Sequence of Operation:

1. Each lighting zone shall be individually programmable to switch lights on and off in accordance with time schedules determined by the Owner. Coordinate with the Owner to determine initial lighting schedules.
2. Sequence shall include a momentary flashing of the lights on and off to signal occupants to initiate an override command at the local switch. Build in an adjustable time interval before turning off lights after flashing sequence.
3. Exterior lighting shall be controlled as separate zones and switched on and off in accordance with time schedules or with an input from a photocell.
4. All lighting zones shall be manually commanded by the BMS operator to override the automatic software status.

D. Testing and Start Up:

1. Provide operational test report in matrix form indicating each lighting zone showing successful operation of the automatic control sequence.

2.11 INPUT AND OUTPUT INTERFACE

A. All input points and output points shall be protected such that short circuiting of the point to itself or to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 volts of any duration, such that contact with this voltage will cause no damage to the controller. Inputs and outputs shall be arranged on interchangeable modules or circuit boards to allow the replacement of a damaged module or board without replacing the entire controller.

B. Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 milliamps to be compatible with commonly available control devices, and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.

C. Pulse Accumulation Input Objects: This type of object shall conform to all the requirements of binary input objects, and also accept up to 10 pulses per second for pulse accumulation.

D. Analog inputs shall allow the monitoring of low-voltage (0 to 10 volts DC), current (4 to 20 milliamps), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with, and field-configurable to commonly available sensing devices.

E. Binary outputs shall provide for On/Off operation, or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on Building and Custom Application Controllers shall have three-position (On/Off/Auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.

F. Analog outputs shall provide a modulating signal for the control of devices. Outputs shall provide either a 0 to 10 volts DC or a 4 to 20 milliamp signal as

required to provide proper control of the output device. Analog outputs on Building or Custom Application Controllers shall have status lights and a two-position (Auto/Manual) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4 percent of range per year.

G. Tri-State Outputs: Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

H. Input/Output points shall be universal type, i.e., controller input or output may be designated (in software) as either a binary or analog type point with appropriate properties. Application Specific Controllers are exempted from this requirement.

2.12 POWER SUPPLIES

A. Control transformers shall be UL Listed. Furnish Class 2 current-limiting type, or furnish over-current protection in both primary and secondary circuits for Class 2 service per NEC requirements. Limit connected loads to 80 percent of rated capacity.

B. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 millivolt maximum peak-to-peak. Regulation shall be 1.0 percent line and load combined, with 100 microsecond response time for 50-percent load changes. Unit shall have built-in over-voltage and over-current protection, and shall be able to withstand a 150-percent current overload for at least 3 seconds without trip-out or failure.

C. Unit shall operate between 0 and 50 degrees C. EMI/RFI shall meet FCC Class B and VDE 0871 for Class B, and MIL-STD 810G for shock and vibration.

2.13 SENSORS AND CONTROL DEVICES

A. General:

1. Provide sensors and control devices, as specified, indicated on mechanical plans, control flow diagrams and as required to meet specified performance. Where performance specifications exceed capabilities of hardware specified, performance governs. The installation of such devices, if not specifically indicated, shall be the responsibility of the Contractor.
2. Equip analog sensors with industry standard 4 to 20 milliamp transmitters with built-in circuit protection against reverse polarity and supply voltage transients. The transmitters shall be matched to the sensing element and compatible with the DDC Building Management System.
3. All sensor/transmitters assemblies shall be factory calibrated.
4. All sensor wiring, analog or digital, input or output shall be capable of sharing single conduit runs without affecting signal performance. All signal wiring shall also be capable of sharing single conduit runs with switched AC of 120 or 277 volts.

5. The sensor range and type shall be suitable to the application.
6. Minimum contact rating of relays and switches shall be 10 amperes, 110 volts resistive.
7. Devices shall be UL Listed for electrical safety.
8. All components of sensors exposed to process shall be rated to withstand 150 percent of maximum process temperature and pressure.

B. Thermowells: Provide Type 316 stainless steel thermowells for each immersion type temperature sensor and switch. Thermowells shall have extension for pipe insulation and threaded connection to pipe. Threaded connection shall be a minimum of 3/4-inch nominal pipe thread. Maximum insertion length shall be 6 inches or 75 percent of the pipe diameter whichever is smaller. Thermowells shall be rated for moving water.

C. Temperature Sensors (4-20mA Type):

1. Temperature sensor assemblies shall consist of a 100 or 1,000 ohm platinum RTD sensor and a solid state, 2-wire, 4- to 20-milliamp transmitter protected in a housing suitable for the environment in which it is installed.
2. Where acceptable, non-critical areas may be provided with thermistor type temperature sensors shall be supplied for protected in a housing suitable for the environment in which it is installed.
3. Sensor accuracy shall be plus or minus 1.0 degree F except for chilled water temperature applications the accuracy shall be plus or minus 1.0 degrees F.
4. Sensors for mixed air and coil discharge applications and for fan discharge applications in systems over 5,000 cubic feet per minute shall be averaging type sensors. Probe lengths shall be minimum one linear foot per four square feet of duct or coil area or equal to duct, plenum or AHU casing width where installed, whichever is longer.
5. Outside air sensors shall be mounted on a northern exposure and mounted within a ventilated enclosure.

D. Humidity Sensors:

1. Humidity sensor assemblies shall consist of a capacitive or bulk polymer type sensor and a solid state 4- to 20-milliamp transmitter protected in a housing suitable for the environment where it is installed.
2. Provide low profile sensor housing 1-inch diameter by 0.35-inch thick.
3. Performance:

    a. Accuracy at 77 degrees F: Plus or minus 2.5 percent relaive humidity over a range of 20 to 95 percent relative humidity including hysteresis, linearity and repeatability.
    b. Temperature effect: Less than 0.06 percent per degree F.
    c. Sensitivity: 0.1 percent relative humidity.
    d. Hysteresis: Less than 1 percent.
    e. Sensor interchangeability: Plus or minus 3 percent nominal.
    f. Air velocity: 10,000 feet per minute maximum.
    g. Output: 4 to 20 milliamps, isolated, loop-powered into 0 to 99 ohms.
    h. Long term stability: Less than 1 percent drift per year.

4. Provide cable to transmitter as required. Locate transmitter in an accessible location.

E. Flow Transmitter Assembly – Water (Electromagnetic):

1. The flow transmitter assembly shall be a magnetic flow tube type meter operating on the basis of Faraday's law of electromagnetic induction.
2. The system shall consist of a DC powered, flanged magnetic flow meter capable of monitoring liquids with conductivity of 5 microsiemens/cm (5 micromhos/cm) or greater.
3. The assembly shall be factory calibrated and field-installed to an accuracy of plus or minus 0.5 percent of the actual flow rate over the entire operating span and plus or minus 0.1 percent repeatability as verified by independent laboratory reports. Output: 4 to 20 milliamps, supply voltage 24-volt DC.
4. The meter shall be rated for the temperature conditions of the process.
5. Provide with Model 8712U Universal Transmitter that works with any manufacturer's flow tube. Offers automatic in-process calibration.
6. The meter and transmitter shall conform to NEMA ICS 6, "Industrial Controls and System Enclosures", Standard 4X enclosure.

F. Flow Transmitter Assembly – Water (Ultrasonic):

1. The flow transmitter assembly shall be a clamp-on ultrasonic type operating on the wide beam transit time principle.
2. The system shall consist of two (2) clamp-on transmitter/receivers and a flow rate computer with digital display of flow rate and total flow. The flow computer shall output a digital signal to DDC.
3. The assembly shall be factory-calibrated and field-installed to an accuracy of plus or minus 2 percent of the actual flow rate over the entire operating span.
4. The meter shall be rated for the temperature conditions of the process.

G. Flow Transmitter Assembly – Water (Turbine Type):

1. Meter device shall be dual turbine element flow station set supplied by one manufacturer. Measuring station shall be stainless steel complete with full port shutoff ball valves and quick coupling connections and a permanent metal tag showing designated flow rates, meter readings for designed flow rates, metered fluid, line size and tag, station or location number.
2. Flow stations shall be installed according to manufacturers recommended minimium guidelines.
3. Stations shall be either nipple section or weld insert type and be rated to 400 psi at 280 degrees F. Sensing elements shall be able to be rotated.
4. Accuracy of the flow measuring elements, as verified by independent laboratory reports, shall be

    a. Plus or minus 0.5 percent of reading at calibrated velocity
    b. Plus or minus 1.0 percent of reading from 0.4 to 20 feet per second (10:1 range)
    c. Plus or minus 2.0 percent of reading from 3 to 30 feet per second (30:1 range)

5. Output: 4 to 20 milliamps or 0 to 10 volts DC. Provide 10 feet of plenum rated cable.
6. Supply Voltage: 24-volt AC/DC at 100 milliamps.
7. Pressure Drop: Maximum 1 psi for 2.5-inch pipe size, and decreasing for larger pipe sizes.
8. Repeatability: 0.2 percent.

H. Flow Measuring Probe – Air (Thermal):

1. Probe shall consist of a thermistor or platinum RTD type air measuring station with a low resistance copper or aluminum frame containing an array of sensors spaced four per square foot as per ASHRAE standards, with a solid-state, 4- to 20-milliamp transmitter.
2. Flow stations shall be installed according to manufacturers recommended minimium guidelines.
3. The probe shall be factory-calibrated and field-installed to an accuracy of plus or minus 5 percent of airflow over a range of 200 to 3000 feet per minute. Repeatability shall be plus or minus 0.25 percent.
4. All electronics shall be housed in a NEMA 1 enclosure and mounted in accordance with manufacturer's recommendations.

I. Flow Measuring Assembly – Air (Pitot):

1. Multiple manifold, pitot type sensing average velocity pressure. Each station shall be complete with air directionalizer and parallel cell profile suppressor. Designed for installation at fan discharge and short approach conditions.
2. Provide with temperature compensated velocity pressure transducer and 4- to 20-milliamp transmitter for connection to DDC. Accuracy shall be plus or minus 0.25 percent of span. Provide adjustable span or fixed spans as follows: 0 to 0.10, 0 to 0.25, 0 to 0.50 inches water gauge. Select span that most closely matches station flow range.
3. Total installed accuracy shall be plus or minus 20 feet per minute from 550 to 3000 feet per minute.

J. Energy BTU Measurement System

1. The entire Energy BTU Measurement System shall be built and calibrated by a single manufacturer and shall consist of a flow meter, two matched temperature sensors, a BTU meter, temperature thermowells, and all required mechanical installation hardware. The BTU meter and associated sensors and flow meter shall be installed in accordance with the manufacturer's installation guide.
2. The BTU meter shall provide the following points both at the integral LCD and as outputs to the building control system: Energy Total, Energy Rate, Flow Rate, Supply Temperature and Return Temperature. Output signals shall be either serial network (protocol conforming to BACnet® MS/TP, BACnet/IP, MODBUS RTU, or MODBUS TCP) and/or via individual analog and pulse outputs.
3. Each BTU meter shall be factory programmed and tagged for its specific application and shall be re-programmable using the front panel keypad (no special interface device or computer required).
4. Temperature sensors shall be loop-powered current based (mA) sensors and shall be bath-calibrated and matched (NIST traceable) for the

specific temperature range for each application. The calculated differential temperature used in the energy calculation shall be accurate to within +0.15°F (including the error from individual temperature sensors, sensor matching, input offsets, and calculations).

5. A certificate of NIST traceable calibration shall be provided with each system.
6. The Flow Meter shall be in accordance with meters specified in other sections of this specification.
7. All equipment shall be covered by the manufacturer's two-year warranty.
8. Energy BTU Measurement System shall be Onicon Incorporated System-10 BTU Meter, or as approved by Engineer.

K. Pressure Transmitter Assembly – Air Streams:

1. The assembly shall consist of a pressure sensor and a solid-state, 2-wire, 4- to 20-milliamp transmitter contained in a housing suitable for duct mounting.
2. The assembly shall be factory-calibrated and field-installed to an accuracy of plus or minus 0.05 inches water gauge over a range of 0 to 4 inches water gauge.
3. Probe: 8-inch pitot tube, brass.

L. Building Differential Air Pressure Sensor

1. The differential pressure sensor shall be configured for bi-directional air pressure ranges as low as +/- 0.05 inch full scale.
2. Static standard accuracy is +/- 1.0 percent full scale in normal ambient temperature environments. The units are temperature compensated to within +/- 0.02 percent FS/degree F for zero and span.
3. Utilize stainless steel micro-tig welded sensor. The tensioned stainless steel diaphragm and insulated stainless steel electrode shall position under pressure to form a variable capacitor.
4. Provide a 4 to 20 milliamp dc or 0 to 10 volt dc output.

M. Differential Pressure Transmitter Assembly – Water:

1. Assembly shall consist of a differential pressure sensor and an electronic 2-wire, 4- to 20-milliamp transmitter assembly enclosed in a gasketed, dust- and water-tight case. All body cavities open to the process fluid shall be provided with drain ports at the cavity bottom and vent ports at the top of the cavity. Both drain and vent ports shall be minimum 1/4-inch nominal pipe thread.
2. The transmitter shall be 24-volt DC powered and capable of sustaining up to 50 psig differential pressures in either direction, up to the body rating without damage of the instrument, loss of accuracy, or zero shift. Minimum pressure rating: 200 psig.
3. The transmitter shall be fully compensated for both process and ambient temperature variations. The transmitter shall be furnished complete with input gauges and factory mounted 3-valve manifold.
4. Accuracy: Plus or minus 1 percent of full range.
5. Repeatability: 0.5 percent.

N. Demand Control Ventilation Sensor:

1. CO_2 Sensors and Transmitters: Provide a self-compensating, wall mounted CO_2 transmitter with an industry standard, 4-20 ma output signal. Measurement range to be 0 to 2000 ppm with an accuracy of plus or minus 20 ppm + 1 percent of reading and a stability of less than 5 percent in 5 years. Locate the sensors to be as shown on the Drawings.
2. Sensors to be tested utilizing method as stated in form NA7.5.5 MECH-6A Demand Controls Ventilation Systems Acceptance.

O. Gas Detection System

1. Provide a complete installation of a toxic and/or combustible gas detection system including a main control panel, sensors and audible/visual alarm devices. System shall operate as a standalone system. The system shall also be capable of connection to a Building Management System (BMS). The system shall include, but not be limited to, the following:

    a. Future expandability
    b. Display of toxic and/or combustible gas concentration
    c. Ability to modify alarm set points
    d. Display of alarm status

2. Install hazardous gas monitoring equipment including sensors, audible alarms, control panels as shown on Contract Drawings, and as recommended by manufacturer of equipment, and as required by authorities having jurisdiction.
3. Install conduit and wiring from sensors to control panel and to the fan starters/ HVAC control panel as recommended by manufacturer of equipment.
4. After installation, commission, test and calibrate equipment to demonstrate operation of functions described above under sequence of operation by manufactures certified service technician.
5. Provide testing kits (including gas bottles) for testing and calibration by Commissioning Agent.
6. Detectors

    a. Transmitter will be powered by the control panel power supply rated at 24 Vac. Fully addressable gas transmitter must be capable of communicating digitally with controller through an RS-485 communication port. Gas transmitters must be installed in a true daisy chain with an end of the line resistor on the last transmitter. The gas transmitter will incorporate an electrochemical cell for toxic gas monitoring and catalytic bead sensor for combustible gases. Unit sensing cell must compensate for variations in relative humidity and temperature to maintain high levels of accuracy.
    b. When placed in a network configuration the transmitter will be capable of transmitting gas concentrations through the controller. For local activation of fans or louvers (or other equipment) an on-board DPDT relay 5 A, 30 VDC or 250 VAC (resistive load) will be activated at programmable set points (and programmable time delays) through the control panel. An LCD display will provide gas concentration readings.

c. Transmitter will be capable of operating within relative humidity ranges of 5-95%and temperature ranges of -4° F to 104° F (-20° C to 40° C).
d. Unit will be certified to ANSI/UL 61010-1 label and CAN/CSA-C22.2 No. 61010-1. Transmitter must be manufactured in an ISO 9001-2000 production environment.
e. The transmitter should have a plug-in capability for a gas cartridge with a smart sensor capable of self-testing.
f. For local activation of audible alarms, the transmitter shall have an on-board device able to generate an audible output of 85 dBA @ 10 ft (3 m).

1) Carbon Monoxide: Furnish Honeywell Analytics E3Point Model E3SM + E3SCO (Carbon Monoxide) or equal as approved by engineer.
2) Nitrogen Dioxide: Furnish Honeywell Analytics E3Point Model E3SM + E3NO2 (Nitrogen Dioxide) – (NO2 as required by code or application) or equal as approved by engineer.
3) Methane: Furnish Honeywell Analytics E3Point Model E3SM + E3M (Methane) or equal as approved by engineer.
4) Oxygen: Furnish Honeywell Analytics model E3Point Model E3SM+ E3O2 (Oxygen) or equal as approved by engineer.
5) Hydrogen: Furnish Honeywell Analytics model E3Point Model E3SM + E3H2 (Hydrogen) or equal as approved by engineer.

g. Provide quantity or sensors, mounting heights, and alarm activation set points as required to meet all local code requirements at a minimum.

7. Controller

a. The control panel must be capable of communicating digitally with the networked transmitters and relay modules through three RS-485 Modbus communication buses. Each communication bus must be capable of accepting a combination of up to 32 addressable transmitters, relay modules, or annunciator panels at a maximum distance of 2,000 feet. The power supply shall be of either 24 VAC or 24 VDC.
b. The controller will manage four internal DPDT relays at fully programmable alarm levels (and within programmable time delays) and be capable of activating multiple relay modules of eight relays each. The relay rating will be no lower than 5 A, 30 VDC or 250 VAC (resistive load).
c. BACnet: The controller must enable BACnet™ communication through its BACnet output using BACnet/IP protocol over twisted-pair Ethernet (10BaseT) wires.
d. The controller must include a self-test function that allows for the activation/deactivation of all the programmed outputs by simulating a continuous 5% increase/decrease value until the maximum/minimum value is reached.

e. The controller must include a real-time clock that enables operation of the outputs for a specific timeframe.
f. The controller must also include an energy saving feature that allows for output operation on alarms set at the max, min or average value of a specific group of transmitters. This feature must also allow for the activation of outputs upon a certain number of a specific group (¾, ½, ⅓ and ¼) of transmitters reaching their alarm levels. A total of 128 groups can be assigned.
g. The controller will be capable of communicating with an annunciator panel that can serve as a remote display panel in a secondary control room.
h. The controller will indicate the exact concentration of gas, the gas detected, and the location of the sensor by sweeping through the network and displaying the detected levels at each point on a graphic LCD display.
i. Data logging: Data logging capability must provide long-term data logging to determine trends. The controller must collect data automatically and must store it on a digital Flash media card.
j. Furnish Honeywell Analytics model 301C-DLC-BIP controller or equal as approved by engineer.

8. Strobe and Horn

a. Strobe & Horn combo unit will be capable of operating within relative humidity ranges of 0-100% and temperature ranges of -30 degrees F to
b. 150 degrees F (-35C to 66C). Rating of horn will be no less than 72dB at 10 feet. Intensity of light will be no less than 40W and will flash at a frequency of 1 per second. Unit will be certified by CSA.
c. Furnish Honeywell Analytics model P2W-P with colored lens strobe & horn or equal as approved by engineer.

9. Annunciator Panel

a. Where required, an annunciator panel will be powered by the control panel's power output or by power transformer rated at 24 Volts AC or DC (always respect minimum voltage requirements at device). Module must be capable of communicating digitally with the Honeywell Analytics controller through an RS-485/MODBUS communication port. Annunciator panel will have three relays rated at no lower than 5A, 30 VDC or 250 VAC (resistive load) and will act as a remote display reflecting the display of the main controller.
b. Furnish Honeywell Analytics model 301-AP or equal as approved by engineer.

10. Relay Module

a. Where required, a relay panel will be powered by the control panel's power output or by power transformer rated at 24 Volts AC or DC (always respect minimum voltage requirements at device). Module must be capable of communicating digitally with

the Honeywell Analytics controller through an RS-485/MODBUS communication port. Relay module will have eight relays rated at no lower than 5A, 30 VDC or 250 VAC (resistive load) and will act as additional relays programmed by the gas detection main control panel.

b. Furnish Honeywell Analytics model 301-R8 or equal as approved by engineer.

P. Carbon Monoxide Gas Detection Sensor

1. Provide wall mounted electrochemical cell type carbon monoxide detection sensor.
2. Provide sensors with UV-resistant plastic enclosure and ½-inch EMT conduit fitting.
3. Carbon monoxide detection sensors shall meet, at minimum, the following requirements:

   a. Range of 0-100 ppm.
   b. 4-20 mA or 0-10 VDC output proportional to ppm.
   c. 24 VAC/VDC input voltage
   d. Accuracy of 5 ppm.
   e. Life expectancy of 4 years.

Q. Watt Transducer:

1. The assembly shall consist of the hardware necessary to generate a pulsed signal indicating the total power being measured by the kilowatt-hour meter provided by others.
2. If existing meter cannot be modified to provide a pulsed output, provide a watt transducer.
3. Watt transducer shall consist of current and voltage transducers and 4- to 20-milliamp transmitters. The assembly shall have output open and short circuit protection. Total accuracy of plus or minus 2 percent of span.

R. Current Sensing Switches (Split Core):

1. Current switches shall produce a digital signal corresponding to the current draw of the device being monitored, and such signal shall be scaled in amperes. Current switches shall incorporate an automatic adjustment feature and be sized such that the rated current of the device to be monitored is between 20 percent and 80 percent of the maximum current transducer. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

S. Current Sensing Transducer (Split Core):

1. Current transducers shall produce an industry standard 4-20mA output signal. Accuracy shall be plus or minus 2 percent full scale from 10 percent to 100 percent of selected range.

2. Provide sensor with amperage range that is most closely matched to, but not less than, the device to be monitored.

T. Electropneumatic Transducer:

1. Electropneumatic transducers shall accept an industry standard 4-20mA input signal. Accuracy shall be plus or minus 1 percent full scale. Control range shall be jumper selectable 0-20 or 3-15 psig.
2. Transducers shall be equipped with a selector switch for auto or manual mode and an LCD display.

U. Differential Pressure Switch – Liquid:

1. Provide completely enclosed contact mechanism.
2. Switch differential setpoint shall be adjustable without removing the cover.
3. Maximum differential pressure of 200 psig.
4. Maximum low side pressure of 180 psig.
5. Bellows shall be stainless steel.

V. Differential Pressure Switch – Air:

1. Provide diaphragm operator to actuate a single-pole double-throw snap-acting switch. Operating point shall be adjustable. Range shall suit application.
2. High- and low-sensing ports shall be 1/8-inch nominal pipe thread connected to angle type tips designed to sense pressure.
3. Switches used for fan shut-down shall be manual reset type.

W. Differential Pressure Switch – Filters – Indicating:

1. Differential pressure switch shall incorporate gauge and switch setpoint indicators for continuous indication of applied pressure and switch settings. Operating point shall be adjustable. Range shall suit application.
2. High- and low-sensing ports shall be 1/8-inch nominal pipe thread connected to angle type tips designed to sense pressure.

X. Level Switch:

1. Float type level switch with stainless steel float, hardware and single-pole double-throw snap acting contacts. Electronics shall be housed in a water-tight enclosure.

Y. Damper End Switch:

1. Provide oil-tight, roller type, single-pole double-throw snap-acting switch. Mechanism to provide ample overtravel to prevent stress on damper and control equipment.

Z. Low Limit Thermostat:

1. Shall have a 20-foot flexible vapor charged element. When temperature sensed by any 12-inch segment of the element falls below setpoint

(usually 35 degrees F), thermostat shall operate double-pole double-throw manual reset contacts.

AA. Liquid Level Analog Sensor:

1. Analog continuous water level sensor shall provide an industry standard 4-20mA output signal. Accuracy shall be plus or minus 1 percent of range. Electronics shall be housed in a water-tight enclosure.

BB. High-Low Liquid Level Sensors:

1. Digital water level sensors shall be a two-station switch with 2-inch NPT mounting. High and low level SPST switch sensors shall be included together and mounted in 2-inch threaded hub.

CC. Photocell:

1. Weatherproof housing suitable for outdoor installation
2. Sensor range zero to 750 foot candles
3. 4-20 milliamp output proportion to ambient light level
4. Accuracy at 100 degrees F, plus or minus 2.5 percent
5. Sensing device and transducer as required for BMS interconnection
6. Mount in a north facing direction on the roof

2.14 AUTOMATIC CONTROL DAMPERS

A. Provide automatic control dampers as indicated on the Drawings.

B. Automatic control dampers shall be low leakage type, with published AMCA certified leakage data. Leakage through a 48-inch by 48-inch damper at 4 inches water gauge pressure difference shall be less than 6.2 cubic feet per minute per square foot of damper.

C. Automatic control damper blades and frames shall be fabricated from extruded aluminum, reinforced for rigidity. Blades shall be of airfoil design with full-length edge seals with inflatable pockets to enable air pressure from either direction to assist in blade seal off. Edge seals shall be mechanically locked to the blades locked without the use of cement but easily replaceable in the field. Edge seal material shall meet all local codes and requirements of city officials. Bearings shall be non-corrosive and axles shall provide positive locking connection to blades and linkage. Blades mounted vertically shall be supported by thrust bearings. Jamb seals shall be aluminum, flexible compression type.

D. Automatic control dampers used for modulating control application shall be of opposed blade configuration and dampers used for open/closed applications shall be parallel blade type.

E. Automatic control dampers shall have a maximum blade length of 48 inches and a maximum blade width of 8 inches. The maximum height of each damper section shall be 72 inches. Where greater length or height is required, provide an assembly of multiple damper sections.

F. Install automatic control damper actuators of sufficient quantity and size to limit leakage to specified rate. Damper assemblies consisting of multiple damper

sections shall be provided with a minimum of one damper actuator per section or be connected with an approved jack-shafting arrangement.

2.15 HEAVY-DUTY INDUSTRIAL AUTOMATIC CONTROL DAMPERS

A. Provide heavy-duty automatic control dampers as indicated on the Drawings for variable volume manifolded laboratory fume exhaust systems bypass pressure control.

B. Heavy-duty industrial automatic control dampers shall be rated at 4,000 feet per minute duct velocity. Leakage through a 60-inch wide damper at 12 inches water gauge pressure difference shall be less than 4.0 cubic feet per minute per square foot of damper.

C. Heavy-duty industrial automatic control damper blades and frames shall be fabricated from 14-gauge Type 316 stainless steel. Blades shall be of airfoil design with full-length EDPM edge seals. Edge seals shall be mechanically locked to the blades locked but easily replaceable in the field. Bearings shall be stainless steel sleeve bearings in cast housing bolted to the frame. Axles shall be Type 316 stainless steel, 3/4-inch diameter. Jamb seals shall be compression type.

D. Heavy-duty industrial automatic control dampers shall be of opposed blade configuration.

E. Install heavy-duty industrial automatic control damper actuators of sufficient quantity and size to limit leakage to specified rate. Damper assemblies consisting of multiple damper sections shall be provided with a minimum of one damper actuator per section.

2.16 MODULATING AIRFLOW MONITOR DAMPER

A. Provide integral air monitor and damper to control the minimum amount of outside air. Damper shall be mounted in an aluminum frame. Damper blades shall be heavy gauge aluminum airfoil type with “neoprene” equivalent blade edge seals. Jamb seals shall be flexible metal compression type.

B. Air monitor damper shall incorporate an air-straightener section to ensure proper airflow readings.

C. Air monitor damper shall be provided with a 24-volt AC modulating motor and an application-specific digital controller designed for the damper and provided by the damper manufacturer. Airflow damper shall be calibrated in an AMCA laboratory and calibration certification shall be included with the damper.

D. The damper application-specific controller shall provide a 0-10 volt DC output representative of actual airflow. The controller shall accept a 0-10 volt DC input from the BMS representing a cfm flow setpoint adjustment.

2.17 AUTOMATIC VALVES

A. Automatic control valves shall be globe type with modulating plug, throttling guides, replaceable seats and discs, and stainless steel stems.

B. Valves 2-inch and smaller shall have bronze bodies with screwed ends. Valves 2.5-inch and larger shall have iron bodies with flanged ends.

C. Valve body rating shall be equal or greater than the piping in which it is installed and the valve shall be rated for operation against the minimum system differential pressure. Rangeability shall be at least 40 to 1 or as required to provide proper control. Leakage shall not exceed 0.1 percent for single seated valves and 1 percent for double-seated valves.

D. Characteristics:

1. Chilled Water Service: Equal percentage flow characteristics, single seated type.
2. Isolation Service: Linear flow characteristics. Single or double seated.

E. Valve Action:

1. Cooling valves normally closed.
2. Or as noted or specified.

F. Size valves to meet the heat transfer loads as specified and as follows:

1. 2-Position Valves: Line size unless noted.
2. Water Service: Maximum pressure drop shall be equal to the pressure drop of the associated coil or exchanger, or 5 pounds per square inch whichever is greater.
3. Cooling Tower Bypass Valves: Sized according to pressure available.
4. Chilled Water Service: Where load exceeds capacity of 4-inch control valve provide two valves piped in parallel and operating in sequence. The larger valve shall have a coefficient of flow (Cv) that is between 2 and 3 times larger than the smaller valve.

2.18 AUTOMATIC CONTROL DAMPER / AUTOMATIC VALVE ELECTRIC ACTUATORS

A. The actuator shall have electronic overload or digital rotation sensing circuitry to prevent damage to the actuator throughout the rotation of the actuator.

B. Where shown, for power-failure/safety applications, an internal mechanical, spring-return mechanism shall be built into the actuator housing.

C. All rotary spring-return actuators shall be capable of both clockwise and counter-clockwise spring-return operation. Linear actuators shall spring-return to the retracted position.

D. Proportional actuators shall accept a 0- to 10-volt DC or 0- to 20-milliamp control signal and provide a 2- to 10-volt DC or 4- to 20-milliampfeedback signal .

E. All 24-volt AC/VDC actuators shall operate on NEC Class 2 wiring and shall not require more than 10 volt-amps for AC or more than 8 watts for DC applications. Actuators operating on 120 volts AC or 230 volts AC shall not require more than 11-volt-amps.

F. All non-spring-return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered.

Spring-return actuators with more than 60 inch-pounds torque capacities shall have a manual crank for this purpose.

G. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.

H. Actuators shall be provided with a raceway fitting and a minimum 1m electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.

I. Actuators shall be UL Listed Standard 873.

J. Actuators shall be designed for a minimum of 60,000 full-stroke cycles at the actuator's rated torque.

K. Actuators shall have visual mechanical position indication, showing output shaft and valve position. The actuator shall be capable of operating the valve from the fully closed to the fully open position and vice versa in less than 60 seconds.

2.19 BUTTERFLY VALVES

A. Butterfly valves are permitted for use for two-position operation on low temperature water applications only.

B. All butterfly valves shall be of the full lug body style with lugs drilled and tapped and have drip-tight shutoff capabilities in either direction up to and including maximum system working pressure. Butterfly valves shall be capable of closing tight after long periods of inactivity.

C. All valves shall be suitable for use with ANSI Standards flanges. Bodies shall be semi-steel or cast iron.

D. Valves shall provide tight shut-off up to the full valve rating on dead-end or isolation service without the use of downstream flanges.

E. All valves shall be furnished with self-lubricated bronze bearings. Shafts seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

F. Seats shall be of the reinforced resilient type (or retained seat on high performance valves) and shall also act as a body liner to prevent flow from contracting the body casting. Resilient seats shall have flange sealing lips to provide a positive seal without use of flange gaskets.

G. Seats shall be Nordel suitable for use with HVAC water to 250 degrees F. Shafts shall be one piece, machined from Type 416 stainless steel, finish ground and polished to minimize bearing and shafts seal wear. Shafts of 8-inch and larger valves shall have a non-adjustable thrust collar.

H. Discs shall be semi-steel with welded nickel edge. The disc-to-shaft connections shall be Type 316 stainless steel. Pins, shaft and disc of all valves shall be individually machined and completely interchangeable.

I. Valves shall be line size unless otherwise noted on the Drawings.

2.20 FIBER OPTIC CABLE SYSTEM

A. Optical Cable: Optical cables shall be duplex 900-millimeter tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed Optical Fiber Nonconductive Plenum (OFNP) in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 millimeter.

B. Connectors: All optical fibers shall be field-terminated with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

2.21 SOFTWARE

A. General:

1. Fully implement, optimize, and commission all software described under this Paragraph and required for a complete operable system.
2. Although “Program” implies software, hardware solutions may be acceptable after review and approval of Authorized Representative. Such differences shall be considered deviations and presented as such.
3. Software programs are described as to general intent. It is recognized that BMS contractors’ software differ; however, the programs that are provided shall incorporate the features described.
4. Each point shall be identified in software with a unique point name of not less than 8 alphanumeric characters. Point names shall be logically and consistently coded to allow identification of the point location (e.g., Building, MER), associated HVAC system (e.g., AHU-1, Chiller-2), and point function (e.g., supply temp, freezestat) as a minimum. See standard point naming convention below:

POINT NAMING CONVENTION					
LOCATION[2]	CATEGORY	EQUIPMENT TAG[3]	COMPONENT[4]	PROPERTY	TYPICAL UNITS
NOTE 2	ELEC	FROM EQUIPMENT SCHEDULES	SW CHWS CHWR CWS CWR HWR HWS STM SF RF OA MA RA EA SA FILT ZONE COMP_X	COMMAND (CMD) STATUS (STS) TEMPERATURE (TEMP) POSITION (POS) POWER (PWR) DAMPER POSITION (DMPR_POS) VALVE POSITION (VLV_POS) VFD SPEED (VFD_SPD) HUMIDITY (HUM) CARBON DIOXIDE (CO2) STATIC PRESSURE (STP) BUILDING STATIC PRESSURE (BLDG_STP) AIRFLOW (CFM) DIFFERENTIAL PRESSURE TRANSMITTER (DPT) DIFFERENTIAL PRESSURE SWITCH (DPS) VFD FEEDBACK (VFD_FDBK) VFD FAULT (VFD_FLT) ENERGY (BTU) WATER FLOW (GPM)	ON/OFF ON/OFF °F OPEN/CLOSED W OR kW % OPEN % OPEN % OR Hz % RH PPM in. WC in. WC CFM in. WC ON/OFF % OR Hz ON/OFF BTU GPM
	HVAC				
	PLBG				
	MISC				

NOTES:
1. SAMPLE:
   A. BUILDING 1 AIR HANDLING UNIT 1 MIXED AIR DAMPER POSITION = BLDG1_HVAC_AHU-1_MA_DMPR_POS
   B. FOR ALL NETWORKED POINTS ADD "NTWRK" TO BEGINNING OF POINT NAME (I.E. NTWRK_BLDG1_HVAC_AHU-1_MA_DMPR_POS)
2. LOCATION:
   A. LOCATION PREFIX TO BE DETERMINED BASED ON SPECIFIC PROJECT.
3. FOR SYSTEM LEVEL DEVICES UTILIZE SYSTEM NAME IN LIEU OF EQUIPMENT TAG (I.E. HW_SYSTEM, CHW_SYSTEM, ETC.)

4. ALL POINT NAMES SHALL ADHERE TO THE FORMAT AS ESTABLISHED ABOVE UNLESS OTHERWISE AGREED TO BY THE ENGINEER. COMPONENTS AND PROPERTIES NOT SPECFICALLY ADDRESSED ABOVE MAY BE ADDED WITH APPROVAL FROM THE ENGINEER.

5. Naming to be consistent throughout graphical user interface. In addition, graphics for identical type systems to be identical.

B. Executive Software:

1. The executive software shall include all programs required for systems, applications, peripheral devices and communications networks.
2. Restrict user software modifications to insure system security. User access to the executive software shall be provided as follows:

    a. Ability to switch failing output devices to another device without loss of data or otherwise handle device failures (e.g., jammed printers).
    b. Ability to modify the priorities and scheduling of application programs.
    c. Ability to add or delete peripheral devices.

3. Provide diagnostic programs to report and display DDC system failures at the Operator's console both on video display and printer. Provide on-line error detection and messages for the discs, power supplies, CPUs, communications boards, and peripherals. Upon failure of a video display system, the system shall be operable using the printers and keyboard.
4. Provide a software time clock which shall display date, time information where required to resolution of one second and otherwise supply data to programs at resolution of 0.1 seconds; display real-time clock in 12-hours or 24-hours format and date. Time and date shall be resettable by mouse or keyboard entry.
5. Peripheral Equipment Selection:

    a. Provide peripheral equipment selection control to apportion data to peripheral console as required (e.g., alarms to alarm printer).
    b. Apportionment of data and control functions shall be a programmable function by an authorized operator at any console. Initialization of the apportionment of data shall be according to the description of the functional requirements stated under each console description. Contractor shall provide all software and programming time required to initialize the system. Submit initial apportionment for all monitored and control functions for review prior to final programming.
    c. The graphics display shall allow simultaneous operator interaction and alarm indication in separate on-screen windows.

6. System Access Control: Provide a minimum of three levels of access using selectable passwords to the system software. Each higher level will increase the allowed interaction by the user. Each password must be entered by the operator to access a particular level of system operation. The password shall not be displayed or printed. Each password shall be unique for each operator.
7. The system shall observe the following command priorities (from highest to lowest):

a. Smoke Control and Life Safety
b. Manual Operator Command
c. Energy Management
d. Automatic Control

C. Operator Interface Program:

1. Provide Microsoft Windows© compatible software as the operator interface with the BMS for defining and selecting points, parameters, report generation, graphics, time schedules and all functions associated with day-to-day operation of the system.
2. Provide software to notify the operator of the occurrence of an alarm condition. All alarm messages displayed on the video terminal, on the local printer, and on the remote printer shall be in simple English-language format. System shall print and sound an audible alarm at each occurrence. Operator acknowledgement shall silence the audible alarm. System shall print upon return to normal.
3. Report generation software shall be provided to present system information in an organized manner:

   a. System Point Log: A log for each system shall include all points required for operation and monitoring of the system. Do not include points used in intermediate calculations and program logic or points used for system tuning and set-up.
   b. Display for each point: Point Name, Point Description, Current Value, Engineering Units, Alarm Status and Command Priority.
   c. Application program logs: Log for each program shall include current values of all points and parameters used in application program.
   d. Summary logs: Logs shall summarize system status. Include as minimum:

      1) Alarm summary
      2) Run-time totalization summary
      3) Disabled point summary

4. Provide fully implemented interactive graphics with latest available process data fully integrated with the display. Point values shall be dynamically updated at an operator selectable rate from 5 to 120 seconds.

   a. Provide a minimum of 32 different operator-selectable colors for the various system components to facilitate rapid recognition and ease of interaction. Colors shall be uniform on all displays, such as all master alarms red blinking with reverse field.
   b. Graphics generation and editing shall be via Windows© based mouse-operated interactive software. The graphics program shall be provided with a library of standard symbols with the capability for use to add custom symbols or modify library symbols Provide graphics for, but not limited to, the following:

      1) Scale floor plans of each level showing status of associated points within area including but not limited to: smoke detectors, HVAC equipment, controls, sensors.

Indicate locations of equipment within area such as DDCs, FEPs, MERs, transmitters, actuators, sensors, lighting control panels, etc.

2) Separate air and water systems riser diagrams showing all systems in block diagram form. System status (on, off, alarm) shall be indicated. Risers shall include common sensing points such as outside air and supply and return temperature in main piping systems.
3) Each air and water system.
4) Each third party system interface.
5) Lighting control indicating each floor plan level and all lighting zones, exterior lighting plan showing all zones and an overall tabular display showing status and switching capability for all lighting control zones.

5. Provide software to output a user-programmed message to the printer or video terminal in response to an alarm or change of value of any system point. Message length shall be at least 4 lines of 80 characters each.
6. All software shall be mouse-operated (point and click; drop-and-drag, etc.) with the option of using predefined keyboard commands.

D. Application Software:

1. Time-of-Day and Event Scheduling:

a. Software shall automatically start and stop equipment based on the time of day and day of week, including holidays and the type of event. The scheduled time-of-day program shall operate in conjunction with the Start/Stop Time Optimization program.
b. Schedule assignments shall be for individual points or group of points. For points assigned to one group, assign variable time delays between each successive start or stop command within that group if required. The system shall have the capacity to accommodate a minimum of 500 uniquely defined schedules. Each load group shall be capable of accommodating a minimum of 250 loads. Initialize the system with Owner schedules and load assignments.
c. System Equipment Rotation: Where multiple pieces of equipment operate in lead/lag or lead/standby manner, a drop down menu shall be available on the equipment graphic to select rotation method (i.e. daily, weekly, monthly, based on runtime, etc.). Graphic should also note the equipments current place in the rotation (lead, lag, standby, etc.).
d. The operator shall be able to define the following information:

1) Time, day, dates
2) Commands such as on, off, auto, etc.
3) Load or loads assigned to groups
4) Time delays between successive commands

e. Include provisions for manually overriding each schedule.
f. The following reports shall be provided:

1) Report of any and all defined time schedules

2) Loads assigned to each time schedule

2. Start/Stop Time Optimization (SSTO):

a. Software shall perform optimized start-up and shut-down of selected equipment. The SSTO program shall start HVAC equipment at the latest possible time that will allow the equipment to achieve the desired zone conditions by occupancy time. The SSTO program shall also shut down HVAC equipment at the earliest possible time before the end of the occupancy period, and still maintain desired comfort conditions. Initialize the system with default values used on previous projects of similar construction with similar equipment.

b. The SSTO program shall operate in both the heating and cooling seasons. It shall be possible to apply the SSTO program to all individual systems.

c. The SSTO program shall operate on outside weather conditions, as well as inside zone conditions, and empirical factors. The empirical factors shall relate to the dynamic responsiveness of particular zones such as heat retention and transfer coefficients. The program shall be fine tuned during the warranty period using empirical data compiled during operation of the building.

d. The program shall automatically adjust itself utilizing adaptive control techniques.

e. The system operator shall be able to, for each system under control of the SSTO program, establish and modify the following parameters:

1) Occupancy period
2) Desired occupancy temperature
3) Heating/cooling transfer coefficients
4) Heating/cooling retention coefficients
5) Primary equipment lag time

f. A report shall be provided detailing SSTO parameters such as zone coefficients, zone occupancy time and temperature, activated/inactivated zones, etc.

3. Demand Limiting (If Applicable):

a. Software shall perform electrical demand limiting (EDL). The EDL program shall monitor the rate of electrical power consumption and forecast the total demand during each demand interval using a sliding window approach.

b. The program shall automatically shed and restore loads to prevent the electrical demand from exceeding an operator set level.

c. Kilowatt rating of each load shall be prioritized by the operator to ensure proper number and sequencing of loads being shed when excessive electrical demand is predicted. For initial scheduling purposes, each load shall be assigned to five priority groups.

1) Priority Groups 1, 2 and 3: Automatically shed as required.
2) Priority Groups 4 and 5: Issue operator advisory to manually shed particular load by operator action at console.

d. When load shed condition exists, program begins searching for loads in Group 1 and continues through Group 3 until the necessary number of kilowatts have been shed. Loads within each group shall be shed on an operator selectable basis. Load restoration procedure is opposite of load shedding procedure.
e. Each load shall be programmed with maximum off time, minimum on time and minimum off time.
f. The operator shall be able to define the following information:

1) Load kilowatt and priority
2) Maximum demand setpoint

g. The following information shall be available in report from:

1) Load data
2) Maximum demand for a given period (day, week, month, etc.)
3) Current demand and loads shed

h. When an operator-selectable percentage of maximum target is exceeded alarm shall sound, current demand in kilowatt displayed and printed out with time of occurrence on alarm printer.
i. Degraded mode: Loss of all or part of data trunk cable shall not cause the shed loads to restart and the electrical load to exceed setpoint. DDCs shall cycle connected loads in a stand-alone mode to eliminate or reduce potential increases in maximum demand level.

4. Automatic Restart: During a power outage the DDC operating programs and database shall be protected against loss of memory with battery back-up. If length of the power outage exceeds the battery back-up capacity, the programs and database shall be automatically reloaded from disk storage upon power restoration. After power has been restored, the system points shall either be returned to the state they would be in if there were no power outage or remain off as defined by equipment and operational requirements. Points to be restarted shall start over a programmed time schedule to affect soft start.
5. Automatic False Alarm Lockout: When systems are off, certain analog variables may drift past programmed alarm limits. Inhibit analog variable limit alarms until after system is restarted and stabilized.
6. Historical Trending:

a. Any system point either real or calculated shall be assignable to the historical trending program. All changes in point value shall be recorded for points assigned. The trend interval shall be user selectable.

b. All trend information shall be recorded in non-volatile memory and graphically displayed. Display shall accommodate up to twelve different point trends simultaneously displayed in user selectable colors and dynamically updated.

7. Custom Application Program:

a. Provide real-time control programming capability to allow operator to create customized control strategies based on arithmetic, logical, conditional, and time logic.

E. Remote Alarm and Communication Software: The BMS shall have the ability to alarm and communicate with other off-site PC (LOT) by using the modem dial out/in using BACnet Point To Point service or PC Anywhere or equal commercial software. The BMS shall have the ability to notify the Owner via voice or numeric pager of serious alarms on the BMS.

F. Web Access:

1. The system shall be capable of supporting at least 64 clients using a standard web browser such as Google Chrome. Systems requiring additional software to enable a standard web browser are not acceptable.
2. The web browser software shall run on any operating system and system configuration that is supported by the web browser.
3. The web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
4. The web browser client shall support, at a minimum, the following functions:

a. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using authentication and encryption techniques to prevent unauthorized access shall be implemented.
b. Graphical screens developed for the GUI shall be the same screens used for the web browser. Any animated graphical objects supported by the GUI shall be supported by the web browser interface.
c. HTML programming shall not be required to display system graphics or data on a web page. HTML editing of the web page shall be allowed if the user desires a specific look or format.
d. Storage of the graphical screens shall be in the BMS, without requiring any graphics to be stored on the web access computer.
e. Real-time values displayed on a web page shall update automatically without requiring a manual “refresh” of the web page.
f. Users shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

1) Modify common application objects, such as schedules, calendars, and setpoints in a graphical manner.

a) Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
b) Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

2) Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
3) View logs and charts.
4) View and acknowledge alarms.

g. Graphic screens on the web browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.22 PNEUMATIC CONTROLS

A. Thermostats:

1. Space thermostat shall be two-pipe, non-bleed, relay operated type, fully proportioning with feedback, have adjustable sensitivity, a scale range of at least 30 degrees F and test ports to measure control air pressure. Control action shall be direct or reverse acting.
2. Thermostat shall be capable of controlling within plus or minus 1.5 degrees F, and be responsive (change control pressure) to a 0.25-degree F change.
3. Thermostat, in general, shall be non-indicating, lock type, key-adjusted. Thermostat adjustment shall require removal of the cover to gain access for adjustment. Finish color and final locations shall be approved by the Architect.
4. Thermostats controlling both heating and cooling shall be dual setpoint (dead band) type. Each setpoint and sensitivity shall be independently adjustable.
5. Provide aspirating type thermostats as shown on the Drawings.

B. Pneumatic Damper Operators:

1. Damper operators shall be of the molded synthetic rubber diaphragm piston type, fully proportioning, unless otherwise specified, quiet in operation and have ample power to overcome friction of damper linkage and air pressure acting on louvers to position dampers accurately and smoothly. Provide a suitable linkage between operator and damper. Operators capable of operating at varying speed shall correspond to controller output signals and variable load requirements, and shall operate in sequence when required by the Sequence of Operation. External adjustable stops shall limit the stroke in either direction.

2. The operator linkage arrangement shall permit field-selectable normally open or normally closed fail-safe positions of the dampers as required. If damper is an integral part of a smoke control system the actuator shall stroke from fully open to fully closed or vice versa in less than 15 seconds.

C. Automatic Valve Pneumatic Actuators:

1. Valves shall be quiet in operation and fail-safe in either normally open or normally closed position in the event of the control air failure. Valves capable of operating at varying speed shall correspond to controller output signals and variable load requirements, and shall operate in sequence when required by the sequence of operation.
2. Valve operators shall be of the pneumatic, spring return, molded synthetic rubber diaphragm type sized to insure tight seating against maximum differential pressure. Provide pressure gauges at all modulating valves located in mechanical rooms and any valves 2.5 inches or larger. Gauges shall be 1.5 inches in diameter minimum. Provide mechanical direct reading movement indicators on all valves 2.5 inches or larger. Provide positive positioning relays on valves operated in sequence and all valves 2.5 inches or larger.

D. Compressed Air Supply:

1. Provide duplex air compressors, air storage tank, air dryers, air filters, silencers, motor starters, automatic alternator, pressure reducing valves and all other required auxiliary and safety equipment to supply clean, oil-free uninterrupted compressed air supply to control instruments, domestic water heaters, expansion tanks, thermostats, variable air volume terminal units, fan inlet vane, inlet cones, or inlet plug operators, and all other devices requiring compressed air.
2. Provide minimum one air storage tank constructed in accordance with ASME Code for unfired vessels and be rated for no less than 200 pounds per square inch (psi). The tank shall be sized to limit the number of compressor starts to 10 per hour. Provide pressure relief valve, automatic drain valve and pressure gauge for each tank provided. Provide piping from drain valve to nearest floor drain.
3. Provide two refrigerated air dryers of the non-cycling type piped to permit operation of either dryer with the other as a stand-by. Each dryer shall be equipped with pre-filter, bypass valve, and automatic drain valve, and be sized to reduce the 100 pounds per square inch pressure dewpoint to 38 degrees F at maximum demand. Provide piping from drain valve to nearest floor drain.
4. Downstream of the air dryers provide two parallel filter and pressure reducing stations piped to permit operation of one station with the other valve off for stand-by operation. Provide at each station a 1-micron prefilter and a 0.5-micron, 99-percent oil-coalescing afterfilter, a non-relieving pressure regulator and a pressure relief valve set at a maximum of 20 percent above the pressure regulator setting. Pressure gauges shall be installed upstream and downstream of each filter and PRV.
5. A pressure switch at the discharge of the filter and PRV station shall indicated a low air pressure condition to the BMS system.
6. High pressure compressed air at 60 to 80 pounds per square inch gauge from the central filter and PRV station may be carried to each field

equipment panel, then reduced to control air pressure through pressure reducing stations, including a high efficiency filter with 0.5 micron cartridge, relief valve set at a maximum of 20 percent above operating pressure, and air gauges, all in conformance with the requirements of the central filter and PRV station.

7. Compressed Air Piping:

    a. Type “L” hard drawn copper
    b. Soft copper
    c. Steel: Galvanized Schedule 40
    d. Nonmetallic: Polyethylene flame retardant, high-density type FR tubing. Multi-tube bundles shall have numbered tubes and enclosed in flame retardant polyethylene jacket.

E. Field Equipment Panel:

1. Provide field equipment panels to interface the DDC panels with pneumatic control devices. The panels shall house, current to pneumatic (I/P) transducers, I/P switches, pressure gauges, interface relays, 3-way pilot valves, and other miscellaneous control components.
2. Connect the panel to its associated DDC panel and provide barrier type terminal strips mounted for input and output wiring terminations. Pneumatic piping internal to the panel shall be fire resistant polyethylene tubing.
3. Identify all equipment internal to panel or face mounted with nameplates to match approved shop drawings.
4. Field equipment panels shall be NEMA-1 master key locked with a hinged and gasketed front door cabinet, construction to match DDC enclosures.

PART 3 – EXECUTION

3.01 LOCATION OF EQUIPMENT

A. The Drawings and Specifications describe approximate locations of the work. Verify all locations in the field.

B. Locate equipment and accessories so as to provide easy access for proper service and maintenance.

3.02 INSTALLATION

A. Provide wiring for control devices, monitoring devices, instrumentation, and interlocks as required for a complete system. Coordinate with Divisions 21, 22, 23, 25 and 26 of the Specifications for devices requiring wiring under this Section.

B. Run all wiring in compliance with the requirements of the Division 26 Specification and in accordance with Authorities and Codes Having Jurisdiction. Provide separate conduit for control wiring under this Section.

C. Provide all BMS wiring, including power wiring to DDCs and BMS equipment. All power wiring for control system shall be from an emergency power panel.

3.03 INSTALLATION OF PNEUMATIC CONTROLS

A. Adequately size all tubing runs so that all subsystems have ample capacity to handle the controls connected. It is the intent of this Specification to provide an air distribution system that divides the building into several areas of control, which may be conveniently isolated for future maintenance and repair.

B. Instrument air piping installed concealed in finished accessible areas shall be copper or polyethylene tubing when permitted by local codes. Instrument air piping installed exposed in mechanical equipment rooms and shafts or in concealed inaccessible areas shall be copper tubing. Polyethylene tubing shall not be permitted in smoke control or life safety systems, buried locations, in outdoor air intakes, in outdoor locations, in ducts, plenums and mechanical equipment rooms, for service in excess of 30 pounds per square inch gauge, or in any location in which the temperature may exceed 125 degrees F.

C. Use number-coded tubing throughout with coding rapidly identifiable at points of control and equipment. No piping shall be concealed under or within duct insulation or acoustic lining. Air piping shall be run horizontally level and vertically plumb and parallel to building lines. Tubing shall be fastened and adequately supported to prevent sagging. Only tool-made bends in copper tubing shall be acceptable.

D. Installed piping shall not interfere with the maintenance of process equipment such as the removal of tube bundles, pump casings, coils, etc. Instrument piping and tubing shall be installed with sufficient space around the instrument for servicing and adjustment. Connections to instruments shall allow the disconnect and removal of each individual instrument without distortion of tubing.

E. Whenever copper tubing crosses from a vibration-isolated piece of equipment to a stationary structure, crosses a flexible connection or spans a building expansion joint or seismic joint, plastic tubing (maximum length 12 inches) shall be installed to absorb vibration and accommodate equipment start-up or building movement. The final connection to moving control equipment, such as damper actuators, shall be made via a short section of plastic tube. Exception – tubing for smoke control or life safety systems shall be braided metal hose.

F. Air Pressure Test:

1. Instrument Air Piping Pressure Test:

a. Test all high pressure (80 psig) piping at 100 psig sustained for 24 hours. Pressure loss shall not exceed 10 pounds per square inch gauge at the end of the 24-hour test period.
b. Test all low pressure (25 pounds per square inch gauge) piping at 30 pounds per square inch gauge sustained for 24 hours. Pressure loss shall not exceed 3 pounds per square inch gauge at the end of the 24-hour test period.

G. Provide 1.5-inch air pressure gauges at DDC to indicate pressure at each field device and at controlled devices located further than 50 feet or in a different room than the DDC. Gauges are not required at terminal units.

3.04 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the Engineer for resolution before rough-in work is started.

C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate, or if any discrepancies occur between the plans and the Contractor's work, and the plans and the work of others; the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor's work with the work of others. Any changes in the work covered by this Specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by, and at the expense of, this Contractor.

3.05 PROTECTION

A. The BMS Contractor shall protect all work and material from damage by its work or employees, and shall be liable for all damage thus caused.

B. The BMS Contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open of work with temporary covers during storage and construction to prevent entry of foreign objects.

3.06 INSTALLATION OF CONTROL EQUIPMENT

A. Device and panel locations are the responsibility of the BMS Contractor. Group instrumentation on ductwork, air handling units, packaged equipment and fan casing in an organized manner. Locations shall be consistent for each type of system. Each control device, field- or panel-mounted, shall be identified by an engraved lamacoid nameplate permanently attached to its enclosure.

B. Sensors mounted on air ducts having exterior insulation shall be provided with stand-off spacers with insulating material firmly fitted around spacers.

C. Averaging temperature and low temperature detectors shall be installed in serpentine fashion and supported by steel grid or multiple bulb holders. Minimum coverage 1 linear foot of sensor element per 4 square feet of coil face area.

D. Wall-mounted sensors shall be 42 inches above finished floor and consistent with ADA requirements as outlined in Division 1 of the Specification. In service corridors where subject to damage, mounting height shall be 84 inches unless noted otherwise. Provide insulated base where mounting on exterior wall is required. Provide metal guards where mounted in mechanical, electrical, storage, and maintenance areas or in any area where subject to damage.

E. Install sensors in accordance with the manufacturer's recommendations to sense the variables specified.

F. Mount sensors securely. Mountings shall be suitable for the environment within which the sensor operates.

G. Install sensors as required to properly sense the controlled medium. Sensor locations shall be such that access to the instruments can be obtained for service and removal. If the installation location is found to be unacceptable to the Consultant, then the sensors shall be relocated as directed at no additional cost to the Owner.

H. Locate pressure transducers within 50 feet of sensing point. Connect sensors with tubing of diameter recommended by sensor manufacturer and as required to prevent signal phase lag. Provide gauge tees at transducer for connection to pressure gauge.

I. DDC panels and other control panels shall not be located directly underneath valves or other areas where they may be subject to water or heat damage. In addition, panels shall be mounted with the bottom no lower than 3 feet and the top no higher than 7 feet above the floor, with a minimum of 3-foot clearance at the front.

J. Provide seismic restraints and attachments to wall or floor using neoprene bushings or pad with steel disc to spread load over the entire neoprene element.

3.07 IDENTIFICATION

A. All tagged components shall be in accordance with ASME A13.1.

B. Each control device, field- or panel-mounted, shall be identified by an engraved lamacoid nameplate permanently screw-fastened to its enclosure. Nameplates shall be black surface, white core laminated Bakelite with engraved letters. Plates shall be a minimum of 3 inches long by 1 inch wide with white letters 3/8 inches high.

C. Each major component of equipment shall be labeled with the manufacturer's name, address, model and serial number. Equipment shall be identified by an engraved lamacoid nameplate permanently screw-fastened to the equipment. Nameplates shall be black surface, white core laminated Bakelite with engraved letters. Plates shall be a minimum of 3 inches long by 1 inch wide with white letters 3/8 inches high.

D. All communication wiring shall be labeled to indicate origination and destination data.

E. All input and output wiring should be tagged according to the Point Naming Convention stated in section 2.20.

F. Control valve and control damper labeling to match drawing labels. Use metal tags of minimum 2-inch diameter, fabricated of brass, stainless steel or aluminum. Attach tags with jack chain s-hook or split ring of same materials. For stamped tags, use 1/4-inch high letters.

G. Identify service and type of control equipment behind all architectural access doors.

H. Removable ceiling tile used for access to control devices located above ceiling tile shall be marked by a permanent small green color tab at corner of ceiling tile.

3.08 WIRING

A. All control and interlock wiring shall comply with national and local electrical codes and Division 26 of this Specification. Where the requirements of this Section differ with those in Division 26, the requirements of this Section shall take precedence.

B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved raceway per NEC and Division 26 requirements.

C. All low-voltage wiring shall meet NEC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current-limit.

D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations including ceiling return air plenums, approved cables not in raceway may be used, provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.

E. All wiring in mechanical, electrical, or service rooms – or where subject to mechanical damage – shall be installed in raceway.

F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).

G. Do not install wiring in raceway containing tubing.

H. Where Class 2 wiring is run exposed, wiring is to be run parallel along a surface or perpendicular to it, and neatly tied at 10-foot maximum intervals.

I. Where plenum cables are used without raceway, they shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical raceways, piping, or ceiling suspension systems.

J. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

L. Maximum allowable voltage for control wiring shall be 120-volt. If only higher voltages are available, the Contractor shall provide step-down transformers.

M. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

N. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at all penetrations.

O. Size of raceway and size and type of wire shall be the responsibility of the Contractor, in keeping with the manufacturer's recommendation and NEC requirements, except as noted elsewhere.

P. Include one pull string in each raceway 1-inch or larger.

Q. Use coded conductors throughout with different colored conductors.

R. Control and status relays are to be located in designated enclosures only. These enclosures include packaged equipment control panel enclosures unless they also contain Class 1 starters.

S. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 inches from high-temperature equipment (over 104 degrees F).

T. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

U. Adhere to Division 26 requirements where raceway crosses building expansion or seismic joints.

V. Provide seismic restraints for BMS control system wiring that serves life safety system equipment, pressurization fans, smoke control equipment and exhaust systems containing flammable, toxic or combustible product].

W. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

X. The Contractor shall terminate all control and/or interlock wiring, and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

Y. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 feet in length and shall be supported at each end. Flexible metal raceway less than 1/2-inch electrical trade size shall not be used. In areas exposed to moisture – including chiller and boiler rooms – liquid-tight, flexible metal raceways shall be used.

Z. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (per code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.09 BMS COMMUNICATION WIRING

A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

B. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.

C. Maximum pulling, tension, and bend radius for cable installation as specified by the cable manufacturer shall not be exceeded during installation.

D. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

E. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.

F. All runs of communication shall utilize repeaters. Repeaters shall be installed per manufacturer's instructions.

G. All networks (main and sub-networks) shall utilize network diagnostic devices if available. Network diagnostic devices shall be installed per manufacturer's instructions.

H. All runs of communication wiring shall be un-spliced length when that length is commercially available.

I. All communication wiring shall be labeled to indicate origination and destination data.

J. Grounding of coaxial cable shall be in accordance with NEC Regulations Article no. 800 on Communications Circuits, Cable and Protector Grounding.

K. Provide seismic restraints for BMS control system wiring that serves life safety system equipment, pressurization fans, smoke control equipment and exhaust systems containing flammable, toxic or combustible products.

3.10 TRAINING

A. The Contractor shall furnish the services of competent instructors to give instruction in the adjustment, operation and maintenance, including pertinent safety requirements, of the equipment and system specified. The training shall be oriented toward the system installed rather than being a general training course. Each instructor shall be thoroughly familiar with all aspects of the subject matter they are to teach. The Contractor shall provide all equipment and material required for classroom training.

B. The training program shall be accomplished in two phases for the time interval specified for each phase.

1. The first phase shall be given prior to the acceptance test period at a time mutually agreeable between the Contractor and the Owner, and shall be at least five (5) days (8 hours/day) in length. Operating personnel shall be trained in the functional operations of the BMS installed and the procedures that the operators will employ for system operation. The training shall include but not be limited to:

a. General BMS configuration

b. Operation of computer and peripherals
c. Command-line mnemonics
d. Report generation
e. Operator control functions
f. Graphics generation
g. General equipment layout
h. Troubleshooting procedures
i. Preventative maintenance procedures
j. Sensor maintenance and calibration
k. Proper use of service kit

2. The second phase shall be conducted after system acceptance testing for a period of eight (8) days. The training shall occur up to one year after the first phase of training as determined by the Owner and shall include but not be limited to:

a. DDC programming
b. Database generation
c. Supervisory level operator commands
d. Topics requested by Owner

3.11 CALIBRATION AND COMMISSIONING

A. Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets that shall be submitted prior to acceptance testing. Notify the Owner in writing of the testing schedule so that operating personnel may observe calibration and commissioning.

B. Field I/O Calibration and Commissioning:

1. Prior to system program commissioning, verify that each control panel has been installed according to the shop drawings and test, calibrate, and bring on-line each control device. Commissioning to include but not be limited to:

a. Sensor accuracy at 10, 50 and 90 percent of range
b. Sensor range
c. Verify analog limit and binary alarm reporting
d. Point value reporting
e. Binary alarm and switch settings
f. Actuator spring ranges
g. Failsafe position on loss of control signal

2. Record calibration and test data on commissioning data sheets and submit. Data sheets shall include the device designation, the date of commissioning and the name of person who performed commissioning.

C. System Program Commissioning: After control devices have been commissioned, each DDC program shall be put on-line and commissioned. The Contractor shall confirm that the DDC program logic follows the approved software flow chart and sequence of operation. Each control loop shall be adjusted to provide stable control and control within the specified accuracies.

System program test results and loop adjustments shall be recorded on commissioning data sheets and submitted.

D. Integrated System Commissioning:

1. After all DDC programs have been commissioned, the Contractor shall verify the overall system performs as specified. Tests shall include but not be limited to:

a. Data communication, both normal and failure modes
b. Fully loaded system response time
c. Impact of component failures on system operation
d. Time/date changes
e. End of month/end of year operation
f. Global application programs
g. System back-up and reloading
h. System status displays
i. Diagnostics
j. Power fail/restart
k. Battery back-up

3.12 ACCEPTANCE TESTING

A. Submit a detailed acceptance test procedure designed to demonstrate compliance with contract requirements at least four (4) weeks before the start of testing. This procedure to be approved prior to the start of the testing.

B. During acceptance testing provide services of a fully qualified building automation technician who is knowledgeable of the project.

C. Using the commissioning test data the Owner shall select, at random, functions to be demonstrated. The Contractor in accordance with the acceptance test procedure shall demonstrate these functions. At least 15 percent of the systems functions shall be demonstrated. At least 95 percent of the functions demonstrated must perform as specified and documented on commissioning data sheets or the system must be retested.

D. Furnish instruments required for testing. Submit catalog data on all instruments for approval prior to performance tests.

Instrument Accuracy	
Temperature:	1/4 degree F or 1/2 percent of full scale, whichever is less
Pressure:	1/2 pound per square inch or 1/2 percent of full scale, whichever is less
Humidity:	1/2 percent relative humidity
Electrical:	1/4 percent of full scale

E. After the above acceptance tests are complete and the system is demonstrated to be functioning as specified, a thirty-day endurance test period shall begin. If the system functions as specified throughout the endurance test period requiring only routine maintenance and adjustment, the system shall be accepted. If during the endurance test period the system fails to perform as specified and

cannot be corrected within eight (8) hours, the Owner may request that the endurance tests be repeated after problems have been corrected.

END OF SECTION

SECTION 23 21 13
PIPING

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Piping
2. Fittings
3. Jointing Materials
4. Welding and Jointing Procedures
5. Unions and Couplings
6. Heat Tracing
7. Leak Detection System

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping

C. Section 23 05 23 – General-Duty Valves for HVAC Piping

D. Section 23 05 29 – Hangers and Supports for HVAC

E. Section 23 05 48 – Vibration and Seismic Controls for HVAC

F. Section 23 05 53 – System Identification for HVAC

G. Section 23 07 00 – HVAC Insulation

H. Section 23 09 23 – Direct Digital Control System for HVAC

Section 23 25 00 – HVAC Water Treatment

I. Section 23 82 16 – Air Coils

1.03 REFERENCE STANDARDS

A. ASME – American Society of Mechanical Engineers

1. ASME Standard B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, 250 and 800
2. ASME B16.3 Malleable Iron Threaded Fittings.
3. ASME B16.4 Gray Iron Threaded Fittings.
4. ASME Standard B16.5 Pipe Flanges and Flanged Fittings, NPS ½ through 24
5. ASME Standard B16.15 Cast Copper Alloy Threaded Fittings, Classes 125 and 250
6. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.

7. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
8. ASME Standard B16.24 Cast Copper Alloy Pipe Flanges and Flanged Fittings, Classes 150, 300, 400, 600, 900, 1500 and 2500
9. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
10. ASME B31.1 Power Piping.
11. ASME B31.5 Refrigeration Piping and Heat Transfer Components.
12. ASME B31.9 Building Services Piping.
13. ASME B36.10M Welded and Seamless Wrought Steel Pipe.
14. ASME Section IX Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

B. AHRI (ARI) – Air Conditioning and Refrigeration Institute

C. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers

D. ASTM – American Society for Testing and Materials

1. ASTM A47 Standard Specification for Ferritic Malleable Iron Castings
2. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A90/A90M Standard Test Method for Weight [Mass] of
4. Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
5. ASTM A105/A105M Standard Specification for Carbon Steel Forgings for Piping Applications
6. ASTM A106/A106M Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
7. ASTM A135-01 Standard Specification for Electric-Resistance-Welded
8. Steel Pipe
9. ASTM A139-00 Standard Specification for Electric-Fusion (Arc)-Welded
10. Steel Pipe
11. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
12. ASTM A181/A181M Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
13. ASTM A182 Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
14. ASTM A183 Standard Specification for Carbon Steel Track Bolts and Nuts
15. ASTM A234/A234 M Standard Specification for Piping Fittings of
16. Wrought Carbon Steel and Alloy Steel for Moderate and High
17. Temperature Service
18. ASTM A312 Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
19. ASTM A376 Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
20. ASTM A395/A395M: Standard Specification for Ferritic Ductile Iron
21. Pressure-Retaining Castings for Use at Elevated Temperatures
22. ASTM A403 Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
23. ASTM A536 Standard Specification for Ductile Iron Castings

24. ASTM A674 Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
25. ASTM B32 Standard Specification for Solder Metal
26. ASTM B43 Standard Specification for Seamless Red Brass Pipe, Standard Sizes
27. ASTM B68/B68M Standard Specification for Seamless Copper
28. Tube, Bright Annealed
29. ASTM B75/B75M Standard Specification for Seamless Copper Tube.
30. ASTM B88 Standard Specification for Seamless Copper Water Tube
31. ASTM B280 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
32. ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications
33. ASTM B633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
34. ASTM B816 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
35. ASTM B813 Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
36. ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy tube and Fittings
37. ASTM C591 Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
38. ASTM D638 Standard Test Method for Tensile Properties of Plastics
39. ASTM D1330 Standard Specification for Rubber Sheet Gaskets
40. ASTM D1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
41. ASTM D1785 Standard Specification for Poly(Vinyl Chloride) (PVC) Pipe, Schedules 40, 80 and 120
42. ASTM D2104 Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40
43. ASTM D2464 Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
44. ASTM D2466 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
45. ASTM D2467 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
46. ASTM D2609 Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
47. ASTM D2657 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
48. ASTM D2846 Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
49. ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
50. ASTM F1290 Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings

E. AWS – American Welding Society

1. AWS A5.8/A5.8M Specification for Filler Metals for Brazing and Braze Welding
2. AWS A5.31 Specification for Fluxes for Brazing and Braze Welding

3. AWS B2.1 Specification for Welding Procedure and Performance Qualification
4. AWS B2.2 Specification for Brazing Procedure and Performance Qualification
5. AWS C3.4M/C3.4 Specification for Torch Brazing
6. AWS D10.12M/D10.12 Guide for Welding Mild Steel Pipe

F. ISO – International Organization for Standardization

1. ISO 9001 Quality Management System Requirements

G. MSS - Manufacturers Standardization Society

1. MSS SP6 Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
2. MSS SP9 Spot Facing for Bronze, Iron and Steel Flanges
3. MSS SP43: Wrought Stainless Steel Butt-Welding Fittings
4. MSS SP44: Steel Pipe Line Flanges
5. MSS SP-51 Class 150LW Corrosion Resistant Cast Flanges and Flanged Fittings

H. NFPA – National Fire Protection Association

1. NFPA Standard 70 National Electrical Code
2. NFPA Standard 99 Standard for Health Care Facilities

I. UL – Underwriters Laboratories Inc.

1. UL Standard 719 Nonmetallic-Sheathed Cables
2. UL Standard 910 Test for Flame-Propagation and Smoke Density Values for Electrical and Optical-Fiber Cables Used in Spaces Transporting Environmental Air

J. Local Codes and Standards

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 and the requirements of the listed related documents.

B. Welding materials and labor to conform to ASME Code and applicable state Labor Regulations.

C. All welders shall be certified by ASME B31.9 – Standards of Pressure Piping – Building Services Piping or “Qualification Tests” in Section IX of the ASME Boiler and Pressure Vessel Code: Welding and Brazing Qualifications.

D. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

E. Each length of pipe, fitting, trap, fixture or device used in any piping system shall be stamped or indelibly marked with type, weight, quality and manufacturer’s name or mark.

F. Furnish and set all sleeves for passage of pipes through structural masonry and concrete walls and floors and elsewhere as required for proper protection of each pipe passing through building surfaces. Coordinate this work with Construction Manager/General Contractor in order to expedite and properly perform this work.

G. Field drilling, cutting and/or reinforcing of holes in structural metal deck required for work under this section shall be coordinated through the Construction Manager/General Contractor and must be approved by the Structural Engineer.

H. Leak detection systems shall comply with all codes having jurisdiction. The manufacturer shall guarantee the system for one year from the date the system is accepted by the Owner. Contractor shall replace all equipment found to be defective during this period.

1.05 SUBMITTALS

A. Submit the following for review:

1. Product Data: Submit manufacturer's latest information on construction details, rated capacity data, operating characteristics and installation data.
2. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiates between manufacturer-installed and field-installed wiring and location and size of all required field connections.
3. Submit manufacturer's installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories and maintenance data.
4. Submit schedule indicating the ANSI, ASME, ASTM, AWWA Standard Specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service. The schedule must include system type, location, working pressure, type of pipe, and fitting type for each pipe type and size.
5. Submit ISO 9001 certifications where required by specifications.
6. Submit shop drawings indicating anchoring details, anchor points, guide details, etc.
7. Submit dimensioned drawings locating pipe penetrations through walls, slabs and other structural elements, anchor and guide locations, etc.
8. Submit pipe expansion and flexibility calculations.
9. Submit test reports on all systems tested. Tests required by Authorities Having Jurisdiction over the work shall be submitted on appropriate forms to the satisfaction of such authorities.
10. Welder's Certificate: Submit welder's certification of compliance with ASME Section IX and AWS D1.1 prior to proceeding with any welding.

B. Heat Tracing: Equipment sizes, locations, performance data, installation details, wiring diagrams and controls. Manufacturer's latest published data for materials, equipment and installation.

C. Leak Detection System:

1. Manufacturer's literature and illustrated installation instructions.

2. Wiring diagrams and parts list.
3. Written description of sequence of operation.
4. A graphic display map mounted near the module shall be prepared, after completion of installation, from “as-built” drawings furnished by the installer. The map shall indicate the location of the cables; connectors; landmarks such as columns and walls; and changes of cable direction.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Steel Pipe: Wheatland Tube, USS, Koppel Steel, Tex-Tube

B. Steel Fittings: Anvil International, Hackney Ladish, Bonney Forge Foundry, Weldbend

C. Copper Pipe: Alaskan Copper & Brass, Cerro Flow, Wieland Copper

D. Copper Fittings: Elkhart, Mueller Streamline, Nibco

E. Dielectric Fittings:

1. Unions: Watts, Perfection, Central Plastics, EPCO, Zurn, Hart
2. Insulating Flanges: Watts, Capital, Central Plastics, EPCO, Walter Vallett Co., V-Line
3. Flange Kits: Calpico, Central Plastics, Advanced Plastics
4. Couplings: Calpico, Lochinvar
5. Nipples: Perfection, Sioux Chief, Victaulic Company

F. Flange Gaskets: Flexitallic, Garlock, Victaulic

G. Pre-Insulated Pipe and Fittings: Perma-Pipe, Rovanco

H. Leak Detection System: TraceTek, or approved equal

I. Cleaning of Piping Systems: Use chemicals as recommended by the water treatment specialist engaged under Section 23 25 00: Water Treatment

J. Testing of Piping Systems: American Gas and Chemicals “Leak-Tee”, Cosgille Scientific “Sho Gas”, Flamort Chemical “Detect-A-Leak”, Highside Chemicals “Leak Finder Foam”

2.02 SCHEDULE OF PIPING AND FITTING MATERIALS AND WEIGHT

Service	Pipe Size (Inches)	Pipe Material	Fittings
Closed Condenser, Chilled, Glycol, Hot Water Systems (All Piping, Up to 150 psig)	2 ½” and Smaller	ASTM A53 Grade B Seamless or ERW Schedule 40	Malleable Iron Screwed Class 150 Same Schedule

Service	Pipe Size (Inches)	Pipe Material	Fittings
	3” to 10”	ASTM A53 Grade B Seamless or ERW Schedule 40	Forged Steel Weld End
	12” and Larger	ASTM A53 Grade B Seamless 0.375” Wall	Forged Steel Weld End
Optional: Chilled, Glycol, and Hot water runouts (radiation, fan coils, VAV terminal units), Up to 150 psi	2 ½” and Smaller	ASTM B88 Copper Type L Hard	Wrought Copper Brazed
Cooling Coil Drain Piping	All	ASTM B88 Copper Type L Hard	Wrought Copper Soldered
	All (Only Unpressurized)	CPVC Schedule 40	Solvent Welded Socket
Equipment Drains and Overflows, Atmospheric Vents	Galvanized Steel	Schedule 40	Malleable Iron Screwed Class 150 Same Schedule
	All	ASTM B88 Copper Type L Hard	Wrought Copper Soldered
Fresh Water	2 /12” and Smaller	ASTM B88 Copper Type L Hard	Wrought Copper Soldered

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical, thermal, and pressure conditions of piping system contents.

B. Flange gaskets shall be rated ASME B16.21, non-metallic, flat, asbestos-free full faced or flat ring type to suit flange facings. Selected from one of the following materials:

FLUID	MAXIMUM TEMPERATURE (°F)	MAXIMUM PRESSURE (PSIG)	GASKET	THICKNESS
WATER	200°F	400	GARLOCK IFG 5500	1/16”

C. Pipe threads shall be ANSI/ASME B1.20.1.

D. Pipe grooved ends shall be in conformance with ASME/AWWA C606 (or similar).

E. Flange bolts and nuts shall be rated ASME B18.2.1, carbon steel.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer.

G. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

1. 100 percent lead free, silver bearing solders equivalent to:

a. “Silverflo” by Canfield
b. “Stay-Safe Bridget” by J.W. Harris

2. 95-percent tin and 5-percent antimony composition.

H. Brazing Filler Metals:

1. General Duty: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys, unless otherwise indicated equivalent to:

a. “Stay-Silv 15” by J.W. Harris
b. “Sil Can 15” by Canfield

2. Refrigerant Piping: AWS A5.8/A5.8M, BAg1, silver alloy for refrigerant piping, unless otherwise indicated equivalent to:

a. “Safety-Silv 45” by J.W. Harris
b. “Sil Can 45” by Canfield

I. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 UNIONS AND FLANGES

A. Unions for Pipe 2 Inches and Smaller:

1. Steel Piping: ASME B16.3 malleable iron unions with brass seats. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 pounds square inch, ground joint.
2. Copper Piping: Class 250 bronze unions with soldered or brazed joints
3. CPVC Piping: CPVC solvent-weld socket to screwed joint adapters at connections to equipment.

B. Flanges for 2 ½” inches and larger:

1. Pressure-temperature rating of the pipe flanges shall match the pressure-temperature rating of the flanges on the equipment to which the piping connects.
2. Steel Piping: ASTM A181/A181M or ASTM A105/A105M, Grade 1 hot forged steel flanges welding neck pattern and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2.5 inches may be used as required for connecting to equipment and piping specialties.

Use raised face flanges ASME B16.5 for mating with other raised face flanges on equipment with flat ring or full-face gaskets. Use ASME B16.1 flat face flanges with full-face gaskets for mating with other flat face flanges on equipment. Gasket material to be non-asbestos and suitable for pressures and temperatures of the piping system. Slip on flanges are not acceptable.

3. Copper Piping: Class 150/300/400 slip-on bronze flanges.
4. CPVC Piping: CPVC flanges.

C. Unions and flanges for disconnect and servicing are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points.)

2.05 DIELECTRIC FITTINGS

A. General Requirements: Assembly or fitting with separating nonconductive insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Combination of copper alloy and ferrous materials with separating nonconductive insulating material.
2. Threaded, solder, plain, and weld neck end connection types compatible with piping system materials.
3. Insulating material shall be suitable for system fluid, temperature and pressure and shall not restrict flow.

B. Unions:

1. Fittings to meet ASSE 1079
2. Pressure Rating: Minimum pressure rating equal to pressure rating of piping system installed, not less than 250 psi.

C. Insulating Flanges:

1. Pressure Rating: Minimum pressure rating equal to pressure rating of piping system installed, not less than 175 psi.
2. Dielectric-Flange Kits: Provide companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
3. Provide separate companion flanges and steel bolts and nuts, 150 or 300 psig minimum working pressure where required to suit system pressures.
4. 2 inches and smaller: Walter Vallett Company, V line or approved equal.
5. 2.5 inches and larger: Brass half-union, ASME B16.1, EPCO Model X or approved equal.

D. Couplings:

1. Pressure Rating: Minimum pressure rating equal to pressure rating of piping system installed, not less than 300 psi.
2. Provide galvanized-steel coupling with inert and non-corrosive, thermoplastic lining, threaded ends.

E. Nipples:

1. Pressure Rating: Minimum pressure rating equal to pressure rating of piping system installed, not less than 300 psi.
2. Provide electroplated steel nipple or ductile iron casing with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends. Victaulic Style 47, or approved equal.

PART 3 – EXECUTION

3.01 APPLICATION

A. In addition to applicable portions of the PART 3, refer to the following specification sections for installation, testing and cleaning requirements for specific piping systems identified in these sections.

1. Section 23 05 29 – Hangers and Supports for HVAC
2. Section 23 05 93 – Testing, Adjusting, and Balancing
3. Section 23 21 16 – Hydronic Piping Specialties
4. Section 23 25 00 – Water Treatment

3.02 INSTALLATION

A. General:

1. Verify existing conditions before starting work and coordinate available space with the other trades.
2. All piping materials shall be compatible for temperature, pressure and service.
3. Coordinate all work with other contractors that have scope within the space or those that have scope which impacts this work so that all project work can be completed properly.
4. Install piping to best suit field conditions and coordinate with other trades.
5. The drawings indicate the general location and arrangement of piping and systems. Contractor during their coordination process may require relocation of piping. Any revisions should be identified for review by the Engineer.
6. Do not scale the Drawings for exact location of piping.
7. Piping arrangement: Arrange piping along walls in horizontal groups in an organized, orderly, well executed manner. Each group shall be in one plane if possible. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated
8. Contractor shall coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Follow manufacturer's published recommendations
9. Do not sleeve structural members without consent of Architect.
10. Identify all items requiring access and coordinate with the ceiling contractor.
11. Install all work to allow access for servicing of valves and equipment. All work shall allow sufficient space for ceiling tile removal.

12. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require removal of adjacent equipment or pipe work.
13. Install piping at indicated slope free of sags, bends, and kinks. Install components having pressure rating equal to or greater than system operating pressure.
14. Riser branches and other offsets shall be made up with 3-elbow swings. This shall also apply to copper risers and branches.
15. Changes in direction on cooling coil condensate drains shall be made with tees with removable plugs or caps to facilitate cleaning.
16. Branch connections to mains or sub-branch connections to branches (screwed or welded) shall be made with Tee Fitting (full line size) when the branch or sub-branch connection is equal to or one pipe size smaller. Reduce fittings shall be used after the Tee fittings. For branch or sub-branch connections to mains or branches that are two pipe sizes or smaller maybe made utilizing a weld-o-let or thread-o-let (ANSI B16.9). Weld-o-lets or thread-o-let shall have the same schedule and pressure standard as the pipe to which they connect. No branch or sub-branch shall be made by burning a hole in the pipe it connects to and welding connection. No connection shall be made using a saddle type fittings. T-drill connections are not permitted in copper piping system.
17. Piping shall be properly anchored and guided to limit stress on either piping, anchors, expansion joints, expansion compensators and/or expansion loops.
18. Vents shall be provided at all high points of hydronic piping systems. The discharge of all automatic air vents to be provided with strainer and valve and piped to a funnel drain.
19. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations.
20. Furnish and install sleeves for pipe passing through roofs, partitions, walls and floors. Piping penetrating roofs must maintain the integrity of the roof assembly.
21. Provide pans under all piping over electrical equipment. Pans shall be constructed of 16 gauge stainless steel, be water-tight, and have a minimum 6”vertical lip. The pan shall be constructed to drain away from the electrical equipment.
22. Contractor is responsible for piping or equipment that is air bound and shall be responsible for remedying all occurrences, including removing and refinishing completed construction.
23. Clean off scale, rust and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.
24. Use main sized saddle type branch connections for directly connecting branch lines to main piping lines in steel piping if main is at least one pipe size larger than the branch for up to 6-inch main and if main is at least two pipe sizes larger than branch for 8-inch and larger main. Do not project branch pipes inside the main pipe.
25. Cap all openings in pipes during progress of the work.
26. Do not connect bottom of pipe risers until riser is complete. Rod or tap to clear loose material before making bottom connection.
27. Correct leaks in piping immediately using new materials. Leak-sealing compounds or peening is not permitted.
28. Install drains throughout the systems to permit complete drainage.

29. Not acceptable: mitered ells, bullhead tees, notched tees, bushings on threaded piping.
30. Do not allow any other subcontractor (electrical, telephone company, BMS, elevator, etc.) to electrically ground to any mechanical system.
31. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Encase underground piping with polyethylene film according to ASTM A674 or AWWA C105/A21.5.
32. Provide continuous lengths of straight runs of piping upstream and downstream from venturis and balancing devices as recommended by manufacturer. No joints, welds, fittings or taps are permitted in the straight runs.
33. Piping connections: Except as otherwise indicated, making piping connections as specified below:

    a. All piping connections to coils and equipment shall be made with offsets and bolted flanges (screwed or welded) arranged so that the coil and/or equipment can be serviced or removed without dismantling piping.
    b. Install unions in piping 2 ½ inches and smaller adjacent to each valve, piping specialties, and connections to each piece of hydronic equipment having 3 inch or smaller threaded piping connection. Do not screw unions directly to coil header piping connections.
    c. Install flanges in piping 3 inch and larger adjacent to flanged valves, piping specialties, and final connections to each piece of hydronic equipment having flanged.
    d. Water Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
    e. Unions or flanges shall be installed at connections to equipment, traps, instruments, etc., and wherever else required to permit easy connection and disconnection.
    f. Install non-conducting dielectric flanges, unions or couplings in accordance wherever dissimilar metals are joined.
    g. Connections from headers to pump suction and discharge piping shall be made with laterals. Connections from overhead piping to the inlet and discharge of pumps shall be made with reducing elbows, and connections from horizontal headers shall be made with eccentric reducers.

34. Except as otherwise indicated, protect piping as specified below:

    a. Allowance for thermal expansion and contraction shall be provided for piping passing through a wall, floor, ceiling or partition by wrapping with an approved tape or pipe insulation, and by installing through an appropriately sized sleeve to allow for thermal movement.
    b. No ashes, cinders, refuse, stones, boulders or other materials that can damage or break the piping or promote corrosive action shall be used in backfilling any trench or excavation in which piping is installed.

35. All piping systems, etc., shall be tested prior to application of insulation.

36. Install expansion loops, expansion joints, anchors, and guides per Section 23 05 16 - Expansion Fittings and Loops for HVAC Piping
37. Support all piping per Section 23 05 29 – Hangers and Supports for HVAC.
38. Brace all piping per Section 23 05 48 – Vibration and Seismic Controls for HVAC.
39. Identify piping as specified in 23 05 53 – System Identification for HVAC

B. Sloping, Air Venting and Draining:

1. Piping shall be properly installed to allow proper circulation and prevent noise and water hammer. Water piping shall pitch upward in direction of flow. Dirt pockets with valved outlet with hose adapter shall be provided at all riser heels, low points, and other places where dirt and scale may accumulate.
2. Cooling coil condensate drain piping shall have a minimum pitch in the direction of flow of 1/8 inch per foot.
3. Return and Drip Mains: All low-pressure mains and drips shall gravitate to the receiver of the condensate pump or condensate cooler.

C. Drains, Vents and Reliefs shall be provided as follows:

1. Provide drain valve with cap and hose connection at the heel of all interior water risers.
2. Pipe miscellaneous drains, vents reliefs and overflows from tanks, equipment piping system relief valves to the nearest open drain, floor drain or roof drain. Provide drain valves whenever required for complete drainage of piping system, including system side of pumps.
3. Provide domestic water piping connections from valved domestic water outlet (provided as part of the work of Division 22) to all equipment requiring domestic cold water make-up.
4. Provide automatic relief valveon vessel or in the leaving hot water line on the vessel side of shut-off valve.
5. Provide cap or plug in all open ended piping systems, all open ended valves for future connections, drains and vents.
6. To mitigate corrosion at dead legs, provide a 1 inch by-pass line from supply to return with a balancing valve in all open condenser water systems.

D. Reducers:

1. Eccentric:

   a. In condensate piping, bottom side flat
   b. Heating water and chilled water piping, top side flat
   c. Between water piping and pump suction, top side flat

2. Concentric:

   (1) In vertical piping
   (2) May be used as increasers in horizontal piping

E. Care of Floors:

1. Do not set pipe vises or threading machines on unprotected concrete floors.
2. Cover floor when making plumbing connections to avoid staining floors with oil, white or red lead or other substances. Bear cost of removing any stains.

3.03 PIPE JOINTING

A. Fittings:

1. Provide standard, manufactured fittings in all cases.
2. Prohibited fittings:

   a. Field fabricated
   b. Bushings on pressure piping
   c. Clamp-on branch connections

3. Dielectric separation:

   a. Provide insulating couplings or dielectric fittings at all connections or metal-to-metal contact of ferrous materials to non-ferrous materials.
   b. Locations shall be accessible. Coordinate with General Contractor.

4. Branch connections, steel piping:

   a. Equal to main and to two pipe sizes smaller: Weld or grooved end tees, same weight as piping.
   b. Three or more pipe sizes smaller than main, but 2.5 inches and larger: Bonney Weld-o-lets.
   c. Up to two inches and smaller: Bonney Weld-o-lets, Thread-o-lets, threaded Nip-o-lets, steel couplings.

5. Where indicated on the Drawings

B. Pipe Ends: Perform pipe cutting and end preparation to result in clean ends with full inside diameter. Grind and ream ends of pipe and tube and remove burrs to restore full inside diameter.

C. Nipples: Provide extra heavy pipe for nipples where unthreaded portion is less than 1.5 inches long. Close nipples not permitted.

D. Threaded Joints: Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Apply appropriate tape or thread compound to external pipe threads (except where dryseal threading is specified).
3. Align threads at point of assembly.
4. Tighten joint with wrench and back-up wrench as required.

5. Damaged threads: Do not use pipe or pipe fittings having threads that are corroded or damaged.
6. Sealed with sealant compounds or Teflon tape. Hard setting pipe thread cement or caulking shall not be allowed.
7. Threaded fittings on water systems containing glycol shall be utilize Permabond LH050 thread sealant, or equal designed for glycol applications.
8. Threaded fittings on other systems to utilize sealant compounds: John Crane or Rector Seal as required.

E. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. When required, use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using a torque wrench.

F. Flared Tube Joints: Flared copper tube joints shall be made by the appropriate use of cast copper alloy fittings conforming to ASME B16.26. Flared ends of copper tube shall be of the 45-degree flare type and shall only be made with a flaring tool designed specifically for that purpose. Copper alloy tube shall be reamed to remove burrs and restore full inside diameter prior to forming the flared end.

G. Welded Joints:

1. All welding shall comply with ANSI/ASTM B31.9, or local codes that may supersede this standard. Refer to Section 1.04 for conditions where B31.1 shall apply.
2. Where required, peen and wheel-grind welds.
3. Ends of pipe may be burned for welding:

    a. Grind, bevel and remove scale between welding joint.
    b. Ragged edges with metal beads, poor alignment or other inferior work shall be rejected.
    c. Preparation of pipe ends: For wall thickness up to 3/16-inch, ends shall be finished square or with 37.5-degree bevel with a $^{1}/_{16}$-inch band; for wall thickness 3/16-inch to ¾-inch inclusive, ends shall be machined or ground to have a 37.5-degree bevel with a $^{1}/_{16}$-inch band per latest edition of ANSI/ASME B31.1.

4. Perform welding with oxyacetylene or electric arc process.
5. Welding shall be from outside only on pipe configurations.
6. Tack welds shall be of same quality as required in the completed weld and shall be visually examined for defects before applying any complete passes. The ends (starts and stops) of the tacks shall blend in smoothly with the base metal so that subsequent passes can be applied without interruption.
7. Inspection: Visual inspection shall be done by the welder after each pass.
8. Inspection Criteria: Cracks, cold laps, open porosity and tungsten inclusions shall not be allowed. If the above occurs, the weldment shall be removed and rewelded per this specification. Weld beads shall be applied in such a manner that they are smooth into adjacent beads and

the base metal with no areas, such as crevices, undercuts, or overlaps, that would weaken the structure or prevent adequate penetration of subsequent weld passes. Undercut of the final pass, which reduces the initial material thickness, shall be repaired by additional welding.

9. Repair: All materials welded using this procedure or which fall within the requirements of this procedure may also be repair welded using this procedure.

H. Brazed Joints:

1. Filler metal shall conform to the requirements of the latest edition of ANSI/AWS A5.8 Specifications for Brazing Filler Metal with the following classifications: BCuP-2, BCuP-3, BCuP-4,BCuP-5, BAg-5 or BAg-7.
2. Flux shall be compatible with the materials brazed and with the filler metal used, and shall conform to the requirements of the latest edition of ANSI/AWS A5.31 Specifications for Fluxes for Brazing and Braze Welding. All flux residue must be removed after joint is completed.
3. Brazing shall be performed in accordance with the Copper Tube Handbook of the Copper Tube Development Association, as well as the latest edition of ANSI/AWS B2.2 Standard for Brazing Procedure and Performance and ANSI/AWS C3.4 Specifications for Torch Brazing.
4. Clean surfaces to be jointed of oil, grease, rusts and oxides.

I. Soldered Joints:

1. Filler metal shall conform with the requirements of the latest edition of ASTM B32 Specifications for Solder Metal.
2. All joints shall be made with 95% tin and 5% antimony solder, having a melting point of not less than 460°F (238°C).
3. All soldered joints shall be thoroughly cleaned before the application of the solder. Flux shall be compatible with the materials brazed and with the filler metal used, and shall conform with the requirements of the latest edition of ASTM B 813 Specifications for Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Tube. All flux residue must be removed after joint is completed.

    a. Soldered joints shall be assembled in accordance with the Copper Tube Handbook of the Copper Tube Development Association and ASTM B828 Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

4. Be very careful about specifying any plastic piping in buildings especially hi-rise buildings where pipe routing must go through return air plenums, shafts, fire separations, etc. Use steel as the outer containment, or the plastic containment piping needs to be in a separate enclosure.

3.04 FLUSHING AND CLEANING

A. Refer to Section 23 25 00 – Water Treatment in addition to the below.

B. All piping systems shall be thoroughly flushed out with the approved cleaning chemicals to remove pipe dope, slushing compounds, cutting oils, and other

loose extraneous materials. This also includes any piping systems which are not listed as requiring water treatment.

C. Develop plan for flushing and cleaning piping. Submit plan for approval prior to completion of piping. Provide all temporary and permanent piping, equipment, materials necessary to complete flushing and cleaning.

D. Prior to flushing, temporarily remove, isolate or bypass dirt sensitive equipment and devices, including the following. Reinstall after flushing is complete:

1. Automatic flow control valves
2. Heating and cooling coils
3. Boilers
4. Heat exchangers
5. Flow measuring devices

E. Prior to flushing, install fine mesh construction strainers at inlet to all equipment with connections 2-1/2" and larger. Install fine mesh construction element in permanent strainers.

F. During flushing and cleaning, remove and clean strainers periodically. At completion of final flush, clean permanent strainers, remove construction strainers.

G. Flush all piping with cold water for a minimum of 6 feet per second for at least one hour, until water runs clear. Water supply shall be equivalent to piping to be flushed. Drain all low points.

H. Circulate flush water and clean strainers prior to installing cleaning chemicals. Provide cleaning chemicals, under the direction of the chemical supplier. Following flushing, install cleaning chemicals and circulate through the entire system for a minimum of one hour, or as directed by chemical supplier. Take water sample for owner's use. Drain system, including all low points. Flush, drain and fill system, circulate for one hour, sample for owner's use. Drain, flush, fill, circulate and sample until system is free of cleaning chemicals, as indicated by analysis of samples.

I. Provide temporary pumps and piping to chemically clean piping at a minimum velocity of 6 fps without using the system pumps.

J. The cleaning chemicals shall be added by the mechanical trade. The chemical supplier shall verify that the chemicals are compatible with all the materials in the systems. The chemical supplier shall instruct as to the proper feed rates, shall check that the cleaning solution is actually in each system, shall instruct the contractor as to when to flush the system and shall check each system following flushing to ensure all cleaning chemicals have been removed from each system.

K. A certificate of cleaning shall be provided by the cleaning chemical supplier to the Architect's representative.

3.05 FIELD QUALITY CONTROL

A. General:

1. Any deviation from the cleaning, installation, testing, and certification requirements herein shall be approved in writing by the Architect.
2. All materials and workmanship shall be subject to inspection and examination by the Engineer at any place where fabrication or erection occurs.
3. The Engineer reserves the right to reject all or any part of the system that does not conform to the requirements herein. Rejected materials or equipment shall be returned at the Contractor's expense for re-cleaning and certification.
4. The Engineer reserves the right to remove random samples of the installed work sufficient to establish the quality of materials and workmanship. If such samples indicate materials and workmanship do not meet the contract specification, the Contractor shall be required to replace or re-clean the installed work at no expense to the Owner. The Owner shall reimburse the Contractor on a time and materials basis for such work if the system proves to be installed to specification.
5. All testing shall be done in the presence of the Owner's Representative.
6. Upon completion of this work, all systems shall be adjusted for use. Should any piece of apparatus or any material or work fail in any of the required pressure tests, it shall be immediately removed any replaced by new materials. The defective portion of the work shall be replaced by new materials. The defective portion of the work shall be replaced by the Contractor in the presence of the Owner at no expense to the Owner.
7. Test gauges shall be installed and test medium source connections shall be made to convenient process connections. After completion of testing, the gauges and source connection shall be removed and the specified process attachments replaced.
8. Any leaks found shall be repaired in the following manner:

    a. Welded joint – Grind out defect and re-weld.
    b. Brazed and/or Soldered joint – Cut out and re-braze/solder.
    c. Screw joint – Taken apart and re-do (do not use compound).

B. Pressure Tests:

1. Less than 100 pounds per square inch operating pressure: Test hydrostatically to 150 pounds per square inch.
2. Over 100 psi operating pressure:

    a. Test hydrostatically to 1.5 times operating pressure.
    b. Never exceed test pressure ASME B16.1 basis.

3. With system valves capped and pressure apparatus disconnected, a 4-hour duration pressure test shall exhibit:
4. Hot water heating piping shall be heat stressed by raising temperature to operating level from ambient two times before pressure test.
5. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or

equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking.

6. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

   a. Inspections performed
   b. Procedures, materials, and gases used
   c. Test methods used
   d. Results of tests

END OF SECTION

SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Air vents
2. Air separators
3. Relief valves
4. Suction diffuser
5. Expansion tanks
6. Strainers

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 48 – Vibration and Seismic Controls for HVAC

C. Section 23 09 23 – Direct Digital Control System for HVAC

D. Section 23 21 13 – Hydronic Piping

1.03 REFERENCE STANDARDS

A. ANSI – American National Standards Institute

B. ASME – American Society of Mechanical Engineers

1. ASME Standard for Boiler and Pressure Vessel Code

a. ASME BPVC – I through XII

2. ASME DRF U-1 Form U-1 Manufacturer's Data Report for Pressure Vessels – As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules, Section VIII, Division 1

C. ASTM – American Society for Testing and Materials

D. NFPA – National Fire Protection Association

1. NFPA Standard 70 National Electrical Code

E. UL – Underwriters Laboratories Inc.

F. California Code of Regulations, Title 24 – Building Standards Code

G. California Plumbing Code

H. International Plumbing Code

I. Washington State Building Code – Chapters 51-56 and 51-57 WAC, Uniform Plumbing Code and Uniform Plumbing Code Standards

1. Effective July 1, 2007

J. Local Codes and Code Amendments

1.04 QUALITY ASSURANCE

A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 – Reference Standards, and with the requirements listed in Paragraph 1.02 – Related Documents.

1.05 SUBMITTALS

A. Product Data: Certified manufacturer's latest published data indicating performance data, catalog cuts, model numbers, materials of construction, dimensional information, and pressure rating and pressure drops.

B. Submit ASME Pressure Vessel Forms.

C. Submit manufacturer analysis of installed glycol solution.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Air Vents: Armstrong, Bell & Gossett, Sarco, Hoffman, Amtrol

B. Air Separators: Armstrong, Bell & Gossett, Amtrol

C. Relief Valves: Armstrong, Bell & Gossett, Amtrol, McDonnell Miller, Kunkle

D. Suction Diffusers: Armstrong, Bell & Gossett

E. Expansion Tanks: Armstrong, Bell & Gossett, Amtrol, Taco, Wessels

2.02 AIR VENTS

A. Provide air vents with ¾-inch IPS inlet connection and ⅜-inch outlet, suitable for the system and for the system working pressure and temperature. Design vents to eliminate air from the system automatically without permitting the passage of water. Construct vents of brass or semi-steel body, copper float and stainless steel valve parts.

2.03 AIR SEPARATORS

A. In-Line Air Separator: Provide as indicated on the Drawings, a horizontal in-line air separator designed to effectively separate free air in water systems. Construct the air separator of heavy-duty cast iron designed to function satisfactorily at working pressures up to 175 pounds per square inch and liquid

temperatures to 300 degrees F. Provide an integral weir designed to decelerate system flow to maximize air separation.

B. Centrifugal Air Separator:

1. Provide as indicated on the Drawings, a centrifugal type air separator. Provide with inlet and outlet connections tangential to the vessel shell. Vessel shell diameter to be minimum three times the nominal inlet/outlet pipe diameter.
2. Provide an internal stainless steel air collector tube with $^{5}/_{32}$-inch diameter perforations and 63 percent open area designed to direct accumulated air to an external air vent via an NPT connection at top of unit.
3. Construct the unit with a removable galvanized steel system strainer with $^{3}/_{16}$-inch diameter perforations and a free area of not less than five times the cross-sectional area of the connecting pipe. Provide a blow-down connection to facilitate routine cleaning of the strainer.
4. Manufacturer shall provide data sheet specifying air collection efficiency and pressure drop at rated flow.
5. Provide a Manufacturer's Data Report for Pressure Vessels, Form U-1 as required by the provisions of the ASME Boiler and Pressure Vessel Code for each air separator.

2.04 RELIEF VALVES

A. Provide diaphragm-operated safety relief valve, ASME labeled, for relieving pressure. Refer to the Drawings for pressure rating of valve and relief setting. Discharge water shall be through NPT connection.

B. Provide valve with a low blow-down differential constructed of bronze or iron body. The valve seat and all moving parts exposed to fluid shall be of non-ferrous material.

2.05 SUCTION DIFFUSER

A. Provide suction diffuser as indicated on the Drawings. Units shall consist of angle type body with straightening vanes and combination diffuser-strainer-orifice cylinder with $^{3}/_{16}$-inch diameter openings. Provide a permanent magnet located within the flow stream and removable for cleaning. Equip the orifice cylinder with a start-up disposable fine mesh strainer. Design orifice cylinder to withstand pressure differential equal to pump shut-off head a free area equal to five times cross-section area of pump suction opening. Straightening vanes shall extend the full length of the orifice cylinder and be replaceable. Provide unit with adjustable support foot to carry weight of suction piping.

2.06 EXPANSION TANKS

A. Provide a replaceable bladder type hydro-pneumatic expansion tank especially designed for use on the services specified. Construct the expansion tank of welded steel and equip with a heavy-duty butyl rubber flexible bladder to maintain a separation between the system water and the air cushion. The system water shall be contained within the bladder. Provide with top inlet connection for all water systems.

B. Each tank shall bear an appropriate ASME label for the following minimum working pressures and temperatures:

1. Building Chilled Water: 125 [175] [250] pounds per square inch gauge; 100 degrees F.
2. Building Closed Condenser Water System: 125 [175] [250] pounds per square inch gauge; 100 degrees F.
3. Building Hot Water: 125 [175] [250] pounds per square inch gauge; 240 degrees F.

C. The minimum total tank and bladder volume shall be as specified on the Drawings. Provide a factory initial charge of 12 pounds per square inch gauge] [as indicated on the Drawings.

D. Provide suitable structural and seismic support as required for each tank as indicated on the Drawings.

E. Provide for each tank, lifting lugs, base ring, drains, charging connections, piping connections, and specialties as required for bladder replacement and as indicated on the Drawings. Provide one (1) bottle of nitrogen gas and manifold to be used to charge all tanks.

F. Each tank shall have an ASME relief valve set at the appropriate pressure.

G. Provide a UL Listed pressure switch operated by a brass bourdon tube activating a mercury switch. This switch shall activate a low-pressure alarm as indicated in Section 23 09 00 – Building Management System (BMS). Mercoid Series DA31-153-7 or approved equal.

H. Paint the outside of the tank with a shop coat of approved rust-inhibiting primer after fabrication.

2.07 STRAINERS

A. Provide screwed ends up to 2-inch size, flanged or grooved end 2.5-inch and larger.

B. Body:

1. Up to 150 pounds per square inch: Y-type; ductile or cast iron body; bolted, coupled or threaded screen retainer tapped for a blow-off valve; threaded body in sizes through 2-inch and rated at not less than 175 psi WOG; flanged or grooved end body in sizes over 2-inch and rated at not less than 125 psi WOG at 230 degrees F. Cast iron body with clamped cover, tapped for a blow-off valve; 125 psig flanged body for 2.5-inch and larger.
2. Up to 150 pounds square inch, basket type: Cast iron body with clamped cover; body tapped for a blow-off valve; 125 psig flanged body for 2.5-inch and larger.
3. Over 150 pounds per square inch: Y type; ductile or cast iron or cast steel body; stainless steel screens; bolted, coupled or threaded screen retainer tapped for a blow-off valve; threaded or socket weld body in sizes through 2-inch and rated at not less than 300 psi WOG at

150 degrees F; flanged, grooved end or butt weld body in sizes over 2-inch and rated at not less than 300 psi WOG at 150 degrees F.

4. Steam service up to 100 psig: Y type; steel body, bolted or threaded screen retainer tapped for a blow-off valve; threaded or flanged in sizes through 2-inch; flanged in sizes over 2-inch; rated at not less than 250 psi at 400 degrees F.
5. Steam service over 100 psig: Y type; cast steel or forged steel body, bolted or threaded screen retainer tapped for a blow-off valve; threaded, socket weld, butt weld, or flanged end connections in all sizes; suitable for steam service at 600 psig.

C. Strainer screen shall be Type 316 stainless steel or monel, reinforced, with free area not less than 2.5 times inlet area.

1. Perforations:

a. Water:

(1) Up to 2-inch: 1/32 inches
(2) 2.5-inch to 8 inch: 1/16 or ⅛ inches
(3) 10-inch and larger: ⅛ or 5/32 inches

2. Magnets, except for handwheel operated type:

a. Water strainers:

(1) All 8-inch and larger
(2) Each pump suction

b. Provide continuous magnetic field around entire circumference of screen.
c. Removable cast Alnico No. 5 channel magnets or approved baskets constructed of magnetic alloy.
d. Secure magnets with stainless steel retaining lugs and threaded rods.

D. Y-Type:

1. Screwed: Faced cap, straight thread and gasket, Muessco No. 11M or approved equal
2. Flanged: Bolted cover, Muessco No. 751 or No. 752 or approved equal
3. Grooved: Coupled over, Victaulic Series 732

E. T-Type:

1. Grooved, through 12 inches: Coupled cover, Victaulic Series 730
2. Grooved, 14 through 24 inches: T-bolt hinged closure, Victaulic Series W730

F. Basket Type: Bolted cover, bottom drain connection.

1. Up to 6-inch: Provide cast iron or steel body with bolted cover, stainless steel ball valve and integral mechanism to permit servicing without interrupting flow; Muessco 792FD or approved equal.
2. 8-inch and larger: Diverting type, cast iron body with stainless steel basket and integral mechanism to permit servicing without interrupting flow; Muessco 692 MFA, or approved equal

G. Grooved End Type: Wye or Tee type grooved joint for vertical or horizontal installation with blow-off plug.

2.08 MANUAL AIR VENT

A. Construct from short vertical section of 2-inch diameter maximum or line size pipe to form air chamber. Provide ⅛-inch brass needle valve at top of chamber.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide automatic air vents at high points of all piping and as required for removal of air from the system using ¾-inch steel pipe suitable for the pressure service between the main pipe and inlet. Provide ⅜-inch OD hard drawn Type L copper tubing from vent outlet for overflow in case of defective action. Copper tubing shall run into a suitable drain. When vents are located above hung ceilings, connect all vent drains to a common drain main and pipe to nearest sink or floor drain. Provide ¾-inch valve in the inlet line for servicing of automatic air vent. Manual vents may be substituted for automatic vents, at system high points, only as directed by the Architect and where readily accessible.

B. Provide at each heat transfer element supplied with water, not less than one ½-inch manual air vent.

C. Provide manual air vent valves in the piping connections to each hot water heating coil and each chilled water coil (both supply and return where not automatically vented). Provide a soft tempered copper tube pigtail or manual vents so that vent can be discharged into a bucket.

D. Provide relief valves at expansion tanks, pressure tanks and as indicated. Install relief valves in upright position with discharge piped to nearest floor drain.

E. System relief valve capacity shall equal makeup valve capacity. Equipment relief valve capacity shall exceed flow rating of connected equipment. Where one pipe vents several relief valves, cross-section area shall equal sum of individual vent areas.

F. Install suction diffusers on pump inlets with ample space for basket removal. Where pumps are mounted on inertia pads, suction diffuser will be supported with steel pipe section on inertia pad. All other installations, the suction diffuser shall be supported by steel pipe section on a neoprene pad 1-inch thick. Remove start-up strainer after start-up and pipe cleaning has been accepted by Owner.

G. Provide two glycol concentration analysis kits for on-site analysis of glycol system. After charging the system with glycol and circulating for minimum 30 minutes, take glycol sample and send to glycol manufacturer for analysis.

H. Strainers:

1. Install at following locations:

   a. Inlet to each water pump.
   b. Inlet to each water feeder and make-up water connection.
   c. Inlet to each water regulating valve.
   d. Inlet to each vent.
   e. Inlet to each diaphragm valve.
   f. Inlet to each control valve.
   g. Inlet of steam traps
   h. Elsewhere as indicated on Drawings

2. In water service, up to 250 degrees F maximum; and compressed air:

   a. Install globe valve for blow-off with full outlet size and same pressure rating as piping system.
   b. Hose-end fittings are acceptable for water service only.

END OF SECTION

SECTION 23 21 23
HYDRONIC PUMPS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. In-line circulating pumps.
2. Vertical in-line pumps.
3. Manufacturer's factory representative's supervision of installation, alignment and start-up.

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 14 – Variable Frequency Drives for HVAC

D. Section 23 05 48 – Vibration and Seismic Controls for HVAC

E. Section 23 21 13 – Hydronic Piping

1.03 REFERENCE STANDARDS

A. ANSI – American National Standards Institute

1. ANSI/UL 778 Motor Operated Water Pumps

B. ASME – American Society of Mechanical Engineers

1. ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings

C. ASTM – American Society for Testing and Materials

1. ASTM A105-89/ASME SA-105 Standard Specifications for Forgings, Carbon Steel Piping Components
2. ASTM A108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
3. ASTM A159 Standard Specification for Automotive Gray Iron Castings
4. ASTM B36 / B36M Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
5. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications

D. Associated Air Balance Council Standards

E. ISO 9001 Quality Management System Requirements

1.04 QUALITY ASSURANCE

A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

B. Ensure pump operation at specified system fluid temperatures without vapor binding and cavitation, is non-overloading in parallel or individual operation, and operates to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

C. Ensure pump pressure ratings are at least equal to system's maximum operating pressure at point where installed but not less than specified.

D. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment with a minimum of 20 years experience.

E. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

F. Alternates to scheduled pumps shall operate at or near their point of peak efficiency, allowing for operation at capacities of approximately 25 percent beyond design capacity. Maximum impeller size shall not exceed 85 percent of the difference between the maximum and minimum impeller diameter.

G. In order to insure stable operation and prevent any possibility of hunting, the pump curve shall be continuously rising from maximum capacity up to the shut-off point. Pumps shall be non-overloading over the full range of the pump curve.

H. Furnish each pump and motor with a metal engraved nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.

I. All pumps shall operate without excessive noise or vibration.

J. Furnish one spare seal and casing gasket for each pump to Owner.

K. After completion of balancing, provide replacement of impellers, or trim impellers to provide specified flow at actual pumping head, as installed.

L. Pump manufacturer shall be ISO-9001 certified.

1.05 SUBMITTALS

A. Shop drawing submittals shall include pump curves, net positive suction head requirements, and pump performance characteristics with pump and system operating points plotted.

B. Submit construction details, materials of construction, type of seals, pump base, and mounting details.

C. Submit motor construction, winding type and efficiencies as specified in Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

D. Submit certification of alignment for each pump and obtain approval prior to start-up of pumps.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the site in such a matter as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Materials damaged by the elements should be packaged in such a matter that they could withstand short-term exposure to the elements during transportation.

B. Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.

C. Use all means necessary to protect equipment before, during, and after installation.

D. All scratched, dented, and otherwise damaged units shall be repaired or replaced as directed by the Architect Engineer.

1.07 WARRANTY

A. Provide a minimum Five (5) year warranty on materials and installation

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Vertical In-Line: Armstrong 4300 Series, B&G Series E-80, Paco VL Series, Taco KS Series.

B. In-Line Circulators: Armstrong, Paco, B&G, Aurora, Grundfos, Taco.

2.02 VERTICAL IN-LINE PUMPS

A. Pump shall be of the vertical in-line bronze fitted, single stage centrifugal type, split-coupled to a vertical electric motor.

B. The casing shall be close-grained cast iron free from blowholes, sand pockets and other detrimental defects. Liquid passageways shall be smooth and contoured to permit maximum efficiency. Casing shall be designed for working pressure as scheduled and shall be hydrostatically tested at 150 percent of the maximum working pressure. Suction and discharge flanges shall be drilled to ANSI standards.

C. Suction and discharge connections shall be the same size, flanged, 180 degrees opposite on centerline for pipeline mounting.

D. Casing shall have bronze replaceable wear ring.

E. Impeller shall be a one-piece bronze casting, enclosed, statically, dynamically, and hydraulically balanced.

F. Motor shaft shall be solid carbon steel with bronze or stainless sleeve.

G. Provide John Crane Type 1B, elastomer, non-pusher type balanced mechanical seals on pump serving system above 150 pounds per square inch gauge. Provide unbalanced mechanical seals on pumps serving systems with 150 pounds per square inch gauge rating. Seals shall be removable without disassembly of piping or motor.

H. Pump bearings shall be heavy-duty conrad type suitable for grease lubrication and contained in moisture- and dust-proof bearing housings with a minimum B_{10} life of 20,000 hours.

I. Provide pumps suitable for maximum system working pressure with pump seals rated to operate continuously at fluid temperature up to 250 degrees F.

2.03 IN-LINE CIRCULATING PUMPS

A. Furnish centrifugal close coupled single stage circulating pumps with capacities as scheduled in the Pump Schedule on the Drawings.

1. Centrifugal circulating pumps shall be of the in-line type suitable for vertical or horizontal installation and be serviceable without dismantling the circulator piping connections.
2. Casings shall be cast iron, ASTM A159.
3. Pump working pressure shall be 175 psi.
4. Impeller shall be cast bronze, closed type, ASTM B584 or brass, closed type, ASTM B36/B36M; 304 stainless steel impeller key, keyed to the shaft, brass impeller washer, 304 stainless steel impeller lock washer and a 304 stainless steel impeller cap screw.
5. Pump shall be ASTM A108 grade 1045 carbon steel. Shaft sleeve shall be copper alloy 110 or aluminum bronze, ASTM B584.
6. Shaft seal assembly shall be an internally flushed single seal of the stuffing box design with EPR O-Rings, Carbon-Tungsten Carbide faces, all metal parts and spring shall be stainless steel. Seal shall be rated for continuous operation at 225 degrees Fahrenheit. The wetted area under the seal shall be completely covered by a bronze shaft sleeve.
7. Pump casing shall have gauge ports and vent and drain tapings at the suction and discharge nozzles.
8. Pump motor shall be as specified on the Drawings for horsepower, voltage and phase, and in Section 22 05 13 – Common Motor Requirements for Plumbing Equipment. Motor shall be non-overloading throughout the entire range of the pump curve.
9. Impeller shall be hydraulically and dynamically balanced to ANSI-Hydraulic Institute Pump Standards, Grade G6.3.
10. Each pump shall be factory-tested per the ANSI-Hydraulic Institute Pump Standards.
11. Pump manufacturer shall be ISO 9001 certified.

12. Pump shall be a Bell & Gossett, bronze fitted pump, Series 90 or approved equivalent.

B. Furnish centrifugal long (flexible) coupled single stage circulating pumps with capacities as scheduled in the Pump Schedule on the Drawings.

1. Centrifugal circulating pumps shall be of the in-line type suitable for horizontal installation and be serviceable without dismantling the circulator piping connections.
2. Casings shall be cast iron, ASTM A159.
3. Pump working pressure shall be 175 psi.
4. Impeller shall be cast bronze, closed type, ASTM B584; carbon steel impeller key, keyed to the shaft, carbon steel impeller washer, carbon steel impeller lock washer and a plated steel impeller cap screw.
5. Pump shaft shall be steel, grade SAE 1144, and connected to the motor with a flexible type coupling. Shaft sleeve shall be copper alloy 110.
6. Shaft seal assembly shall be an internally flushed single seal of the stuffing box design, consisting of a housing of brass, ASTM B36/B36M; EPT bellow; carbon steel rotating ring; 304 stainless steel spring; ceramic seat and EPT seat gasket. Seal assembly shall be rated for continuous operation at 225 degrees Fahrenheit. The wetted area under the seal shall be completely covered by a bronze shaft sleeve.
7. Pump casing shall have gauge ports and vent and drain tapings at the suction and discharge nozzles.
8. Pump motor shall be as specified on the drawings for horsepower, voltage and phase, and in Section 22 05 13 – Common Motor Requirements for Plumbing Equipment. Motor shall be non-overloading throughout the entire range of the pump curve.
9. Impeller shall be hydraulically and dynamically balanced to ANSI-Hydraulic Institute Pump Standards, Grade G6.3.
10. Each pump shall be factory-tested per the ANSI-Hydraulic Institute Pump Standards.
11. Pump manufacturer shall be ISO 9001 certified.
12. Pump shall be a Bell & Gossett, bronze fitted pump, Series 60 or approved equivalent.

2.04 COOLING COIL CONDENSATE PUMPS

A. Provide a fully automatic condensate removal pump with ½-gallon capacity integral leakproof tank. Pump capacity shall be 20 gallons per hour with a 15-foot lift.

B. The pump shall be a vertical-type with stainless steel motor shaft, rust proof, high-impact ABS tank and motor cover, 3 drain inlet connections.

C. Provide a removable ⅜-inch barbed check valve.

D. Provide a solid polymer float switch for high-level water detection (overflow detection switch to shut down the associated HVAC unit or wired to a tank high level alarm.

E. Pump shall be rated for high-efficiency gas furnace applications that produce an acidic condensate.

F. The 120-volt single phase motor shall be thermally protected motor and UL Listed for hardwire connection. Verify the pump accommodates hardwired connection and coordinate with the electrical engineer.

2.05 COOLING COIL CONDENSATE PUMPS (LOW PROFILE / PLENUM RATED)

A. Provide a fully automatic low profile condensate removal pump with 1.2-quart capacity integral leakproof tank. Pump capacity shall be 45 gallons per hour with a 10-foot lift.

B. The pump shall be constructed with plastics that have been tested by Underwriter's Laboratories' to UL Standard 2043 "Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces".

C. The pump shall be a vertical-type with stainless steel motor shaft, rust proof, high-impact glass fiber reinforced polypropylene tank and motor cover, 2 drain inlet connections.

D. Provide a removable ⅜-inch barbed discharge adapter with built-in check valve.

E. For critical applications, don't shut down unit. Provide tank high level alarm and/or water detection.

F. Provide a solid polymer float switch for high-level water detection (overflow detection switch to shut down the associated HVAC unit or wired to a tank high level alarm.

G. The 120-volt single phase motor shall be thermally protected motor and UL Listed for hardwire connection. Verify the pump accommodates hardwired connection and coordinate with the electrical engineer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The mechanical contractor shall be responsible for aligning in the field prior to start-up of all flexibly coupled pumps. Alignment accuracy of plus or minus 0.002 inches shall be verified with a dial indicator. Prior to start-up, the manufacturer shall submit a written report certifying that the alignment work has been performed and that the pumps are ready for operation.

B. Base-mounted pumps shall be leveled up on tapered steel wedges in such manner to permit a minimum of ¾ inches of grout between the pump base and the top of the concrete base.

C. Pump motor, suction and discharge openings shall be covered during construction period. If the motor is started, the Contractor shall be responsible to ensure that the environment in which the motor is running is clean.

D. Install condensate pumps with tank level and allow access for tank removal.

E. Install all pumps in strict accordance with manufacturer's instructions. Access/service space around pumps shall not be less than minimum space recommended by pump manufacturer.

F. Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow.

G. Proper access space around a device should be left for servicing the component. No less than the minimum recommended by the manufacturer.

H. Provide an adequate number of isolation valves for service and maintenance of the system and its components.

I. Circulating pump shall have sufficient capacity to circulate the scheduled GPM against the scheduled external head (feet) with the horsepower and speed as scheduled and/or as denoted on the drawings. Motors shall be of electrical characteristics as scheduled, denoted and/or as indicated on the electrical plans and specifications. Pump characteristics shall be such that the head of the pump under varying conditions shall not exceed the rated horsepower of the drive motor.

J. On systems where the final balancing procedure requires the triple duty valve to be throttled more than 25% to attain design flow (on a constant speed pumping system), and no future capacity has been built into the pump, the pump impeller must be trimmed to represent actual system head resistance. The pump provider and engineer of record, based on the balancing contractor's reports, shall determine the final impeller trim diameter.

K. Install foot mounted and base mounted pumps on vibration isolation pad or house keeping pad, via anchor bolts. Set and level and grout in place.

L. All piping shall be brought to equipment and pump connections in such a manner so as to prevent the possibility of any loads or stresses being applied to the connections or piping. All piping shall be fitted to the pumps even though piping adjustments may be required after the pipe is installed.

M. On components that require draining, contractor must provide piping to and discharging into appropriate drains.

N. Provide drains for bases and seals, piped to and discharging into floor drains.

O. Power wiring, as required, shall be the responsibility of the electrical contractor. All wiring shall be performed per manufacturer's instruction and applicable state, federal, and local codes.

P. Control wiring for remote mounted switches and sensor / transmitters shall be the responsibility of the controls contractor (or mechanical contractor when they are contracted to provide controls). All wiring shall be performed per manufacturer's instructions and applicable state, federal, and local codes.

3.02 PIPING

A. Support piping adjacent to pump such that weight is not carried on pump casings.

B. Decrease from line size at pump connections with long radius reducing elbows or concentric reducers/increasers in the vertical piping, or eccentric reducers/increasers for horizontal piping. Install eccentric reducers/increasers with the top of the pipe level.

C. At all pump suctions, install a straight pipe length of 4 times the suction diameter.

D. Seals for all pumps serving condenser water or open cooling towers shall be supplied with a flushing water line piped with Crane Kynar Series 100 abrasive separator and Akron ball type sight flow indicator.

E. Provide needle valves and drain connection on pump casings, or at pump inlets to allow for complete drainage of pump casing.

F. Connect pump discharge to copper condensate drain piping with a 8-inch long maximum length of clear plastic tubing.

END OF SECTION

SECTION 23 25 00
HVAC WATER TREATMENT

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Heating hot water glycol piping
2. Chemical treatment equipment, chemicals and service
3. Glycol

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 21 13 – Hydronic Piping

C. Section 23 21 16 – Hydronic Piping Specialties

D. Section 23 21 23 – Hydronic Pumps

REFERENCE STANDARDS

1.	NEMA	National Electrical Manufacturing Association
2.	ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
3.	UL	Underwriters Laboratories Inc.
4.	OSHA	Occupational Safety and Health Act
5.	EPA	Environmental Protection Agency
6.	IBC	International Building Code
7.	UMC	Uniform Mechanical Code
8.	UPC	Uniform Plumbing Code
9.	IMC	International Mechanical Code
10.	IPC	International Plumbing Code
11.	The State of New York Codes	
12.	Local Codes	

1.03 QUALITY ASSURANCE

A. Retain a national water treatment chemical company to provide water treatment chemical feed equipment and chemicals for circulating water systems, steam systems and equipment as defined herein and as may be required to maintain the integrity of the piping systems and mechanical equipment.

B. The water treatment chemical and service supplier shall be a recognized specialist, active in the field of industrial water treatment, whose business is in the field of water treatment, and who has full time personnel within the trading area of the job site. Supplier shall have completed five existing chemical treatment systems of equal or greater size as this project and these projects shall have been operating for a minimum of two years.

C. Furnish and install all equipment and material on this project in accordance with the requirements of the Authority Having Jurisdiction, suitable for its intended use on this project, approved by the Environmental Protection Agency (EPA), and so certified by the manufacturer.

D. Analyze water from the local water company to be used on the project before establishing treatment procedures.

E. Provide dual containment tanks for all liquid chemicals.

F. Treatment Standards Control levels are listed in ppm (parts per million) or as noted:

1. Closed Recirculating Water Systems:

a. Multi-metal closed loop corrosion inhibitor
b. Molybdate: Control Level – 30 to 50 ppm as MoO_4
c. Nitrite: Control Level – 500 to 700 ppm as $NaNO_2$ Hot, and 300 to 500 ppm as $NaNO_2$ Chill
d. Tolytriazole: Control Level – 5.0 to 10.0 ppm where copper is present
e. pH: 9.0 to 10.3
f. Reserve Alkalinity: Control Level – 15 to 20 ppm Glycol only

1.04 SUBMITTALS

A. Submit the following for review:

1. Make-up water analysis
2. Layouts of feeding equipment
3. Details of testing equipment
4. Description of treatment program including calculations, list of chemicals and quantities of chemicals to be used on a daily, weekly and monthly basis.
5. Provide system schematics showing the following:

a. Condenser Water Systems:

(1) Circulation rates
(2) Pressures
(3) Temperature differential across cooling tower and condenser

b. Chilled Water and Hot Water Systems:

(1) Volume
(2) Circulation rates
(3) Pressures
(4) Temperature differentials

c. Steam Systems:

(1) Steam rate
(2) Pressure

(3) Condensate return rate

6. Provide written report witnessed by Contractor containing log and procedure of system cleaning, giving times, dates problems encountered and condition of water.
7. Manufacturer's installation instructions.
8. Manufacturer's descriptive literature, operating instructions, and maintenance and repair data.

9. Properties and product datasheets for all chemicals and glycols.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Chemical Water Treatment Service:

1. International Chemtex
2. Nalco
3. Garratt Callahan
4. Pro Chem Tech International, Inc.

2.02 PRE-STARTUP FLUSHING, CLEANING AND TREATMENT

A. Closed Loop Piping System (Chilled Water and Hydronic Hot Water):

1. The following processes are based on strategically installed devices (i.e. flush valves, crossover connections, recirculation barrel, recirculation pump, separate fresh water source, etc.) allowing for the procedure to be followed and expected results to be achieved. The bypass pipe should be sized at a minimum of 20 percent capacity of building service pipe capacity. Location of bypass line shall be immediately adjacent to the isolation valves, on the house side. Flushing pump must have capability to meet flow demands to adequately flush new system piping. Any impacts to the water chemistry of the closed loop existing conditions due to lack of adequate execution of the following directions shall become the liability of the Contractor.

   This process shall immediately follow the successful pressure testing of newly installed piping.

2. Flushing:

   Provide all equipment (temporary and permanent) as necessary to:

   a. Flush building service pipes and coil branch pipes. Confirm adequate flow with pressure gauges at coil branch pipes. RFI engineer to establish referenced pressures. Record and acquire attest signatures.
   b. Flushing may be feed and bleed or fill and drain until the system pH is no greater than 0.5 units above current measured city water pH.
      Example: City water pH 7.5, final flush pH 8.0 or less. Initial flushing times and readings are to be documented and signed.

c. Once initial flushing has been completed, remove the Rock wool/startup strainer element from the strainer, replace with operating strainer element.

3. Cleaning and Second Flushing:

a. It takes a minimum of 48 hours (and possibly 72 hours or more if substantial fouling exists) of water circulation to clean new piping. New Piping must be cleaned with an alkaline cleaner containing iron polymeric dispersants, and surfactants. The cleaning agent must be added until Total Alkalinity equals 3,000 ppm or greater monitored at the drain or recirculation barrel. Cleaning times and readings are to be documented and signed.

b. System is to be flushed a second time. Flushing may be feed and bleed or fill and drain until the system pH is no greater than 0.5 units above current measured city water as monitored at the drain or recirculation barrel. pH.
Example: City water pH 7.5, final flush pH 8.0 or less. Second flushing times and readings are to be documented and signed.

4. Treatment:

a. A complete corrosion inhibitor package added. Treatment is 30.0 ppm as MoO_4, 5 ppm as TTZ (tolytriazole), 100 ppm of iron deposition polymer, and a pH of 9.5 to 10.2. Conditions are measured and recorded, times and readings are to be documented and signed.

b. If the site desires nitrite chemistry, the spec is 200 to 400 ppm $NaNO_2$ and 20.0 ppm as MoO_4. The system TTZ, polymer and pH are the same. Conditions are measured and recorded, times and readings are to be documented and signed as attested to by MCCD personnel or third-party commissioning agent.

5. Acceptance:

a. At the time this project is turned over to the Owner, this level of treatment is desired and the system should be sterile.

2.03 WATER TREATMENT CHEMICALS

A. Provide a one-year's supply of necessary water treatment chemicals including the following:

1. Closed Recirculating Water Systems:

Agent to reduce scale deposits, to adjust pH and to inhibit corrosion. Treatment shall not contain any chromates or other toxic substances.

a. Multi-metal closed loop corrosion inhibitor
b. Molybdate
c. Nitrite
d. Tolytriazole
e. Reserve Alkalinity, Glycol only

2. Propylene Glycol:

a. Provide a glycol solution where indicated or specified, which provides freeze protection to minus 20 degrees F.
b. The fluid shall be industrially inhibited propylene glycol (phosphate based).
c. The fluid shall be easily analyzed for glycol concentration and inhibitor level, and easily recharged using replacement inhibitor readily available from the fluid manufacturer.
d. For systems containing more than 250 gallons of fluid, annual analysis shall be provided free of charge by the fluid manufacturer. Manufacturer shall also provide convenient analytical test aids for use by the operator of a smaller system.
e. The fluid shall pass ASTM D1384 (less than 0.5 mils penetration per year for all system metals).

2.04 CONTROL TESTING EQUIPMENT

A. One year's supply of all reagents and meters for digital testing of control parameters.

B. Myron L Ultrameter 4P Digital pH and Conductivity with one quart standards and storage solutions.

C. One year's supply of log sheets on which to record the test results, and bound copy of full test instructions.

2.05 CHEMICAL FEED EQUIPMENT FOR CLOSED WATER SYSTEMS

A. Provide bypass pot feeders with 5-gallon capacity, ¾-inch brass drain valve furnished with slotted lexan inlet and outlet strainers and sight flow indicator and able to withstand the maximum system working pressure. Wingert, Neptune, or approved equal.

B. Provide glycol feeder system in closed loop systems for consistent pressure control.

2.06 BOILER FEED

A. The preferred method of boiler treatment is to apply the chemicals in neat (undiluted form) with a separate pump to a separate feed point. Sodium Sulfite Oxygen scavenger is fed into the Feedwater or Deaerator Tank. A Polymer Phosphate, phosphonates blend is fed into the boiler supply downstream from the feedwater tank. Amines are then fed into the steam header to control condensate pH.

B. A microprocessor-based boiler conductivity controller with four (4) relays, timed sampling, is desirable. A steam throttling and solenoid valve is to be installed as a surface (skimmer) blow-down to a blow-down cooler to city drain. A sample cooler is to be provided for boiler testing on the blow-down.

2.07 BOILER WATER TREATMENT

A. Applicable to steam boilers up to 50 boiler horsepower and 100 pounds per square inch operating pressure.

B. System equipment, as previously specified:

1. Low pressure chemical metering pump
2. Liquid level switch
3. Automatic blow-down valve assembly
4. Solution tank
5. Agitator
6. Sample cooler

C. Test kits as previously specified:

1. Ortho phosphate or organic test if using polymer treatment
2. Sulfite
3. Alkalinity
4. Hardness
5. pH
6. Conductivity meter

D. Chemicals:

1. Alkaline boil-out compound
2. Alkalinity builder compound
3. Orthophosphate or polymer
4. Sulfite compound
5. Neutralizing amines

2.08 CLOSED SYSTEM WATER TREATMENT

A. Typical for:

1. Heating hot water piping
2. Chilled water piping
3. Heat recovery water
4. Glycol solution piping

B. Provide bypass feeder: five-gallon capacity.

C. Test kits as previously specified: Nitrite.

D. Chemicals:

1. Alkaline boil-out compound
2. Nitrite corrosion inhibitor

PART 3 – EXECUTION

3.01 TECHNICAL SERVICE AND CONTROL

A. Water treatment equipment shall be located in mechanical equipment rooms or spaces when feasible to do so.

B. Supervise the installation of water treatment equipment.

C. Supervise the cleaning of open and closed systems and provide a written certification of cleanliness at completion of cleaning procedure.

D. Provide a four-hour training program to the Owner's operating personnel instructing them clearly and fully on the installation, care, maintenance, testing, and operation of the water treatment system. The training course shall be arranged by the mechanical contractor at the start-up of the system.

E. For a period of one year after completion of system commissioning, provide the services of a fully qualified field engineer for one year at no additional cost to the Owner. This field engineer must be a graduate chemist or chemical engineer or have five years of experience as a service technician in the water treatment field in this locale. The water treatment company shall also provide laboratory and technical assistance from a fully qualified engineering staff to support the following tasks:

1. Make monthly technical service visits to the installation to perform field inspections and to make water analysis on site, with sufficient complexity as to evaluate the water systems operations. Discuss findings with the Owner's personnel in writing advising on proper practices, chemical requirements and any corrective actions needed to protect the water systems from scale, corrosion, and fouling. Copies of the field service report must be forwarded each month to the Owner, Architect and Engineer.
2. Make on-site inspections of equipment during scheduled or emergency outages in order to properly evaluate the success of the water treatment program and to make recommendations in writing based upon these inspections.

3.02 INSTALLATION

A. Chemical Feeders:

1. Chemical pumps shall be mounted at height suitable for pumping chemical treatment solutions directly from supply drums to condenser water system.
2. Top of reservoir tank maximum 4 feet above floor. Provide drip pan of same material as tank with drain under tank and pumps.

B. Piping:

1. Proportioning pump piping shall include pressure gauge and relief valve on discharge line.
2. Install by-pass feeders:

a. Install feeder in location convenient for filling.

3. Drain connections at low points of piping.

C. System connections and feeder locations shall be approved in the field by water treatment firm before installation of treatment equipment begins.

3.03 INITIAL CLEANING OF SYSTEMS

A. Prior to operation, clean system as specified.

B. Upon completion of cleaning, dose system with chemicals to obtain specified treatment conditions.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. Provide all ductwork required to make the various air conditioning, ventilating, and heating systems complete and ready for operation in accordance with the Contract Documents. The work of this Section shall include, but is not limited to, the following:

1. Sheetmetal Materials
2. Plenums
3. Fasteners and Sealants
4. Flexible connectors
5. Turning Vanes
6. Ductwork
7. Flexible ductwork
8. Access Doors
9. Belt Guards
10. Plenum
11. Wire Mesh Screen
12. Duct Drain Piping
13. Installation of Equipment and Materials Furnished Under Other Sections
14. Installation of Duct Smoke Detectors

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 29 – Hangers and Supports for HVAC

C. Section 23 05 48 – Vibration and Seismic Controls for HVAC

D. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

E. Section 23 07 00 – HVAC Insulation

F. Section 23 33 13 – Dampers

G. Section 23 33 19 – Acoustics

H. Section 23 37 00 – Air Outlets and Inlets

I. Section 2382 16 – Air Coils

1.03 REFERENCE STANDARDS

A. Standards applicable to this project:

1. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers Handbooks (Latest Editions)
2. SMACNA – Sheet Metal and Air Conditioning Contractors National Association, Inc.:

   (1) HVAC Duct Construction Standards, Metal and Flexible
   (2) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
   (3) HVAC Systems Testing Adjusting and Balancing
   (4) Seismic Restraint Manual, Guidelines for Mechanical Systems
   (5) HVAC Air Duct Leakage Test Manual

3. AABC – Associated Air Balance Council Manual: National Standards for Total System Balance
4. ANSI – American National Standard Institute
5. NFPA – National Fire Protection Association Standards:

   (1) NFPA 90A, Installation of Air Conditioning and Ventilating Systems
   (2) NFPA 90B, Warm Air Heating and Air Conditioning Systems
   (3) NFPA 96, Exhaust Systems
   (4) NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials – Current Edition.

6. ASTM – American Society for Testing and Materials:

   (1) ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
   (2) ASTM B209-07, Standard Specification for Aluminum Aluminum-Alloy Sheet and Plate
   (3) ASTM A653/A653M – 08, Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process – Current Edition.

7. UL – Underwriter’s Laboratories, Standards for Safety:

   (1) UL 181 – Standard Factory-made Air Ducts and Air Connectors
   (2) UL 181A – Standard for Closure Systems for Use with Rigid Air Ducts
   (3) UL 181B – Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors
   (4) UL 555 – Standard for Fire Dampers
   (5) UL 555C – Standard for Ceiling Dampers
   (6) UL 555S – Standard for Smoke Dampers
   (7) UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials

8. ACGIH – American Conference of Governmental Industrial Hygienists: Industrial Ventilation – A Manual of Recommended Practice

9. Local Codes

B. Above-referenced standards may be superseded by notes and details on the Drawings and in any specification.

C. Where two or more references conflict, the most stringent, as determined by Engineer, shall take precedence.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 90A – 'Installation of Air Conditioning and Ventilation Systems' unless otherwise specified or referenced.

B. Construct ductwork according to the pressure-velocity classifications established by SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", and as called for on the duct drawings.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code – Steel" for hangers and supports.
2. AWS D1.2/D1/2M, "Structural Welding Code – Aluminum" for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code", for duct joint and seam welding.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 – "Systems and Equipment" and Section 7- "Construction and System Startup".

E. ASHRAE Compliance: Applicable requirements in ASHRAE/IESNA 90.1 Section 6.4.4 –"HVAC System Construction and Insulation"

F. Comply with OSHA standards and requirements.

1.05 PERFORMANCE REQUIREMENTS

A. Duct Construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible" and performance requirements and design criteria indicated in the "Duct Schedule" section of this section of this specification.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements of ASHRAE 62.1.

1.06 SUBMITTALS

A. Submit the following for review:

1. Submit ductwork shop fabrication and shop construction standards prior to submittal of ductwork shop drawings.

2. Ductwork shop fabrication and shop construction standards shall include all applicable shop details and product data. Include the following:

    a. Duct reinforcement tables for all pressure classes, duct materials galvanized steel, aluminum, stainless steel, black iron and ductwork shapes rectangular, round, spiral oval to be used on this project.
    b. Duct reinforcement tables shall include material gauges, transverse joint reinforcement type and standard shop joint spacing.
    c. Transfer duct construction detail.
    d. Acoustical lining, perforated metal liner, adhesive, nosing and fastening cuts and details.

3. Installation details for:

    a. Volume dampers (single blade and multi-blade type)
    b. Remote- and cord-operated remote volume dampers
    c. Control dampers
    d. Fire dampers
    e. Smoke dampers
    f. Combination fire/smoke dampers
    g. Backdraft dampers

4. Duct access doors.
5. Duct fitting construction details such as rectangular and radius elbows, turning vanes, offsets, branch connections, etc.
6. Duct support and attachment details.
7. Flanged duct connection details for all systems and each manufacturer used on project. Minimum duct construction gauges shall be as per SMACNA duct reinforcement tables. Duct gauges may not be reduced based on alternative joining manufacturer's recommendations.
8. Ductwork sealant.
9. Diffuser ductwork connection details.
10. Duct penetrating full height partition details.
11. Flexible connection details.
12. Duct and plenum construction details.
13. Product Data including manufacturer's installation instructions, application, materials of construction, gauges, descriptive literature, and maintenance data for:

    a. Ductwork and fittings
    b. Plenums
    c. Fasteners and sealants
    d. Access doors

    e. Chemical resistance of interior duct coatings

14. Shop Drawings:

    a. Submit computer generated drawings of all ductwork drawn to a scale of 3/8 inch to the foot for approval. Ducting

layouts shall be submitted for each individual phase of the project and for the entire completed project. Shop drawings shall include:

(1) Ductwork plans, elevations, sections components, and attachments to other work.
(2) Duct layouts indicating duct system, duct sizes, configuration, duct liner, static-pressure classes, elevations, dimensions of main duct runs from building grid lines, fittings and accessories including dampers, turning vanes and access doors/panels, reinforcements and spacing, and penetrations through fire-rated and other partitions.
(3) Equipment layouts shall be based on actual equipment being used on the Project.
(4) Hangers and supports, including methods for duct and building attachments, seismic restraints, and vibration isolation. Submit plan drawings showing duct point loads to structure and supplementary steel layouts for all systems.
(5) Submit access door, flexible connection, duct and plenum construction details.
(6) Provide a separate set of dimensioned drawings or a partial set at enlarged scale showing all penetrations required for ductwork through structural members, floor and roof slabs, concrete walls and precast walls.
(7) Submit duct materials, reinforcement and construction schedules.
(8) Submit duct support and attachment details.
(9) All sheet metal shop drawings shall be drawn in double line indicating actual dimensions of ductwork, fittings and equipment. Shop drawings submitted with ductwork drawn in single line shall be returned without review.
(10) Sheet metal shop drawing shall indicate, as a minimum, the following data:

    (i) Ductwork sizes and section breaks
    (ii) Location of acoustical lining
    (iii) Bottom of duct elevations for all ducts or other services in conflict with ductwork
    (iv) Diffuser face size, neck size and air quantity
    (v) All volume dampers
    (vi) All air conditioning units
    (vii) All terminal units
    (viii) Dimensioned drawings showing penetrations required for ductwork through structural members, floor and roof slabs, concrete walls and precast walls
    (ix) Duct support and attachment details
    (x) Access door locations

(11) HVAC design drawings shall not be submitted as sheet metal shop drawings.
(12) Submit drawing of location and size of sleeves for openings in floors and walls.

15. Samples

a. Submit samples of flexible ducting and special materials, as required by the Engineer.
b. Submit samples of sheet metal (each gauge) and special materials as required by the Engineer.

1.07 DUCT CLASSIFICATION

A. Duct classification is based on pressure classification as scheduled in Table 1-1 and as described in SMACNA HVAC Duct Construction Standards, Metal and Flexible. Comply with NFPA 90A when ducts traverse through smoke zones. Comply with local codes when more stringent than NFPA 90A or SMACNA standards.

B. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams; snap-lock or button punch seams are not acceptable. If SMACNA seal class A or B is specified, the longitudinal seam shall be sealed from the inside.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Spiral Oval and Round Ducts: United McGill “Uni-form”, Semco, Metco, Ductmate Industries “Spiralmate” and “Ovalmate”

B. Duct Connection Systems: Ductmate Industries “Ductmate 35” and “Ductmate 45”, Nexus, Ward

C. Flexible Connections: Ventfabrics “Ventglas” and “Ventlon”, Duro Dyne “Insulfab”, Advance Elastomeric Systems, Ductmate Industries “PROFlex”

D. Flexible Ducts: Automatic Industries “Thermaflex M-KE”, United McGill, Genflex “IL”

E. Spring Fasteners: Dzus, Simmons “Quick-Lock”

F. Duct Protective Coatings: Wisconsin Protective Coating, Varni-lite of America

G. Duct Sealants: Foster, Childers, Miracle Adhesive, United McGill, Hardcast, Ductmate Industries “PROSeal”, Design Polymeric DP1010.

H. Spin-in Fittings: Young Regulator, Modular Metals

I. Flexible Duct Clamps: Aeroquip Ideal, Tridon, Young Regulator

J. Acoustical Panel Plenums: IAC, Rink, Vibro-Acoustics, United McGill

K. Access Doors, Ducts: Ventfabrics, Duro Dyne, Ruskin. Use “Ventlok” No. 140 latches, Ductmate Industries.

L. Access Doors, Plenums: Ventfabrics, Duro Dyne, Elgen

M. Double Wall Duct: United McGill “Acousti-K27”

N. Plastic Coated Duct: United McGill “Uni-Coat”

O. Pressure Relief Panels: Ruskin PRD18, United McGill ARR or ASR

2.02 SHEET METAL MATERIALS

A. Sheet Metal:

1. General Requirements: Comply with SMACNA’s “HVAC Duct Construction Standards- Metal and Flexible” for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
2. Galvanized Steel Sheets:

    a. Cold rolled steel sheets, lock forming quality meeting ASTM A653/A653M
    b. Galvanized Coating Designation: G90Finishes for Surfaces Exposed to View: Mill phosphatized.

3. Carbon Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
4. Stainless Steel Sheets:
   Comply with ASTM A 480A 480M, type 304 or 316, as indicated in the “DUCT SCHEDULE” section of this specification; cold rolled, annealed, sheet. Exposed surfaces shall be N0.2B,2D, 3, or 4 as indicated in the “DUCT SCHEDULE” section of this specification.
5. Aluminum sheets: ASTM B209 Alloy 3003, H14 temper, with mill finish for concealed ducts, and standard, one side bright finish for duct surfaces exposed to view.

B. Miscellaneous Products:

1. Tie Roads: Galvanized steel, ¼” minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
2. Screws and Rivets:

    a. Same material as sheet, except as noted
    b. Zinc- or cadmium-plated with neoprene grommets, permitted on galvanized sheets
    c. Minimum screw size: No. 10
    d. Minimum rivet size: 4 pound

3. Reinforcement Shapes and Plates" ASTM A 36/36A 36M, steel plates, shapes, and bars; black and galvanized.
4. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

C. Duct Sealants and Gaskets:

1. Duct Sealant

   a. Sealing compound shall be flexible, non fibrated, water-based adhesive sealant designed for use in all pressure classes. Sealant shall be UV-resistant, conform to ASTM E84, be UL 723 Listed and meet NFPA requirements for Class 1 ductwork.
   b. Solvent based sealants are permitted only for underground ductwork as well as ductwork that will be sealed during freezing conditions when a water-based sealant will not be effective.
   c. Acceptable sealant manufacturers shall comply with VOC levels based on LEED V 4.0.

2. Flange Gasket: Provide a continuous butyl rubber gasket which complies with UL 181 and 723 testing and meets MIL-C 18969B and TTS-S-001657. This material shall not contain vegetable oils, fish oils, or any other type of materials that will support fungal or bacterial growth. Gasket width shall match duct flange or angle connection with a minimum thickness of ⅛ inch. Ductmate Industries Model 440 gasket tape or approved equal.
3. Liner Adhesive used to adhere insulation to metal duct shall comply with NFPA 90A, ASTM C916, Type II and UL 723 specifications. Foster 85-60, Ductmate Industries PROtack Liner Adhesive or approved equal.
4. Lagging Adhesive shall be applied to insulated ductwork where the insulated edge of the duct would otherwise be exposed to the airflow. Materials shall comply with ASTM E 84, NFPA 255 or UL 723 testing. Foster 30-36, Childers CP-50AMV1, Ductmate Industries Lag-It or approved equal.
5. Hard-setting joint tape shall be a UL Listed two-part tape consisting of woven fiber tape impregnated with activator/adhesive of polyvinyl acetate type.

   a. Flame spread: 10 maximum
   b. Smoke developed: 5 maximum

6. Spring Fasteners: Self-ejecting oval head stud and receptacle with screwdriver slot.
7. Provide angles, tie rods and structural steel shapes for reinforcing ducts in accordance with SMACNA HVAC Duct Construction Standards, except as noted.
8. Slide-on Transverse Joint Connectors:

   a. Prefabricated slide-on transverse duct connectors and components shall be accepted. Ducts constructed using

pre-fabricated systems shall refer to the manufacturer guidelines for sheet gauge, intermediate reinforcement size and spacing, and proper joint reinforcement. Ductmate Industries, Ward, Nexus, or approved equal.

b. Formed-on flanges shall be constructed as T-25 A/B flanges, of which the construction guidelines are given in Figure 1-4 of the SMACNA HVAC Duct Construction Standards, Metal and Flexible. No other construction standards pertaining to formed-on flanges shall be accepted.
c. Formed-on flanges shall include the use of corner bolts, cleats and gaskets.
d. All components shall be metal unless other materials are required by code or specified.

2.03 FLEXIBLE CONNECTIONS

A. Flexible Connections shall be used where ductwork connects to rotating, vibrating or noise producing machinery. Connectors shall be attached in such a manner to provide an airtight and waterproof seal.

1. Conform to NFPA 90A and SMACNA HVAC Duct Construction Standards, except as noted.
2. Provide roll formed 1.5-inch long minimum collar, or match length and width of fan, plenum or machinery connection companion flange:

    a. Aluminum, 1 gauge heavier than ductwork, plenum, fan or machinery connected.
    b. Galvanized steel, 26 gauge minimum or matching gauge of ductwork, fan, plenum or machinery connected.
    c. Other materials same as gauge and material as ductwork, plenum, fan or machinery connected.

3. Provide 2-inch slack in fabric and install to allow minimum movement of 1 inch.
4. Length of fabric connections: 4 inches minimum; 10 inches maximum.
5. Materials:

    a. Indoor installations shall be a UL Listed, fire-retardant neoprene- or vinyl-coated woven fiberglass fabric. Minimum density 30 ounces per square yard and rated to 200 degrees F.
    b. Outdoor installations shall be a UL Listed ultraviolet light resistant Hypalon-coated woven fiberglass fabric. Minimum density 24 ounces per square yard and rated to 250 degrees F.
    c. Flame spread rating: 25 maximum, smoke developed rating: 50 maximum

    d. Insulated connections:

(1) Two layers of fabric with 1-inch thick fiberglass, 1.5 pound density.
(2) Performance as previously specified in 2.02-C-5-b.

e. Provide wire-embedded uncoated glass fabric with sewn seams for air temperature over 150 degrees F.

2.04 TURNING VANES:

1. Galvanized steel ductwork: Galvanized steel or painted black steel, except as noted.
2. Other ductwork: Same material as ductwork.
3. Construction shall meet or exceed SMACNA "HVAC Duct Construction Standards".
4. Use of single wall vanes with ¾-inch trailing edge shall be limited to maximum air velocity of 2,000 feet per minute and a maximum duct dimension of 18 inches.
5. Double wall vanes shall be used in ducts where air velocity exceeds 2,000 feet per minute, or any duct with a dimension over 18 inches.
6. Vane length: Provide separate equal-size sections for vane length greater than those previously indicated in Paragraph 1.03: Referenced Standards.
7. Vane runners: SMACNA Type 1 or 2 acceptable.
8. Tab spacing shall be as specified in Figure 4-3 of the SMACNA Manual, HVAC Duct Construction Standards, Metal and Flexible. Rail systems with non-standard tab spacing shall not be accepted.

B. Rectangular main duct to round duct take-off fittings shall be factory-fabricated spin-in fittings.

1. Die-formed, same material as ductwork.
2. Pressure ratings shall be equal to the duct pressure rating in which they are installed.
3. Provide balancing damper with locking regulator.

2.05 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS:

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", based on indicated static -pressure class – but no less than 2" – unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible," figure for "Rectangular Duct/Transverse Joints" for static pressure class applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible".

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards – Metal and Flexible" figure for "round Duct Longitudinal Seams' for static -pressure class, applicable sealing requirements, materials involved, duct-support intervals and other provisions in SMACNA's "HVAC Duct Construction Standards – Metal and Flexible".

1. Materials of construction:

   a. Galvanized steel: Supply and return, general and toilet exhaust ducts.
   b. Type 316 stainless steel: Vapor hoods, shower, dishwasher, exhaust ducts.
   c. Aluminum: Vapor hoods, shower, and dishwasher exhaust ducts.

   d. Kitchen Exhaust Ductwork

2.06 FLEXIBLE DUCTS

A. General:

1. Provide UL 181 and UL 181B, Class I air duct with polymeric liner, labeled for compliance with UMC. Use only where indicated.
2. Flexible ducts shall meet criteria as defined in Section 3 of the SMACNA Manual, HVAC Duct construction Standards, Metal and Flexible.

B. Static Pressure Class up to 1-Inch Water Gauge.

1. Insulated Flexible Duct:

   a. Maximum working pressure 1-inch water gauge
   b. Nominal 1-inch insulation with vapor barrier
   c. Maximum thermal conductivity 0.27 BTUH per square foot per degree F per inch at 75 degrees F

2. Similar to Thermaflex M-KE
3. Use at air inlets and air outlets

C. Static Pressure Class Over 1-inch up to 10 inches Water Gauge:

1. Insulated Flexible Duct:

   a. Maximum working pressure 10 inches water gauge
   b. Nominal 1.5-inch resilient glass fiber insulation with flexible vapor barrier jacket and wire reinforced inner core
   c. Maximum thermal conductivity of 0.27 BTUH per square foot per degree F per inch at 75 degrees F.
   d. Maximum length: 12 inches
   e. Maximum offset: 2 inches

2. Use at inlet connections to variable or constant volume terminal units, sized to match terminal unit.
3. Similar to Thermaflex M-KE

D. Provide factory-fabricated collar.

E. Flexible ductwork clamps shall be adjustable screw type stainless steel straps approved for use with flexible ductwork.

F. Regenerative noise due to air turbulence with the flexible duct shall not exceed the following sound power levels for a 12-inch diameter duct with an air speed of 1,000 feet per minute:

	Sound Power Levels, dB re: 10^{-12} Watts, at Octave Band Center Frequency, Hz				
	125	250	500	1,000	2,000
Maximum Regenerative Noise	30	31	30	22	20

2.07 ACCESS DOORS

A. Access doors shall comply with the SMACNA – Duct Construction Standards, Metal and Flexible, except as noted.

B. Duct access doors shall be insulated or uninsulated, same as duct. Make completely accessible.

1. Minimum Size:

   a. 20 inches by 14 inches, 18 inches by 16 inches or larger.
   b. Ducts less than 16 inches: one dimension 20 inches; other dimension 2 inches less than duct width or height.
   c. Larger sizes where required for access.

2. Systems designed for 2-inch water gauge and less (SMACNA Seal Class B or C) shall utilize a hinged and cam, square framed access door.
3. All other systems shall utilize a hinged access door. Construct door in accord with Figure 2-10 of the SMACNA Manual “HVAC Duct Construction Standards, Metal and Flexible”.
4. Provide all access doors with sponge rubber gaskets around their entire perimeter.
5. For ducts conveying humid air, or grease laden air, locate access doors in the side of the ducts.
6. Provide in following locations:

   a. Coils in ducts: entering and leaving side
   b. Automatic dampers: linkage side
   c. Balancing dampers and backdraft dampers
   d. Fire dampers, smoke dampers and combination fire/smoke dampers
   e. Duct-mounted smoke detectors, sprinkler heads, heat detectors
   f. Duct humidifiers
   g. Filter banks in ducts
   h. Fan bearings enclosed in ducts
   i. Inlet side of each single width centrifugal fan
   j. Inlet and outlet sides of each in-line centrifugal and axial fan or sound attenuator
   k. All controls, sensing, processing, transmitting and actuating devices

l. Duct drains

7. Provide permanent label on all access doors identifying the concealed components as specified above.
8. Where removeable hung ceiling panels are installed below access doors, provide markers showing the access door location clearly.
9. Access doors to swing against duct static pressure.

C. Casing and Plenum access doors shall be uninsulated or insulated, same as casings and plenums.

1. Latches similar to Ventlok No. 202
2. Minimum size: 24-inch by 60-inch
3. Provide larger size where required for equipment access, service, maintenance, removal and replacement.
4. Provide in following locations:

a. Fan or equipment enclosures
b. Coil and filter banks
c. Humidifier dispersion tubes and grids
d. Moisture eliminators and air blenders
e. Fire alarm devices, sprinkler heads
f. Dampers
g. All VFDs, controls, sensing, processing, transmitting and actuating devices
h. Coordinate the following with Electrical Department or delete if not applicable.
i. Doors to electronic filter chamber: Provide door-interlocked disconnect switch to break electric circuit when door is open.

5. Doors shall open against pressure.

D. Glass Inspection Panels:

1. Wired safety glass, gasketed and watertight.
2. 12-inch by 12-inch, except as noted or specified.
3. Provide in access doors, or where specified or indicated on the Drawings.

E. Pressure Relief Panels:

1. Provide pressure-relief doors as specified or shown on the Drawings.
2. Frames shall be Z-shape 12-gauge galvanized steel.
3. Door shall be 12-gauge galvanized steel hinged on one side.
4. Provide seal around the door perimeter, allowing maximum 7 cubic feet per minute per square foot of door leakage at 1-inch water gauge.
5. Pressure-relief panels shall include stainless steel springs to close door upon pressure relief and system shut-down. Pressure-relief setting shall be field-adjustable from 3 inches to 10 inches water gauge in increments of 1-inch water gauge.

6. Pressure-relief mechanism shall be factory-calibrated and preset prior to shipment.
7. Similar to Ruskin model PRD18.

F. Special Access Doors:

1. Grease exhaust duct access doors shall be grease-proof with high-temperature gasket. Grind all edges of duct openings smooth.

2.08 BELT GUARDS

A. Provide guards on all belt drives.

B. Provide split type with tachometer opening at shafts fabricated from galvanized metal and braced to prevent rattling.

C. Use solid or expanded metal on motors up to 5 horsepower.

D. Use expanded metal on motors 71/2 horsepower and up.

E. Use angel frames on motors 25 horsepower and larger.

F. Provide sufficient space so that sheaves can be changed to larger sizes.

2.09 PLENUMS AND EQUIPMENT CASING

A. Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", chapter for "Equipment and Casings", for acceptable material, material thicknesses and casing construction methods unless otherwise indicated.

B. Comply with SMACS's "HVAC Duct Construction Standards -Metal and Flexible" for sheet metal thickness based on indicated static-pressure class unless otherwise indicated.

C. Fabricate casings with standing seams and angle iron reinforcements unless otherwise indicated.

D. Reinforce casings with galvanized steel angles.

E. Small plenums:

1. Provide discharge and intake air plenums for connecting the fresh air intake and discharge openings to the various systems, as shown on the Drawings, of insulated double wall aluminum construction.
2. All other air plenums to be single-casing construction.

F. Larger Plenums:

1. Provide large wall-in plenums of insulated double wall construction,

2. Construct the casing panels of two sheets of galvanized sheet steel; the outer sheet (outdoor) solid 20 gauge, inner sheet (mechanical room) solid 16 gauge. Use “Fiberglass 704” (Owens Corning) 4-inch thick fibrous glass, 6 pound per cu.ft. density insulating board between these sheets.

G. Equipment Casing:

1. Provide chambers for field assembled air supply apparatus, and a shown on the drawings, entirely of insulated double wall casing construction.
2. Construct the casing panels of two sheets not less than 20 gauge galvanized sheet steel; the outer sheet solid, the inner sheet peforated. Use “Fiberglass 704” (Owens Corning) 4” thick fiber glass, 6 pound per cu ft, density insulating board between these sheets.

2.10 AUXILIARY DRAIN PANS

A. Construct drain pans of 16 gauge galvanized steel with all joints brazed. Construct pans watertight with hemmed edges.

B. Provide auxiliary drain pans under any equipment for which a pan is shown on the drawings and under all horizontal air handling untis, condensate producing heat exchangers, duct mounted hot water or chilled water coils located above hung ceilings or electrical equipment, piping over electrical equipment, etc.

C. Extend the auxiliary drain pan at least 6” beyond the equipment that it is serving.

D. Drain pan shall be at least 2” high.

1. Drain pan shall be sloped at least .125” per foot from the horizontal toward the drain outlet.
2. Provide drain pipe outlet at the lowest point of the drain pan with a connection size of at least ¾”.
3. Route the galvanized steel or Type “L” copper tube to the nearest equipment room floor or hub drain independent of any air handling unit drains.

2.11 WIRE MESH SCREENS

A. Furnish and install all wire mesh screens indicated in the construction documents.

B. Fabricate frame of extruded aluminum with mitered reinforced corners.

C. Provide non-rewireable frame with permanently secured screen mesh.

D. Provide mesh of ½” square, .06 inch crimped aluminum wire.

PART 3 – EXECUTION

3.01 DUCTWORK INSTALLATION

A. General:

1. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings and where necessary to accommodate conditions arising at the building.
2. Construct with gauges, joints, bracing, reinforcing, and other details per latest SMACNA, or NFPA unless specified otherwise. Comply with most stringent.
3. Install ducts with fewest possible joints. Make joints and seams smooth on the inside and a neat finish on the outside. Make duct joints airtight with laps made in the direction of air flow and no flanges projecting into the air stream. Provide ducts adequately braced to prevent vibration. Provide intermediate reinforcing and/or tie rod construction where necessary.
4. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building walls.
5. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
6. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
7. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
8. On horizontal ducts exhausting humid air from dishwashers, glasswashers, showers, commercial dryers, and as called for on the drawings provide pan construction with longitudinal seams at the side or on top. Provide drainpipes to indirect waste at all low points of the ductwork.
9. Construct all ductwork exposed, or concealed in non-ventilated ceilings, in pool areas of 316 stainless steel.
10. All welds on welded stainless-steel duct to be pickled to remove weld oxide. Passivate stainless surface after welding to remove embedded foreign material.
11. Install duct connected grilles, registers and ceiling diffusers shown on the Drawings. Exact dimensions of openings must await approval of registers and diffusers. Submit exact locations for approval. Do not cut joints for the installation of outlets.
12. Construct ducts with NFPA 90A gauges when traversing smoke zones.
13. Construct of galvanized sheet metal, except where otherwise indicated or specified.
14. Install round and flat-oval ducts in maximum practical lengths.

15. Duct dimensions indicated are net, inside, clear, dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions.
16. At exposed duct penetrations of non-rated walls, floors and ceilings, provide sheet metal angle type escutcheons of the same gauge as the duct, fastened to the duct only. The flanges shall overlap the wall opening by 1 ½" inches.
17. Provide any ductwork passing through waterproof walls, slabs or roofs with counter flashing.
18. Support all ductwork independent of the work of other trades including but not limited to conduits, piping, light fixtures and ceiling supports.
19. Where duct pass through fire rated partitions and walls, install fire dampers (and/or smoke dampers) as required by the Authority Having Jurisdiction.
20. Prior to operating fans, remove all debris and foreign materials from the ductwork. Clean the interior of all ductwork prior to use.
21. Fire stop ductwork all ductwork passing through fire rated partitions, floors and roofs. Refer to architectural drawings for fire ratings.
22. Install exposed ducts as high as possible but within 48 inches of ceiling. Coordinate with other trades to maintain not less than 90 inches clearance above finished floor, unless indicated otherwise.
23. Transitions: Pitch sides of duct in "diverging" or "converging" airflow.
    a. Maximum of 15-degree included angle.
    b. Exception: Provide 7.5-degree concentric diverging velocity cones at the discharge of vane axial fans.

B. Duct Openings: Provide openings where required to accommodate thermometers, smoke detectors, controllers, wiring, conduit, tubing etc. Insert through air-tight rubber grommets.

1. Provide pitot tube openings where required for testing of systems:
    a. Include threaded metal cap, spring loaded cap or threaded plug to eliminate any air leakage.
    b. For Pitot tube tests install Ventlok No. 699 and 699-2 instrument test holes.
    c. Coordinate locations of openings with balancing contractor.
2. Where openings are provided in insulated ductwork for insertion of instruments, install insulation material metal sleeve, flanged on one end for use as plug. Reseal vapor barrier.

C. Duct lining: Install lining in ducts and plenums as specified in Section 23 33 19 – Acoustics.

D. Flexible Duct Connections.

1. Install:

a. At connections to fans, sound attenuators, generator fan discharge, fan coils, heat pumps, air conditioning units and all air handling equipment.
b. As indicated on the Drawings or specified in other sections.
c. Flexible connection shall be limited to 6” in length with 1” of slack allowance.
d. Align ductwork and fans to be plumb

e. Install at building seismic joints and building expansion joints to provide the following minimum free motion:

(a) Axial motion [____]

2. Transverse motion [____]

a. Use sacrificial breakaway ductwork sections on both sides of seismic or building expansion joint.
b. Refer to SMACNA duct construction standards for outdoor flexible connection details.

E. Volume dampers:

a. Install damper as specified in Section 23 33 13 – Dampers and Section 23 37 00 – Air Outlets and Inlets.
b. Install damper in branch duct for all air inlets and outlets at accessible location most remote from air inlet or outlet.

F. Elbows:

1. Use radius elbows in rectangular ducts unless otherwise indicated. Centerline radius shall be a minimum of 150 percent of duct width.
2. Where space does not permit duct radius specified above, install short radius or square elbow with vanes per SMACNA duct construction standards.
3. Do not use turning vanes in the following applications:

a. Grease and vapor exhausts
b. Fume hood exhaust
c. Breeching
d. Toilet exhaust ducts
e. Gravity ductwork
f. Clothes dryer exhaust
g. Hoistway vent

4. For 2-inch water gauge or above pressure class ductwork, spot weld turning vanes to duct.
5. For all 2-way splits in supply, return and exhaust systems, provide 2 elbows, proportionally sized per SMACNA Duct

Standards, either radius or square. A single fitting is acceptable with turning vanes and duct openings sized as specified.

G. Rectangular Duct Joints and Seams:

1. Provide standing, longitudinal seams, except where flush drive slip seam is specified.
2. Use grooved seam for exposed ducts except in garages, electrical or mechanical rooms, and where required for clearance.
3. “Duct Connection System” joints, may be used in lieu of standing seams. Plastic clips are only allowed for breakaway connections.
4. Fabricate ductwork and coordinate installation such that seams or joints shall not be cut or interrupted for the installation of branches, fittings, dampers, access doors, air inlets or air outlets.

H. Joint Sealing:

1. Seal to SMACNA Seal Classifications previously specified by one of the following methods:

   a. 6-ounce canvas strip, 6 inches wide adhered with lagging adhesive.
   b. Hardcast Two Part II Duct Sealing System: DT-5400 tape with RTA-50 sealant.

2. Applications as recommended by manufacturer.
3. Seal punched holes and corner cracks (Duct Tape Not Allowed).
4. After installation and testing, reseal joints found to be leaking.

I. Ducts Out-of-Doors:

1. Ducts shall be water-tight.
2. Construct as follows to assure water run-off and no standing water.

   a. Arrange standing seam, internal reinforcement, joints, flanges and access doors to prevent accumulation, ponding or pooling of water for both horizontal and vertical ductwork.
   b. Locate longitudinal seams at bottom of duct.
   c. Slope entire top of duct down toward sides. Coordinate duct slope with roof slope to avoid situations where roof slope and duct slope cancel each other out resulting in an unsloped top of duct.
   d. Provide mastic within sheet metal joints.
   e. Refer to specification section 23 07 00 for insulation requirements.
   f. Cover all insulated outdoor ductwork with an outdoor cladding product similar to K-FLEX CLAD AL. Seal seams with a multi-layer laminate tape.

3. Installations and penetrations shall be in accordance with SMACNA Guidelines for Roof-Mounted Outdoor Air-Conditioner Installations.
4. Provide sheet metal flashing or skirt at flexible connections to fans or HVAC units to avoid water accumulation.
5. Coordinate exact duct routing and duct support locations on roofs with roofing contractor. Roof-mounted duct support details shall be approved by the roofing contractor and the Architect prior to fabrication and installation.

J. Sound-Rated Duct Packing:

1. Wherever possible, avoid duct penetrations through sound-rated walls, floors and ceilings, in either Architectural elements or plenums specified under this Section.
2. Provide packing specified in Section 23 33 19 – Acoustics for ducts penetrating sound-rated walls, floors or ceilings, and for unavoidable duct penetrations.
3. Any interior walls, floors or ceilings that are internally insulated are considered sound-rated. Refer to Architectural Drawings for wall, floor and ceiling types.

3.02 ROUND AND OVAL DUCTWORK

A. Joints between ducts:

1. Construct with beaded sleeve joints.
2. Mechanically fasten with sheet metal screws or pop rivets except for fume exhaust, dust collection, clothes dryer ductwork.
3. Duct sealer shall be applied to male end and over all joint-, screw- and rivet-heads.
4. Seal as specified for rectangular ductwork.

B. Joints, duct and fitting:

1. Slip projecting collar of fittings into duct with a minimum insertion length of 2 inches.
2. Apply duct sealer. Seal as specified for rectangular ductwork.
3. Mechanical fastener schedule:

Duct Diameter	End Lap	No. of Rivets/Screws in Slip Joint
8 inches	0.75-inch	4
9 to 16 inches	1.00-inch	6
17 inches & up	1.25-inch	7 plus 3 per inch of circumference

C. Junctions between ducts:

1. Branch take-off: 45 degrees

1. Branch take-off: conical 90 degrees

2. Branch connections to unlined rectangular ducts may be made with spin-in fittings as specified.

D. Horizontal supports shall be one-piece clamp band strap, minimum one strap per section. Support fittings as required by SMACNA.

E. Vertical supports shall be one of the following:

1. Clamp bands with extended ends supported at each floor.
2. Clamp bands with knee bracing.
3. Pedestal at base of vertical riser.

F. Use angle iron braces for duct reinforcing. Refer to the SMACNA HVAC Duct Construction Standards, Metal and Flexible, figure numbers 1-9 through 1-12.

3.03 FLEXIBLE DUCTWORK

A. Provide continuous, single pieces.

B. Maximum Length:

1. Above 1-inch water gauge static pressure: 12 inches or as specified.
2. Under 1-inch water gauge static pressure: 4 feet.
3. Local codes or union rules take precedence and may reduce the maximum lengths specified.

C. End Connections:

1. Connect to duct collars, terminal unit connections and round air outlets per manufacturer's instructions.
2. Secure with strap clamps specified above.

D. Installation:

1. Support per SMACNA.
2. Flexible duct pressure rating must match the pressure of the system.
3. Flexible duct is not allowed in lengths greater than that specified. Bends, twists or sagging of flexible duct is not acceptable.
4. Minimum inside bending radius shall be a minimum of two duct diameters. If minimum radius cannot be maintained, provide sheet metal plenum over air outlet and connect flexible duct to side of plenum. Paint interior flat back.
5. Maximum – one 90-degree turn.
6. Install as straight as possible.
7. Do not lay flexible ductwork on ceiling grid support or tiles.

E. Flexible duct is only allowed above lay-in type accessible ceilings only.

F. Flexible ductwork must not pass-through partitions, walls, or floors.

G. Flexible duct is not allowed to be used in lieu of rigid elbows or fittings.

3.04 DUCT CLASSIFICATION

A. Duct classification is based on pressure classification as scheduled in Table 1-1 and as described in SMACNA HVAC Duct Construction Standards, Metal and Flexible. Comply with NFPA 90A when ducts traverse through smoke zones.

B. Longitudinal Seams: Pittsburgh lock shall be used on all longitudinal seams; snap-lock or button punch seams are not acceptable. If SMACNA seal class A or B is specified, the longitudinal seam shall be sealed from the inside.

C. Minimum pressure classification for each duct system and appropriate SMACNA table references are as follows:

Duct System	**SMACNA Pressure Classification (inches water gauge)**	**SMACNA Seal Classification**	**Duct Material**	**Material Gauge**
All rectangular supply ducts on systems with variable or constant volume terminal units from fan discharge to terminal unit (Except outside air handling units)	+2	A	Galvanized Sheet Steel	SMACNA
All rectangular supply ducts on systems without terminal units from fan discharge to air outlet	±2	A	Galvanized Sheet Steel	SMACNA
All rectangular ductwork downstream of terminal units. All rectangular return ducts and exhaust ducts	±2	A	Galvanized Sheet Steel	SMACNA
Outside air and toilet exhaust ductwork on the building side of the volume damper on each floor.	±2 & -2	A	Galvanized Sheet Steel	SMACNA
Outside air makeup and exhaust duct	±2 & -2	A	Galvanized Sheet Steel	SMACNA
Outside air handling unit discharge ductwork, risers, and ductwork to the volume damper on each floor.	+3	A	Galvanized Sheet Steel	SMACNA

Duct System	SMACNA Pressure Classification (inches water gauge)	SMACNA Seal Classification	Duct Material	Material Gauge
Toilet exhaust ductwork, risers, and runouts to the volume damper on each floor.	-3	A	Galvanized Sheet Steel	SMACNA

3.05 DUCT HANGERS AND SUPPORTS

A. General:

1. Support horizontal ducts with hangers of size and spacing as indicated in SMACNA Duct Construction Standards.
2. Attachment to structure shall be as specified in Section 23 05 29 – Hangers and Supports for HVAC.
3. Vibration isolation and seismic restraints for ducts shall be as specified in Section 23 05 48 – Vibration and Seismic Controls for HVAC.
4. Seismic restraints shall comply with SMACNA or local codes whichever is more stringent.

B. Horizontal Duct Supports:

1. Install hangers at each change in direction of duct.
2. Strap hangers:
   a. Extend strap down both sides of ducts.
   b. Turn under bottom two inches minimum. Provide a minimum of 2 screws per side.
   c. Screw hangers to bottom, upper and lower sides of ducts at 12 inches on center maximum.
   d. Seal all screw penetrations of ductwork.
3. Angle hangers:
   a. Per SMACNA Guidelines for Seismic Restraints.
   b. Seal all penetrations of ductwork.
4. Support rectangular fume, vapor and grease exhaust ducts on angle hangers. Do not penetrate duct with fasteners.
5. Support circular fume, vapor and grease exhaust ducts with shop-rolled flat bar bands around duct.
   a. Bands shall be 16-gauge by 1-inch steel minimum, hot dipped galvanized or prime coated after fabrication.
   b. Fasten top to hanger rod and bolt bottom of bands.

C. Vertical Duct Supports:

1. Support vertical ducts at every floor.
2. Use angles or channels riveted to ducts. Seal all duct penetrations.
3. Set angles or channels on floor slab or structural steel members placed in opening, unless otherwise noted.

3.06 DUCT DRAINS:

1. Provide a 1-inch Type L copper drain connection at low points for moisture collection.
2. Provide an S-trap (or P-trap) for water seal. Minimum depth of trap shall be 1.25 times maximum static pressure differential in duct section. Trap shall be tapped to accept a ½-inch trap primer connection.
3. Install piping from duct drain to nearest plumbing floor drain or floor sink. Terminate with 1-inch minimum air gap.
4. Provide tee connection in drain between duct and trap.
5. Connection from trap primer shall be furnished under Plumbing Section.

3.07 PLENUM AND CASING INSTALLATION

A. General:

1. Construct plenums with gauges, joints, bracing reinforcing, and other construction details in accordance with latest SMACNA, unless specified otherwise.
2. Construct with galvanized sheet metal of lock-forming quality.
3. Install hinged access doors where shown, specified, or required for access to equipment for cleaning and inspection. Minimum door dimension 60-inch by 18-inch with 12-inch by 12-inch minimum observation window, per SMACNA Figure 6-11 or Figure 6-12. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles.
4. Coat inside of plenums on discharge of air washers, humidifiers and spray coils with two coats of Bitumastic.
5. Slope floor to duct drain as specified.
6. Install sleeves and air-tight sealing grommets or resilient materials for all piping, conduit, tubing, wiring, shafts or other components penetrating plenum walls. Sealing method shall allow movement of component penetrating the wall.

B. Sheet Metal Plenum Construction (small):

1. Galvanized sheet metal shall be 16-gauge, unless otherwise indicated:
   a. Galvanized angle bracing riveted or bolted to sheet metal as required.
   b. Panels shall be cross-broken.
2. Seams shall be 2-inch standing seams, 24 inches on center and staggered at adjacent panels.

3. Reinforcing shall be 2-inch by 2-inch by ¼-inch galvanized angles riveted or bolted to back of sheet metal and perpendicular to the standing seams.
4. Install angles at all floor, wall, and ceiling corners and around openings.
5. Fasten reinforcing components to floors, ceilings and walls on 16-inch centers. Seams and joints shall be sealed with mastic and made airtight.

C. Sheetmetal Plenum Construction (large) and Equipment Casings

1. Butt top edges of vertical panel into the bottom of the horizontal or sloping top panels with join fully caulked. Form the interior top and bottom edges of the casing with continuous angle, caulked where it adheres to casing. Form panels occurring at corners of casing to "L" shape so that no joint occurs at such corners. Make vertical and horizontal seams (connection any panels) with caulked 1 ½" by 1 ½" by ½ inch angles. In addition, provide necessary internal structural barcing members.
2. All joints must be airtight. Provide additional support for the roof to prevent sagging.
3. Provide longitudinal reinforcing angles on the inside of the casing in accordance with the following:

   a. For walls or roofs that are between 6-8 feet in width, provide one angle in the middle.
   b. For walls or roofs that are between 8-12 feet in width, provide 2 angles at the ½ midpoints.
   c. For walls or roofs that are greater than 12 feet in wideth, provide angles every 4 feet.

D. Acoustical Panel Plenums:

1. IAC pre-fabricated plenum panels

3.08 MISCELLANEOUS INSTALLATIONS

A. Install the following equipment and materials that may furnished under other sections. Comply with manufacturer's installation instructions, code requirements, UL Listing and the requirements of local authorities.

1. Backdraft and balancing dampers
2. Fire, smoke, and fire/smoke dampers
3. Control dampers, automatic louver dampers
4. Filters
5. Sound traps
6. Air blenders and moisture eliminators
7. Air monitors and flow measuring devices
8. Access doors. Allow for adequate length of duct to install access door for all dampers
9. Smoke detectors, flow switches, controls and fire alarm devices
10. Pressure, temperature, humidity sensors/transmitters
11. Humidifiers

3.09 DUCT MOUNTED SMOKE DETECTORS

A. Duct mounted smoke detectors are provided by Division 26 and installed by Division 23. Locate duct mounted smoke detectors in the ductwork in accordance with the manufacturer recommendations, the authority having jurisdiction and NFPA.

END OF SECTION

SECTION 23 33 13
DAMPERS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to the following:

1. Static and Dynamic Fire Dampers
2. Smoke Dampers and Combination Fire/Smoke Dampers
3. Balancing Dampers
4. Backdraft Dampers
5. Installation of Automatic Control Dampers

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

C. Section 23 09 23 – Direct Digital Control System for HVAC

D. Section 23 31 00 – HVAC Ducts and Casings

E. Section 23 37 00 – Air Outlets and Inlets

F. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

A. AMCA 500-L-07, Laboratory Methods of Testing Louvers for Rating

B. NFPA 90A Installation of Air Conditioning and Ventilating Systems

C. NFPA 92A Standard for Smoke-Control Systems Utilizing Barrier and Pressure Differences

D. UL 555 Standard for Fire Dampers

E. UL 55C Standard for Ceiling Dampers

F. UL 555S Standard for Smoke Dampers

1.04 QUALITY ASSURANCE

A. Manufacturer: Test and qualify with UL a complete range of damper sizes covering dampers specified. Testing one size only is not acceptable.

B. Fire dampers shall open and close under HVAC system operating conditions in accordance with UL 555.

C. Smoke dampers and combination fire/smoke dampers shall open and close under HVAC system operating conditions in accordance with UL 555S.

D. Pressure drop ratings of dampers shall be based on tests and procedures performed in accordance with AMCA 500-L-07.

E. Air Flow Rating: UL approved for dual directional airflow.

F. Actuator shall have a minimum five-year manufacturer's warranty.

1.05 SUBMITTALS

A. Dynamic fire damper submittal shall include performance data developed for UL 555 standard tests. Maximum allowed air flow rate and static pressure for duct- and non-duct mounted installations shall be documented.

B. Submit smoke damper and combination fire/smoke damper schedule indicating size, service, location, designator identification, number of actuators, and air velocity through the damper.

C. Submit construction details, hardware details, gauges and certified dimensioned shop drawings for all damper types.

D. Manufacturer's product data:

1. Include leakage, pressure drop, and maximum pressure data.
2. Indicate materials, construction, dimensions, and installation details.
3. Verify conformance to NFPA 90A, NFPA 92A, UL 555, UL 555S, CSFM, AMCA and applicable building codes.
4. Verify damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500-L-07.
5. End switches, wiring diagrams, firefighters relays and override components.
6. Provide actuator electrical power requirements for both running and holding states and quantities per damper.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Static and Dynamic Fire Dampers: Ruskin DIBD2 Style B, IBD2 Style B, or approved equal by Air Balance, AWV, Pottorff, Greenheck.

B. Smoke Dampers: Ruskin SD60, SD37, SDRS25 (round) or approved equal by Air Balance or Pottorff.

C. Combination Fire/Smoke Dampers: Ruskin FSD60, FSD60-3 (3-hour), FSD 37, FSDR25 (round) or approved equal by Air Balance or Pottorff.

D. Grille Access Fire Smoke Dampers: Ruskin FSD60GA or equal by Air Balance or Pottorff.

E. Actuators: Belimo FSNF120 or equal.

F. Remotely Adjustable Operators with Balancing Dampers:

1. Remote adjustable operator shall be Young Regulator Model Number 270-896 with 'C' bracket.
2. Rectangular Balancing Damper shall be Young Regulator Model Number 830ACC for external control or Model Number 830ACC-2 for internally controlled applications.
3. Round Balancing Damper shall be Young Regulator Model Number 5020CC for external control or Model Number 5020CC-2 for internally controlled applications.

G. Backdraft Dampers: Ruskin CBD4 counterbalanced, Ruskin BD2 non-counterbalanced or equal by Air Balance, AWV, Arrow.

H. Heavy Duty Backdraft Dampers: Ruskin CBS92 counterbalanced, or equal by Air Balance, AWV, Arrow.

I. Manual Balancing Damper: Ruskin MD35, MD25, MDRS25.

2.02 FIRE DAMPERS

A. Provide static and dynamic fire dampers in ducts penetrating fire-rated walls, floors, and ceilings as required by NFPA, local codes and authorities regardless if shown or not shown on the Drawings. Dampers shall be factory-marked for static or dynamic use.

B. Provide conveniently located access doors, of ample size for resetting the dampers. Duct-mounted grilles, registers or diffusers can be used for access as long as such access is readily available as determined by the Architect or Authority Having Jurisdiction.

C. Integral sleeve frame shall be minimum 20-gauge roll formed, galvanized steel. Comply with manufacturer's installation instructions and Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Details.

D. Dampers shall be spring-loaded with shutter stored out of the airstream to provide minimum 95 percent free area.

E. Dynamic rated fire dampers shall be labeled in accordance with UL 555. Static fire dampers shall be labeled in accord with UL 555.

F. Dampers shall be actuated by UL-approved fusible link. Upon operation of the link, the dampers shall close automatically and remain tightly closed. Fusible links shall operate approximately 50 degrees F above the maximum temperature the duct system will encounter under normal operation, but not less than 165 degrees F.

G. Dampers shall be of types acceptable to the local authorities, Owner and Architect.

H. Factory-Furnished Sleeve:

1. Minimum 20-gauge thickness, galvanized steel, standard 17-inch length, factory insulated on 4 sides, with front flange for grille.

2. Equipped with all required accessories.
3. Silicone caulk factory-applied to sleeve at damper frame to comply with leakage rating requirement.
4. Provide sufficient sleeve length to accommodate duct connections on non-grille side of opening.

I. Blades:

1. Style: Horizontal airfoil-shaped, single-piece.
2. Action: Parallel.
3. Material: Minimum 14-gauge equivalent thickness, galvanized steel.
4. Width: Maximum 6 inches.

J. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.

K. Seals:

1. Blade: Silicone rubber edge type for smoke seal to 450 degrees F and galvanized steel for flame seal to 1,900 degrees F. Mechanically attached to blade edge.
2. Jamb: Stainless steel, flexible metal compression type.

L. Linkage: Concealed in frame.

M. Axles: Minimum ½-inch diameter plated steel, square or hex-shaped, mechanically attached to blade.

N. Mounting: Vertical.

O. Heat-Actuated Temperature Release Device:

1. Control close and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
2. Allow damper to be automatically and remotely resettable after test, smoke detection, or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
3. Controlled closure and locking of damper shall occur in 5 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
4. Electric fuse link (EFL) with electric actuators.
5. Release Temperatures: 165 degrees F 212 degrees F.

P. Actuator shall be electric, 24-volt, 60-hertz. Controlled closure and locking of damper shall occur within 5 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.

Q. Duct transition connection shall be round, oval or rectangular to match duct configuration.

R. Factory assemble damper, actuator, sleeve, and accessories and furnish as a single unit conforming to UL 555 and UL 555S.

S. Performance Data:

1. Elevated Temperature Qualified: Damper and actuator assembly shall be qualified in accordance with UL 555S to elevated temperature of 350 degrees F.
2. Leakage Class I, when applied in systems with maximum pressure of 4 inches water gauge.

2.03 SMOKE DAMPERS, COMBINATION FIRE/SMOKE DAMPERS

A. Provide dampers of size and location as indicated on the Drawings and as specified.

B. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.

C. For air velocities up to 1,500 feet per minute, the blades shall be single skin 16-gauge minimum galvanized steel with three longitudinal grooves for increased stiffness and reinforcement. For air velocities up to 4,000 feet per minute, the blades shall be double skin 14-gauge minimum galvanized steel. Bearings shall be a self-lubricating stainless steel sleeve turning in an extruded hole in the frame. Blade edge seals shall be silicone rubber designed to withstand 450 degrees F. Jamb seal shall be silicone impregnated fiberglass with stainless steel flexible metal compression type cover. Maximum blade width shall be 6 inches.

D. Each damper shall be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems under the latest version of UL 555S, and bear a UL label attesting to same. The damper leakage rating under UL 555S shall be leakage Class I (4 cubic feet per minute per square foot at 1-inch water gauge).

E. In addition to the leakage ratings already specified herein, the dampers and their actuators shall be qualified under UL 555S to an elevated temperature of 350 or 450 degrees F depending upon the actuator. Appropriately listed electric actuators shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator(s) shall be supplied as a single entity that meets applicable UL 555S qualifications for both dampers and actuators. Provide wiring and conduit materials required to interconnect the actuator(s).

F. Each damper shall be equipped with indication/position switches consisting of two-position indicator switches linked directly to the damper blade to provide the capability of remotely indicating damper blade position.

G. Heat-Actuated Temperature Release Device:

1. Control close and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
2. Allow damper to be automatically and remotely resettable after test, smoke detection, or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.

3. Controlled closure and locking of damper shall occur in 5 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
4. Electric fuse link (EFL) with electric actuators.
5. Release Temperatures: 165 degrees F.

H. Smoke damper and combination fire/smoke damper actuators shall be powered by a 24-volt AC signal from Division 26.

I. Electric damper actuator shall be driven open or closed by the rotating motion of a reversible, overload protected, non-stall synchronous motor. Crank arm shall be connected to the actuator directly with no intermediate linkage.

J. Actuator quantities per damper area shall be as recommended by the manufacturer. Provide additional actuators to meet the damper leakage requirement. Damper actuator shall stroke from fully open to fully closed or vice versa in less than 15 seconds from receipt of control signal.

K. Two-position dampers shall have spring return. Provide UL 555S-listed and -labeled actuators for all dampers.

2.04 ROUND COMBINATION FIRE/SMOKE DAMPERS

A. Provide Class I round combination fire/smoke dampers suitable for application in HVAC systems with velocities up to 4,000 feet per minute.

B. Fire Rating: UL 555-classified and -labeled as a 1.5-hour fire damper.

C. Smoke Rating: UL 555S-classified and -labeled as a Leakage Class I Damper for use in smoke control systems: 4 cubic feet per minute per square foot at 1-inch water gauge and 8 cubic feet per minute per square foot at 4-inch water gauge.

D. Air Flow Rating: UL-approved for dual directional airflow.

E. Frame/Sleeve: Minimum 20-gauge galvanized steel with roll formed beads and retaining plate grooves to accept retaining plates for damper mounting.

F. Blade shall be two-piece, minimum 14-gauge equivalent thickness, galvanized steel.

G. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.

H. Blade Seals: Silicone rubber fully encompassing the blade edge for smoke seal up to 450 degrees F. Mechanically attached to blade edge.

I. Axle: Minimum ½-inch diameter plated steel, mechanically attached to blade.

J. Damper and retaining plates shall be one-piece, minimum 20-gauge galvanized steel with factory matched and shipped with individual damper.

K. Heat-Actuated Temperature Release Device:

1. Control close and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. At no time shall actuator disengage from damper blades.
2. Allow damper to be automatically and remotely resettable after test, smoke detection, or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
3. Controlled closure and locking of damper shall occur in 5 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
4. Electric fuse link (EFL) with electric actuators.
5. Release Temperatures: 165 degrees

L. Actuator shall be electric, 120-volt, 60-hertz.

M. Factory-assemble damper, actuator, sleeve, and accessories and furnish as a single unit conforming to UL 555 and UL 555S.

N. Performance Data:

1. Elevated Temperature Qualified: Damper and actuator assembly qualified in accordance with UL 555S to elevated temperature of 350 degrees F.
2. Leakage Class I, when applied in systems with maximum pressure of 4-inch water gauge.

2.05 ACTUATORS

A. Actuator motor shall be silent microprocessor-controlled providing electronic cut-off.

B. Motor shall be direct-coupled and incapable of burning out if stalled before full rotation is reached.

C. Housing, gears and toothed cold-weld clamp shall be steel.

D. Operation time: 5 to 15 seconds at 32 to 350 degrees F.

2.06 ACCESSORIES FOR DAMPERS

A. Interlock switch: Electrically and mechanically lock damper in closed position when duct temperatures exceed 165 degrees F and still allow appropriate authority to override interlock switch and operate damper as may be required for smoke management functions. Allow damper to remain operable while temperature is below 350 degrees F. Switch shall comply with NFPA 92A and be UL classified.

B. Interface with smoke detectors, building fire alarm systems or remote indicating and control stations.

C. High-Limit Temperature Sensor:

1. Returns damper to fire protection mode when temperatures reach operational limit of damper and actuator assembly of 350 degrees F.

2. Conform to NFPA 92A.
3. Replaces controlled closure devices on standard dampers.

D. Blade Position Indicator Switches: Two position-indicator switches linked directly to damper blade to remotely indicate damper blade position.

E. Picture Frame Mounting Angles:

1. One-piece, roll formed retaining angles, 1.5 by 1.5 inches. Requires factory sleeve.
2. Factory-matched and -shipped on individual damper with factory-prepunched screw holes.

F. Steel Mullions: For dampers in oversized masonry wall openings.

G. Provide breakaway connection: Drivemate, Ductmate or equal.

2.07 BALANCING DAMPERS – SINGLE BLADE

A. Provide volume dampers as specified or shown on the Drawings for proper balancing and distribution of air, in the various branches of the ductwork for use in testing and balancing the system. Dampers shall be installed separate and independent from the damper specified to be set behind supply, return and exhaust air grilles. Provide single-blade dampers in ducts 24 inches in width or less, or 12 inches in height or less. Provide multiple-blade dampers for all other duct sizes. Coordinate with the air-balancing contractor and provide additional dampers required for proper air balance.

B. Provide single-blade and quadrant type volume dampers of minimum 20-gauge round or 22-gauge rectangular galvanized steel construction, pivoted to turn easily. Provide operating handles and Ventlok 641 or equal locking devices mounted on outside of the duct in an accessible location. Blade shall have 4 full-length brakes for increased stiffness and rigidity.

C. Damper component penetration shall be closed and sealed consistent with the specified duct sealing class. End bearings are required for 3-inch water gauge class.

2.08 BALANCING DAMPERS – MULTIPLE BLADES

A. Manual dampers shall have a minimum 16-gauge galvanized steel channel frame with mounting flanges and axles set in molded polycarbonate or oil-impregnated bronze bearings. Axles shall be minimum of ½-inch in diameter and shall be interlocked with blades to positively eliminated slippage.

B. Blades shall be minimum of 16-gauge galvanized steel. Manual dampers shall have a minimum of four breaks running the entire length of the damper to assure rigidity and tight close-off. Blades shall be on centers no greater than 9 inches and no blade shall exceed 48 inches in length. All blades shall be interconnected to act in unison for opposed blade operation.

C. When installed, damper frame shall be gasketed or caulked to eliminate leakage between duct or plenum and damper frame. Head and sill shall have stops. Damper shafts shall be marked to indicate blade position.

D. Dampers shall be provided with Ventline 560 or approved equal, locking quadrants of sufficient size and design to securely hold the damper sections and blade linkage hardware.

2.09 BACKDRAFT DAMPERS – COUNTERBALANCED TYPE

A. Provide counterbalanced backdraft dampers as specified and where indicated on the Drawings. Each damper shall be sized as indicated on the Drawings, and shall be suitable for installation in the mounting arrangement shown.

B. Backdraft damper shall be the heavy-duty pressure relief counter-balanced shutter type similar to Ruskin type CBD4, or approved equal.

C. Damper frame shall be minimum 16-gauge galvanized steel or 16-gauge aluminum. Damper frame shall be of channel construction for ductwork mounting or have a front flange when installed in a wall.

D. Damper blades shall be minimum 16-gauge galvanized steel or 16-gauge aluminum. Provide individual adjustable counterweights on each blade. The damper shall be capable of maintaining static pressures of 0.05 to 0.20 inches water gauge. Furnish tie bars constructed of minimum 16-gauge galvanized steel or 16-gauge aluminum on damper sections over 24 inches wide. After damper has been installed, counterweights shall be adjusted to balance the system static pressure as directed by the test and balancing contractor.

E. Damper blades shall have polyurethane foam, neoprene, or vinyl gaskets glued, riveted or rolled into blade edges.

F. Damper bearings shall be molded polycarbonate, bronze oilite, nylon, or cycoloy.

G. Furnish counter-balanced backdraft dampers with No. 1.5 mesh aluminum bird screen for rear mounting where counter-balanced backdraft dampers are mounted in outside walls.

2.10 BACKDRAFT DAMPERS

A. Furnish and install backdraft dampers as specified and where indicated on the Drawings. Each damper shall be sized as indicated on the Drawings and shall be suitable for installation in the mounting arrangement shown. Backdraft dampers mounted in roof curbs shall be secured to galvanized steel support angles fastened to the curb.

B. Backdraft dampers shall be heavy-duty relief shutter type suitable for wall- and duct-mounting or installation at a centrifugal fan discharge. Backdraft dampers shall be similar to Ruskin Type BD2-A1 for face velocities to 1,500 feet per minute and Ruskin Type BD2-A2 for face velocities to 2,500 feet per minute or approved equal.

C. Damper frame shall be constructed of minimum 0.090-inch thick aluminum or minimum 18 gauge galvanized steel. Damper frame shall be of channel construction when installed in ductwork or have a front flange when installed in a wall.

D. Damper blades shall be constructed of minimum 0.025-inch thick extruded aluminum suitable for face velocities up to 1,500 feet per minute and minimum 0.05-inch thick extruded aluminum for face velocities to 2,500 feet per minute. Damper blades shall have neoprene or vinyl gaskets riveted or rolled into the blade edge. Each backdraft damper section shall be furnished with tie bars constructed of minimum 16-gauge aluminum. Furnish two tie bars on damper sections over 40 inches wide.

E. Damper bearings shall be molded polycarbonate, bronze oilite, nylon, or cycoloy.

F. Furnish backdraft dampers with 1.5-inch by 1.5-inch 22-gauge wire mesh aluminum bird screen for rear mounting where backdraft dampers are mounted in outside walls.

G. Damper leakage shall not exceed 12 cubic feet per minute per square foot of damper face area at 0.5 inches water gauge differential pressure.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install dampers square and free from twist or racking with blades running horizontally.

B. Do not compress or stretch damper frame into duct or opening.

C. Handle and lift damper using sleeve or frame. Do not lift damper using blades, accessories, actuator, or jackshaft. Handle dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

D. Provide conveniently located access doors, of ample size for resetting the dampers. Duct mounted grilles, registers or diffusers can be used for access as long as such access is readily available as determined by the Architect, Owner or Authority Having Jurisdiction.

E. Install automatic control dampers of louver pattern including smoke dampers and fire/smoke dampers, as indicated on the Drawings or as specified in intake ducts and/or plenums, discharge ducts and plenums from fans, etc. These dampers shall be provided by the automatic control contractor.

F. Provide a 16-gauge elevated platform at least ⅛-inch higher than the insulation thickness for all balancing dampers installed in externally insulated ductwork. Damper shaft bearing shall be mounted on elevated platform.

G. Install remote operators for balancing dampers where damper is located above drywall, plaster or other inaccessible ceiling construction where access panels are not provided.

H. Fire damper operation shall be tested after the installation is complete. Static fire dampers shall be tested with the system fans not operating. Dynamic fire dampers shall be tested with system fans operating at their maximum static pressure ratings. A written certificate shall be issued by the Contractor to the Owner stating:

1. Damper identification
2. Damper location
3. Date tested
4. Names and signatures of witnesses and testing personnel

I. Provide a copy of certification to system balancing agent for inclusion in balancing report.

J. Size and quantity of dynamic fire damper shall be based on the UL listing of the damper manufacturer. Provide intermediate mullions and split duct connections as required.

K. Provide ribbon at each manual damper handle.

END OF SECTION

SECTION 23 33 19
ACOUSTICS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Sound attenuators
2. Sound lining
3. Vane axial fan diffuser/silencer

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 48 – Vibration and Seismic Controls for HVAC

C. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

D. Section 23 07 00 – HVAC Insulation

E. Section 23 31 00 – HVAC Ducts and Casings

F. Section 23 37 00 – Air Outlets and Inlets

1.03 REFERENCE STANDARDS

1. AMCA – Air Movement and Control Association Standard 300-08, Reverberant Room Method for Sound Testing of Fans
2. ANSI – American National Standards Institute Standard S1.13, American National Standard Methods for the Measurement of Sound Pressure Levels In Air
3. AHRI (ARI) – Air Conditioning and Refrigeration Institute Standards:
   a. Standard 440-98 – Standard for Room Fan Coil and Unit Ventilator
   b. Standard 575-94 – Method of Measuring Machinery Sound within Equipment Rooms
   c. Standard 885-98 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
4. AHRI(ARI)/ADC 880 – Standard for Air Terminals
5. ASTM – American Society for Testing and Materials
   a. C423-08A – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
   b. E84-09A – Standard Test Method for Surface Burning Characteristics of Building Materials
   c. E90-04 – Standard of Test Method for Laboratory Measurement of Air Borne Sound Transmission Loss of Building Partitions and Elements

d. E413-04 – Classification for Rating Sound Insulation
e. E477-06A – Standard Test for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers

6. ISO – International Standards Organization

a. ISO 5135 – Acoustics – Determination of Sound Power Levels of Noise from Air-Terminal Devices, Air-Terminal Units, Dampers and Valves by Measurements in a Reverberation Room
b. ISO 3741 – Acoustics – Determination of Sound Power Levels of Noise Sources Using Pressure Methods for Reverberation Rooms

7. NLVAP – National Voluntary Laboratory Accreditation Program for Acoustical Testing Services
8. UL – Underwriters Laboratories: UL 181, Factory-Made Air Ducts and Connectors.
9. Refer to Section 23 37 00: Air Inlets and Outlet for additional reference standards.

1.04 QUALITY ASSURANCE

A. Acoustical Criteria:

1. Noise levels, generated by equipment and ductwork, shall be attenuated to permit attainment of sound pressure levels in all 8 octave bands in occupied spaces that conform to the following Noise Criteria (NC) curves:

a. Lobbies, corridors, toilets, spaces within 10 feet of duct penetrations through shaft and equipment room walls and floors of equipment rooms: NC-40.
b. Conference Rooms:

(1) Small: NC-35
(2) Large: NC-30

c. Executive Offices: NC-30
d. All other spaces: NC-35

2. In addition to complying with the standard full octave band sound pressure levels based on maximum NC design requirements, acoustical performance of mechanical equipment when operating under design conditions shall not create any objectionable pure tones. A pure tone is defined as a peak sound pressure level which, when measured in ⅓-octave band frequencies, is higher by more than 5 decibels than adjacent ⅓-octave band frequencies.
3. Comply with specified NC levels for radiated noise from terminal and pressure regulating devices and/or duct breakout noise by having full octave band sound pressure levels of at least two contiguous frequencies tangent to the NC spectrum. A single frequency controlled NC environment is considered obtrusive and unacceptable.

4. During testing of sound attenuators there shall be air flowing through the tested sound attenuators at velocities specified in Paragraph 2.02, plus or minus 5 percent.

B. Mechanical Performance:

1. Air distribution system equipment; terminal device noise:

a. Maximum permissible sound-power levels in octave bands of airborne transmissions through the combination of grilles, registers, diffusers, and terminal units, or related pressure reducing devices, when operated in installed condition with 3-feet of unlined duct shall be as follows:

Octave Band Frequency (Hertz)	**Octave Band Number**	**Maximum PWL in Decibels Referred to 10^{-12} Watts for space being served**						
		NC-20	NC-25	NC-30	NC-35	NC-40	NC-45	NC-50
63	1	51	54	57	60	64	67	71
125	2	40	44	48	52	56	60	64
250	3	33	37	41	45	50	54	58
500	4	26	31	35	40	45	49	54
1,000	5	22	27	31	36	41	46	51
2,000	6	19	24	29	34	39	44	49
4,000	7	17	22	28	33	38	43	48
8,000	8	16	21	27	32	37	42	47

2. Pressure-reducing terminal devices above ceiling; radiated noise:

a. Maximum permissible radiated sound-power levels in octave bands when operated in installed condition over occupied spaces, is as follows:

Octave Band Frequency (Hertz)	**Octave Band Number**	**Maximum PWL in Decibels Referred to 10^{-12} Watts**			
		NC-35	NC-40	NC-45	NC-50
63	1	72	76	79	82
125	2	70	74	77	80
250	3	61	65	68	71
500	4	60	64	68	72
1,000	5	57	62	68	72
2,000	6	56	60	65	70
4,000	7	66	70	75	80
8,000	8	65	70	75	80

3. Provide sound lining in accordance with UL 181.
4. Provide all materials in accordance with NFPA, UL and state and local codes.

1.05 SUBMITTALS

A. Shop Drawings:

1. Sound attenuators, vane axial fan diffuser/silencer.
2. Sound lining.
3. Certification that sound lining meets erosion test method described in UL 181, Factory-Made Air Ducts and Connectors.
4. Non-hardening caulking.
5. Submit certified test data from approved laboratory for pressure drop and insertion loss ratings. ASTM – American Society for Testing and Materials E477 and C423.

    a. For square or rectangular attenuators: Test results for a 24-inch by 24-inch cross-section attenuator.
    b. Certification data for pressure drop and net insertion loss: Based on tests of same attenuator.
    c. Attenuators and tests: Subject to inspection upon request.
    d. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of 2,000 fpm face velocity.
    e. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch water gauge static pressure, whichever is greater.

B. Noise generated by mechanical equipment shall be a guaranteed maximum when operating at the specified conditions.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Sound Attenuators and Vane Axial Fan Diffuser/Silencers: Industrial Acoustics, Koppers, Vibro-Acoustics

B. Sound Linings: Certainteed ToughGuard, Schuller, Owens-Corning Fiberglas

C. Circular Duct Lining: Casco Circliner, Schuller Spiracoustic

D. Factory Pre-Fabricated Double Wall Lined Duct: United McGill, Sheet Metal Products

E. Fire Retardant Adhesive and Sealer: Foster 85-20 or approved equal.

F. Non-hardening caulking shall be guaranteed to be permanently elastic. Tremco Polybutene or approved equal.

2.02 MATERIALS

A. Factory-Prefabricated Sound Attenuators:

1. Fire Performance: Adhesives, sealants, packing materials and necessary accessory materials shall have fire ratings not exceeding 25 for flame-spread index and 50 for smoke-developed index when tested according to ASTM E 84.
2. Rectangular Units: Fabricate casings with a minimum of 22-gauge solid galvanized sheet metal for outer casing and 26-gauge, ASTM A653/A653M, perforated galvanized sheet metal for inner casing.
3. Round Units:

a. Outer Casings:

(1) ASTM A653/A653M, **[G90] [G60]**, galvanized sheet steel.
(2) Up to 24 inches in diameter: 22 gauge.
(3) 26 through 60 inches in diameter: 18 gauge.
(4) Casings fabricated of spiral lock-seam duct may be one gauge lighter than that indicated.

b. Interior Casing, Partitions and Baffles:

(1) ASTM A653/A653M, **[G90] [G60]**, galvanized sheet steel.
(2) Minimum 26-gauge and designed to minimize aerodynamic losses.

4. Sheet Metal Perforations: ⅛-inch diameter for inner casing and baffle sheet metal.

5. Filler Material: **[Inert inorganic glass-fiber vermin-proof and moisture-proof, packed under not less than 5 percent compression]**, mechanically fastened to the steel panels and protected by an impervious membrane. **[Filler material shall be totally encapsulated and sealed with a polymer film of an approximate thickness of 1.5 mils. The encapsulated fill material shall be separated from the perforated baffles by means of a non-combustible, erosion resistant acoustic stand-off.]**
6. Rectangular casing seams shall be located in the corners of the attenuator shell to provide strength and rigidity. Interior partitions shall be fabricated from single piece, perforated sheets with die-formed entrance and exit shapes.
7. Attachment of the interior partitions to the casing shall be by means of an interlocking track assembly. Tracks shall be solid galvanized steel and shall be welded to the outer casing.
8. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the attenuator.

9. No sound-absorptive material of any kind is to be used in the silencers. The silencers shall attenuate air/gas transmitted noise solely by virtue of controlled impedance membranes and broadly tuned resonators.

10. Attenuators subjected to corrosive environments shall be constructed of Type 316 stainless steel.
11. Attenuators shall form rigid units that do not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

a. Do not use nuts, bolts or sheet metal screws for unit assemblies.
b. Lock form and seal or continuously weld joints.
c. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.

12. Performance Data shown based on the following Industrial Acoustics silencer types:

    a. Type L and Type S Silencers: Minimum net insertion loss ratings as determined by duct-to-reverberant room test method at 2,000 feet per minute minimum velocity shall be as follows:

Octave Band Number	Octave Band Frequency (Hertz)	Dynamic Net Insertion Loss in Decibels					
		Sound Trap Types/Lengths					
		3L	5L	7L	3S	5S	7S
1	63	3	5	6	5	6	8
2	125	5	7	11	8	16	16
3	250	8	13	16	14	22	31
4	500	14	22	29	27	40	46
5	1,000	21	30	39	36	46	49
6	2,000	22	35	43	35	46	48
7	4,000	13	18	22	27	40	45
8	8,000	9	13	15	17	25	35

    b. Packless Type XM Silencers: Minimum dynamic insertion loss, at 1,000 feet per minute forward flow direction, shall be as follows:

Octave Band Number	Octave Band Frequency (Hertz)	Dynamic Net Insertion Loss in Decibels		
		Sound Trap Types/Lengths		
		3XM	6XM	9XM
1	63	6	7	8
2	125	4	9	16
3	250	10	15	22
4	500	17	27	35
5	1,000	26	25	29
6	2,000	12	14	20
7	4,000	10	14	19
8	8,000	9	12	18

13. Maximum Self-Generated Noise:

    a. For Type L Silencer: At 2,000 feet per minute face velocity and 4 square feet face area:

Octave Band Number	Octave Band Frequency (Hertz)	Sound Power Level in Decibels re 10^{-12} Watts L Series Sound Trap Type
2	125	51
3	250	51
4	500	49
5	1,000	47
6	2,000	50

    b. For Type S Silencer: At 1,000 feet per minute face velocity and 4 square feet face area:

Octave Band Number	Octave Band Frequency (Hertz)	Sound Power Level in Decibels re 10^{-12} Watts S Series Sound Trap Type
2	125	49
3	250	49
4	500	47
5	1,000	46
6	2,000	49

c. For Type XM Silencer: At 1,000 feet per minute face velocity forward flow direction:

Octave Band Number	Octave Band Frequency (Hertz)	Sound Power Level in Decibels re 10^{-12} Watts XM Series Sound Trap Type
2	125	54
3	250	49
4	500	46
5	1,000	52
6	2,000	60
7	4,000	60
8	8,000	50

B. Vaneaxial Fan Diffuser/Silencer:

1. Construct diffuser/silencers of inorganic, noncombustible materials meeting Code requirements and flame spread rating of 25 and smoke developed of 50.
2. The diffuser/silencer shall be specifically designed for mounting at the inlet and outlet of manufacturer's vaneaxial fan. Diffuser/silencer performance shall be specifically rated with the fan manufacturer and fan size selected. Provide flow direction indicator labels on the exterior casing.
3. Diffuser/silencers shall include an internal core of consistent diameter along the entire length in direction of airflow. The core diameter shall be selected based on the adjacent hub diameter or, in the case of C-frame mounted motors, the motor frame size for the respective fan system on which the diffuser silencer is installed. The core shall be constructed from lock forming quality type G-90 galvanized perforated steel in the same gauge as the internal diffuser core. The core shall be supported by a minimum of three welded radial attachment brackets installed at a 120 degree angle to each other to provide uniform support.
4. Provide 4-inch long, 12-gauge, sleeved end connections as standard. When noted, rolled angle flanges shall be welded to the sleeve by the manufacturer. For units where the minimum diffuser core diameter is 36 inches or greater, an additional support rod shall be welded between the radial bracket and the sleeve to prevent a twist from being exerted on the internal core by the airflow of the fan.
5. Diffuser/silencers shall function as pressure regain devices to minimize system pressure losses at the fan. Fan selections are based on the regain performance of the diffuser/silencer configurations specified.

6. The diffuser/silencer shall meet the following requirements for dynamic insertion loss (forward flow):

Diffuser Outlet Diameter (inches)	Dynamic Insertion Loss in Decibels							
	Octave Band Center Frequency in Hertz							
	63	125	250	500	1,000	2,000	4000	8000
30	1	2	12	20	26	22	16	12
40	1	8	16	19	19	14	10	9
46	2	9	16	18	19	14	10	10
52	3	10	16	18	16	13	11	10
60	3	11	18	19	17	13	12	10
68	3	11	17	19	17	12	12	10
74	4	12	18	20	16	12	11	10
82	4	12	18	20	16	12	11	10
90	4	12	18	18	15	10	10	10

C. Duct Lining:

1. Low-pressure fiberglass duct liner downstream of terminal units shall be finished with an acrylic polymer facing stenciled NFPA 90.
2. Medium pressure duct liner shall be finished with perforated 24-gauge galvanized sheet metal, 28 percent minimum open area or foil facing.
3. Thickness:

    a. In ductwork: Minimum 1 inch matte faced unless otherwise noted on the Drawings or specification.
    b. In plenums and in supply, return or exhaust duct downstream of local floor equipment rooms: Minimum 2 inches, 3 pound per cubic foot density, semi-rigid.
    c. For sound lining where used in lieu of external thermal insulation, minimum thickness shall conform to requirements as specified in Section 23 07 00: Insulation.
    d. Linear Diffuser Supply Plenums: Minimum 0.5 inch, 1.5 pound per cubic foot density.

4. Minimum density ducts: 1.5 pounds per cubic foot.
5. Minimum density, plenums: 3 pounds per cubic foot.
6. Flame-spread shall be maximum 25; fuel contributed and smoke developed shall be maximum 50.
7. Suitable for duct velocity of 4,000 feet per minute. Meet erosion test method described in UL 181.
8. Dynamic Loss Coefficient: Maximum 1.2.
9. K Factor: Maximum 0.23 BTU per inch-hour – degree Fahrenheit – square foot; R Value Minimum: 4.2 at 1-inch thickness.
10. Minimum sound-absorption coefficients (ASTM C423 Type A Mounting) for sound-absorbing duct lining material when tested while mounted per ASTM E795.

Lining Thickness	Noise Reduction Coefficient (NRC) Minimum
0.5 inch	0.45

Lining Thickness	Noise Reduction Coefficient (NRC) Minimum
1.0 inch	0.70
1.5 inch	0.85
2.0 inch	0.95

11. Where acoustically lined circular or oval duct is required, lining shall be positively retained in place.

PART 3 – EXECUTION

3.01 INSTALLATION

A. In order to obtain satisfactory acoustical performance of the mechanical systems, complete the following:

1. Duct connections at inlet to the terminals
2. Air-balancing
3. Avoid excessive dampering right at the terminals

B. Duct and duct supports shall not contact ceiling framing, ceiling supports, piping or pipe supports

C. Sound Attenuators:

1. Install in accordance with manufacturer's recommendations to obtain published and specified performance.
2. Provide 22-gauge galvanized steel wire mesh screen on all sound-attenuator inlets or outlets not connected to ductwork or fans.
3. Provide water-tight aluminum jacket on all sound attenuators installed outside the building or exposed to the weather. Installation shall comply with SMACNA standards for outdoor installations.

D. Sound Linings:

1. Adhere with 6-inch wide strips of adhesive at 12-inch centers at all joints in lining.
2. In addition, secure with grip nail, standard stamp-on or weld pins, and 2-inch diameter integral or press-on head washers on maximum 16-inch centers and in compliance with SMACNA standards.
3. Coat all edges with sealer.

4. Provide continuous sheet metal edge protection nosings at entering and leaving edges of lined duct sections and all joints.
5. Dimensions of lined ductwork are clear inside dimensions after lining has been installed.
6. Extent of ductwork sound linings.

a. Heating, Ventilating and Air-Conditioning Systems:

(1) Supply: Ductwork within mechanical equipment rooms and not less than 25 feet downstream of mechanical equipment room walls and floor slabs.
(2) Exhaust, Relief and Return: Ductwork in mechanical equipment rooms but not less than 25 feet from fan or 15 feet from room walls, floors or ceiling/slabs.

b. Outside air supply systems a minimum distance of 25 feet downstream of fan. Stop lining 10 feet from outside air intake.
c. Ductwork installed outside building: All exposed ductwork a minimum of 10 feet downstream of wall, roof or floor penetrations.
d. Ventilation systems: As indicated on the Drawings.
e. Exhaust systems: As indicated on the Drawings.
f. Ductwork downstream of fan coil units, heat pumps, AC units or terminal units: Minimum 10 feet. Branch take-offs to diffusers are not allowed in this 10-foot lined section.
g. Ductwork upstream of ducted fan coils, heat pumps, AC units: 4 feet minimum.
h. Minimum lengths specified or shown. Provide additional acoustical treatment as required to meet maximum permissible sound-power levels scheduled for equipment.

7. Sound-lined plenums: As specified and indicated on the Drawings.
8. All transfer and jumper ducts.
9. All linear diffuser supply plenums.

E. Soundproofing of Construction:

1. Required for packing between ductwork and the following construction:

a. Fan room and mechanical equipment room walls.
b. Floors, except in shafts.
c. Sound barrier ceilings.
d. Sound-rated walls: Any interior wall or partition with internal insulation. Refer to Architectural drawings.

2. Soundproofing:

a. Fill openings with fiberglass blanket or board for full depth of penetration.
b. Caulk each side of opening with non-hardening, non-aging caulking compound. Schuller “Duxseal” or approved equal.

3. Soundproofing may be deleted when firestopping material is provided.

F. Ductwall External Soundproofing:

1. Extent:

a. Vane axial fans including their inlet and discharge transitions and sound attenuators.
b. Where indicated on the Drawings.

2. Soundproofing Material:

   a. Fiberglass Board:

      (1) Density: 6 pounds per cubic foot.
      (2) Thickness: ½ inch greater than height of ductwork angles, but 2 inches minimum.

   b. External Jacket:

      (1) Lead sheet overlapped 2 inches and secured with tape.
      (2) Weight: 1 pound per square foot.
      (3) Thickness: $^{1}/_{64}$ inch.

G. Sound Attenuators Tests:

1. After installation, measure total system pressure before and after attenuators.
2. If pressure loss exceeds maximum static pressure scheduled on the Drawings, replace attenuators and/or modify entrance and/or discharge aerodynamic flow to obtain specified performance.

H. Do not install flexible duct through walls or ceilings.

I. Acoustical Testing: The contractor shall cooperate with the test and balance contractor to allow acoustical testing to be executed during the testing and balancing.

END OF SECTION

SECTION 23 34 00
HVAC FANS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Centrifugal Fans:

a. Scroll
b. Cabinet
c. Tubular Centrifugal
d. Plug (Unhoused Centrifugal)

2. Axial Fans:

a. Propeller
b. Vaneaxial – fixed blade
c. Vaneaxial – adjustable blade
d. Mixed Flow
e. Tube Axial

3. Backdraft Dampers for vaneaxial fans
4. Discharge Cones for axial fans
5. Roof Exhaust Fans
6. Variable Speed Dryer/Flue Vent/Combustion Fans
7. Ceiling/Wall Fans (Panasonic)

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 14 – Variable Frequency Drives for HVAC

D. Section 23 05 29 – Hangers and Supports for HVAC

E. Section 23 05 48 – Vibration and Seismic Controls for HVAC

F. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

G. Section 23 31 00 – HVAC Ducts and Casings

H. Section 23 33 13 – Dampers

I. Section 23 33 19 – Acoustics

J. Section 23 73 13 – Modular Indoor Central-Station Air-Handling Units

K. Section 23 74 13 – Packaged Outdoor Central-Station Air-Handling Units

1.03 REFERENCE STANDARDS

A. Construct all fans, except vaneaxial adjustable blade, to comply with the requirements of the latest editions of the Air Moving and Conditioning Association (AMCA) Standards and Bulletins. Certify these fans by AMCA for performance and sound ratings and provide the AMCA Performance and Construction Seal for Air and Sound.

B. AMCA – Air Movement and Control Association

1. AMCA 99 Standards Handbook
2. AMCA 203 Field Performance Measurement of Fan Systems
3. AMCA 204 Balance Qualities and Vibration Levels for Fans
4. AMCA 210 Laboratory Methods of Testing Fans for Certified Aerodynamic Performance ratings
5. AMCA 300 Reverberant Room Method for Sound Testing of Fans

C. ABMA – American Bearings Manufacturers Association

1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings
2. ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings

D. NFPA – National Fire Protection Association

1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilation Systems
2. NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

E. UL – Underwriters Laboratories Inc.

1. UL 705 Powered Ventilators
2. UL 762 Powered Roof Ventilators for Restaurant Exhaust Appliances

F. OSHA

1. OSHA guideline 1910.212 – General Requirements for Machine Guarding
2. OSHA guideline 1910.219 – General Requirements for Guarding Safe Use of Mechanical Power Transmission Apparatus

1.04 QUALITY ASSURANCE

A. For each fan, provide a multi-speed fan performance curve with multiple horsepowers on a single sheet. Single-speed fan curves are not acceptable.

B. Provide a full two-year parts and labor warrantee for all fan-mounted control air compressors.

C. All components of exhaust fans used in grease hood exhaust systems shall comply with NFPA 96 and be listed under UL 705 – Standard for Power Ventilators (UL motor, wiring components, UL approved guarding), and UL 762 – Power Ventilators for Restaurant Exhaust.

D. The maximum allowable fan vibration shall be 0.15 inches per second peak velocity, filter-in as measured at the fan RPM.

1.05 SUBMITTALS

A. Submit construction details, gauges of fan wheels and housing components and certified dimensioned drawings.

B. Submit manufacturer's latest published data for weights, materials, accessories and installation details.

C. Submit full technical rating data based on tests in accordance with current AMCA standards and in an AMCA-approved laboratory. Fan curves shall indicate the relationship of airflow to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation shall also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.

1. Include manufacturer's certified fan volume-pressure performance curves, from shut-off to free delivery. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.
2. Include certified sound power ratings based on tests performed in accordance with AMCA 300. Correct all ratings and curves for altitude and temperature where applicable.

D. Motor construction and efficiencies.

E. Bearing life calculations based on maximum design speed for the class of each fan scheduled on the Drawing(s).

F. Fan shaft critical speed at scheduled performance.

G. For variable air volume application, include data that indicates the effect of capacity control devices, such as inlet vanes, on performance.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Centrifugal Fans: Twin City, Chicago, Loren Cook, Greenheck

B. Propeller Fans: Twin City, Bayley, Woods, Loren Cook, Greenheck

C. Axial Fans Fixed Blade: Twin City, Chicago, Loren Cook, Greenheck

D. Axial Fans Adjustable Blade: Twin City, Woods, Joy, Loren Cook

E. Roof Exhaust Fans: Penn, Loren Cook, Greenheck

F. Mixed Flow Fans: Woods, Loren Cook, Greenheck

G. Swing-out Centrifugal Fans: Twin City, Chicago, Loren Cook

H. Clamshell Axial Fans: Twin City, Chicago, Loren Cook

I. Cabinet Fans: Penn, Panasonic

2.02 GENERAL – ALL FANS

A. Unless noted otherwise, provide discharge direction and drive arrangement to suit space conditions and conform as closely as possible to the layouts shown on the Drawings. Maintain clearance for service and access to all components.

B. Provide factory-fabricated, -assembled, -tested, and -finished fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure. Fans shall be quiet operating and non-overloading over the entire range of operation.

C. Provide fan motors in accordance with Section 23 05 13 – Common Motor Requirements for HVAC Equipment. Size motor to drive its respective fan when the fan is operating at a speed 5 percent in excess of that required to meet the scheduled fan performance. Do not select motors within the service factor for this range.

D. Statically and dynamically balance fan wheels/impellers at the factory and certify balance. Design all vertically mounted fans to withstand the vertical thrust loads.

E. Provide precision self-aligning bearings designed to prevent leakage of oil or grease. Provide cups, oil chambers, Zerk or Alemite lubrication fittings in accessible locations for ease of lubrication. Provide heavy-duty split pillow block bearings with tapered, double-row spherical roller assemblies. Provide bearings with ABMA L_{10} service life in excess of 200,000 hours at maximum published fan operating conditions for the AMCA construction class required unless noted or specified otherwise. Bearings shall be fixed to the fan shaft using concentric mounting locking collars, to reduce vibration, increase service life and improve serviceability. Bearings that use set screws shall not be allowed.

F. Provide copper or steel lubrication leads, for lubrication of internal motors and bearings, extending to a capped termination point external to the fan casing or air-handling unit.

G. Extend wire leads on fans driven by direct motor drive from the motor junction box in air-tight rigid walled conduit, to a junction box mounted external to the fan casing.

H. On fans driven by belt drive, provide standard “V-groove” type oil-resistant, non-sparking, and non-static belts with cast iron or steel sheaves suitable for the service intended. Fan sheaves shall be non-adjustable type with removable machined bushings. Provide adjustable pitch type motor sheaves with double locking feature, to 10 percent above and below the rated fan speed. Dynamically balance sheaves with over three grooves. Belt drive shall be sized with a 1.5 service factor; provide sufficient quantity of belts and sheaves capable of carrying the entire load with one belt broken.

I. Provide pre-formed expanded metal and sheet metal belt guards at the fan and motor shafts, for all exposed sheaves and belts. Guard shall comply with OSHA and SMACNA requirements; 0.1046-inch thick, ¾-inch diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short-circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

J. For motors in the airstream, provide TEFC type motors, unless other types are required, and as specified in Section 23 05 13 – Common Motor Requirements for HVAC Equipment.

K. Provide solid hot-rolled steel drive shafts, machined and polished to a close tolerance where in contact with bearings. Secure fan wheels/impellers to the drive shaft by a key and keyway assembly. Shafts shall be sized for first critical speed and at least 1.43 times maximum speed for AMCA fan class. Shaft length shall allow wheel adjustment of 4 inches.

L. Manufacture fans of materials and paint finishes suitable for the service intended.

M. Construct wheels/impellers exposed to normal atmospheres of cast aluminum or hot-dip galvanized steel and finished with two layers of factory-applied non-scaling paint.

N. Construct fans exposed to corrosive atmospheres using all-welded construction of corrosion-resistant materials suitable for intended use, and factory-finished with epoxy or other approved corrosion-resistant coatings.

O. Provide fans exposed to elevated temperatures with components rated for high temperature service. Do not use belt drive assembles exposed to the airstream. Use direct drive motors certified for high temperature service.

P. Use AMCA Type A spark-resistant construction for all fans handling flammable or grease-laden vapors, and use explosion-proof motors.

Q. Electrically ground all fans and drives to prevent accumulation of static charge. Indicate grounding method in fan submittals.

R. Provided threaded drain plugs at fan housing low points.

S. Completely house fan assemblies exposed to weather in weather-proof enclosures including motor and drive.

T. Fan wheels/impellers and housings shall be relieved of residual stresses produced in the forming process.

U. Provide fans used to exhaust grease-laden vapors with motor drive and bearings completely external of airstream, and fan housings continuously welded inside and outside.

V. Provide housings with integral inlet and discharge flanges, complete with bolt holes for flexible or hard duct connections. Shop-fabricate any companion flanges required for connections to sound attenuators. Companion flanges shall be rolled angles matched to both fan housing and sound attenuators.

W. Provide parallel vane pre-rotation vortex vanes at the fan inlet for variable volume control. Vanes shall be steel blades supported at both ends with two permanently lubricated bearings. Variable mechanism shall terminate in single control lever with control shaft for double-width fans. Furnish and install all necessary linkages and accessories required for automatic control.

X. Provide variable frequency drives as specified in Section 23 05 14 – Variable Frequency Drives for HVAC.

Y. Provide gasketed access doors to permit routine maintenance and inspection of motor and internal components. Inside surface of access door shall be flush with the inside surface of the fan housing.

Z. HVAC motors for fans that are less than 1 hp and 1/12 hp or greater are ECM or have a minimum motor efficiency of 70%. Motors also have means to adjust motor speed for balancing or remote control.

2.03 CENTRIFUGAL FANS

A. Scroll Type:

1. Provide backward inclined (BI), backward curved (BC), airfoil (AF), forward curved (FC) fan wheels, and single width single inlet (SWSI), or double width double inlet (DWDI), as specified or indicated on the Drawings, enclosed in a scroll-shaped fan housing with shaped cut-off and doors or panels to allow access to internal parts and components.
2. Weld or securely rivet fan blades to the hub plate and rim.
3. Fan housings:

    a. Heavy-gauge construction, continuously welded inside and outside.
    b. Housings shall be suitably braced to prevent vibration or pulsation and have spun, aerodynamically designed spun inlet cones or inlet venturis for smooth air entry into the wheels.
    c. Fabrication Class: AMCA 99, Class **[I] [II] [III] [IV]**, or as shown on the Drawings.
    d. Rotatable through eight discharge orientations.

4. All fan wheels shall have tapered spun wheel cones or shrouds providing stable flow and high rigidity. Housing with lock seam construction or partial weld shall not be acceptable unless for smaller fan sizes (12-inch wheel diameters or less) where it is standard construction for models listed on the Drawings.

B. Tubular Type:

1. Construct housing of welded rolled plate steel with reinforcing to prevent distortion. Provide each housing with a bolted and gasketed access door for inspection of drive and fan wheel.
2. Provide brackets suitable for horizontal or vertical mounting. Externally mount motors on an adjustable base.
3. Furnish with streamlined inlet cones and straightening vanes downstream of the fan wheel to minimize noise, reduce turbulence and to impart unidirectional airflow.

4. Match the wheel inlet ring to a close tolerance with integral deep-spun aerodynamic venturi inlets.
5. Use non-overloading airfoil blades welded to the wheel cones.
6. Continuously weld fan blades to the hub plate and rim. Backward inclined blades may be securely riveted to the hub plate and rim. Fan wheels shall be precision aluminum castings with machine finish.
7. Bearings shall be grease-lubricated, self-aligning ball bearing type with grease seal and external grease fitting. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.
8. Isolate belt drives from airstream with a belt tube.

C. Cabinet Type:

1. Provide scroll type centrifugal fans, factory-installed within a cabinet enclosure, and comply with the requirements of Scroll Type Centrifugal Fans.
2. Internally isolate fan and motor assemblies from the cabinet.
3. Provide gasketed access doors and panels for inspection and routine maintenance of the internal components.
4. Provide solid state variable speed controllers for small ceiling-mounted direct driven exhaust and transfer fans.

2.04 ROOF EXHAUST FANS

A. Provide roof exhaust fans of the centrifugal, belt-driven type. Construct fan housing of heavy-gauge aluminum.

B. Construct all spun parts with a rolled bead for added rigidity and spun so as to seal the pores of the aluminum providing greater resistance against oxidation and deterioration.

C. Provide all-aluminum fan wheel of the centrifugal blower type with backward inclined blades and a tapered inlet shroud. Statically and dynamically balance wheels.

D. Provide inlet cone of aluminum centrifugal blower type.

E. Enclose motor and drives in a weather-tight compartment separate from airstream and extend motor leads in metal conduit down through support base to facilitate wiring from below roof. Air-cool the motor using air uncontaminated by exhaust fumes.

F. Provide motors of the heavy duty, permanently lubricated, sealed ball bearing type. Size drives for 150 percent of motor horsepower capabilities and of the cast iron type, keyed to the fan and motor shafts. Provide variable pitch drives, with a minimum of 2 belts.

G. Construct fan shaft of steel construction, turned, ground and polished to precise tolerances in relationship to the hub and bearings.

H. Provide drive belts of the oil-resistant, non-static, non-sparking type with an ABMA L_{10} life expectancy of minimum 24,000 hours.

I. Provide flanged, permanently lubricated and sealed ball or roller type bearings.

J. The entire drive and wheel assembly shall be removable as a complete unit from the support structure without disassembling the external fan housing. The assembly shall be hinged on one side with full-length weather-proof piano hinges. Mount the complete drive assembly on rubber vibration isolation.

K. Provide direct drive fans of identical construction as belt drive fans, except for drives, belts, and fan shaft bearings.

L. Construct all belt-drive fan interior and exterior parts, including wheel, wheel hub, supporting posts, fan shaft, drive assembly, and all outside fasteners, of aluminum or non-ferrous material. Include a five-year warranty.

M. Provide a sound-attenuating roof curb .

N. Up-blast fans shall have motor, bearings, and drives completely enclosed and isolated from the exhaust airstream with ventilation provided by outside air. Fans handling grease-laden vapors shall be UL Listed for conveying such vapors, operating continuously at 300 degrees F.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install fans in accordance with manufacturer's recommendations and as shown on the Drawings. Follow SMACNA- and AMCA-recommended procedures for fan installations, belt guards, duct connections, etc.

B. Provide flexible connections as described in Section 23 31 00 – HVAC Ducts and Casings with sufficient separation of ductwork, plenum panels, or air-handling unit casings from fan assembly to prevent metal-to-metal contact due to start-up torque or operating under specified isolator deflections.

C. Install fans and motors with proper support and vibration isolation as specified in Sections 23 05 48 – Vibration and Seismic Controls for HVAC, and 23 05 29 – Hangers and Supports for HVAC.

D. Provide sufficient clearances around fans for access and servicing of components. Install fans such that tachometer openings, access doors, motors, belts, lubrication lines, electrical connections, etc., are readily accessible and not obstructed by other installations or structures.

3.02 START UP

A. Verify thermal-overload protection is installed in motors, starters, and disconnect switches. Verify proper motor rotation direction, fan wheel free rotation and smooth bearing operation. Align and adjust belts, install belt guards and verify lubrication for bearings and other moving parts. Verify that manual and automatic volume control and fire/smoke dampers in connected ductwork systems are fully open.

B. Bump start fans to check that fan wheel/impeller has maintained static and dynamic balance and the rotation corresponds to the desired direction for airflow.

Correct fans found to be rotating in a direction opposite to that desired. Unbalanced wheels shall be re-balanced by an AABC-certified test and balance contractor.

C. Tighten belt drives, taking into account the service factor and any other design of the drive. Exercise care not to over-tension belts.

D. Check all bolts and fasteners to ensure proper tightness. Do not over-tighten nuts and bolts.

E. Check bearings and motor for proper lubrication, taking care not to over-lubricate. Use only lubricants recommended by the manufacturer.

3.03 FAN ACCESSORIES

A. Provide the following accessories:

1. Inlet cone, inlet bell, inlet box, inlet screen, inlet vortex breaker
2. Outlet cone, outlet screen
3. Support legs, hanger brackets welded to housing
4. OSHA-approved belt guard
5. Weather-proof motor and drive cover
6. Shaft seal

7. AMCA 99 Type **[A] [B] [C]** spark-resistant construction
8. Threaded drain connection
9. Backdraft damper
10. Automatic spring-loaded belt tensioner on roof-mounted ventilators

B. Provide a drain at the bottom of the housing for fans discharging upward from the roof. Pipe drains from housings of interior fans discharging directly up through the roof indirectly to a floor drain. Pipe drains from housings of kitchen grease exhaust fans to a grease interceptor.

C. Provide 22-gauge wire mesh reinforced galvanized steel inlet and discharge guard screens for all fans or sound attenuators connected to fans without inlet or discharge ductwork.

D. Shaft Cooler: For all smoke exhaust fans, provide metal disk between bearings and fan wheel, designed to dissipate heat from shaft.

E. Provide shaft seal to reduce leakage and protect the bearings from contaminated airstream. Seal shall be constructed of non-asbestos woven fibrous materials (ceramic felt) compressed between an aluminum cover plate and the fan housing.

F. Coatings: **[Thermoplastic vinyl] [Epoxy] [Zinc] [Synthetic resin] [Phenolic] [Color-match enamel] [Polytetrafluoroethylene] [Vinyl ester] [Hot-dip galvanized] [Powder-baked enamel]**; **[Insert manufacturer and trade name]**.

1. Vinyl Coatings Groups II and VI: All vinyls shall be thermoplastic material and resistant to most organic and inorganic acids with medium concentrations and low temperature. Group II – Rustoleum 9000 Series; Group VI – Bisonite M, or equal.

2. Epoxy Coatings Groups III-E, VII-S, VII-P and IX: Longer service life than conventional paint against mild acid of caustic solvent. Their resistant characteristics are similar to phenolic. Group III-E – Rustoleum 9100; Group VII-S – Plasite 7122; Group VII-P – Plasite 7133; Group IX – Coal Tar Epoxy; Bitumastic 300-M or Sherwin Williams Sher-Tar Epoxy or equal.
3. Zinc Coating Group III-Z: Cold zinc coating applied as a spray shall provide better corrosion resistance than hot-dip galvanizing and high impact resistance. Zincilate Synthetic Resin Coating (Eisenheiss now called Sanitile) or equal.
4. Group III-S: Low in cost and adequate in resistance to severe acidic and alkaline conditions makes this coating popular for evaporative cooling and other air conditioning equipment. Sanitile or equal.
5. Phenolic Coatings Groups IV and VIII: Good resistance to high concentrations of organic or inorganic acids with the exception of strong oxidizing agents, i.e., nitric and chromic. Resistant to only low-concentrated alkalis, but excellent solvent resistance. Not recommended for hydrofluoric acid or hypochlorite salts. Air-dried phenolic will have shorter life than baked phenolic. Heresite baked phenolic is most effective while handling dust and explosive gases. Group IV – Heresite VR500; Group VIII – Heresite P-403, P-4403 or equal.

END OF SECTION

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Variable air volume (VAV) terminal units
2. Factory-mounted and calibrating control modules, actuators

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 53 – Identification for HVAC

D. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

E. Section 23 07 00 – HVAC Insulation

F. Section 23 09 23 – Direct Digital Control System for HVAC

G. Section 23 09 93 – Sequence of Operations for HVAC Controls

H. Section 23 33 19 – Acoustics

I. Section 23 82 16 – Air Coils

J. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

A. ASHRAE 130 - Methods of Testing for Rating Ducted Air Terminal Units

B. AHRI 880 – Performance Rating of Air Terminals

C. UL 1995 - Standards for Heating and Cooling Equipment

D. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors

E. NFPA 90A – Standard for Installation of Air Conditioning and Ventilation Systems

F. NFPA 70 – National Electrical Code

1.04 QUALITY ASSURANCE

A. Electric coils shall be given a 2,000-volt dielectric test.

B. Each size of each device to be used on the project shall be laboratory-tested for air performance and acoustics. The acceptability of the laboratory and testing facilities is subject to review by the Owner.

C. Pneumatic tubing shall be UL Listed, fire retardant (FR) plenum-rated type.

D. Sound ratings for all units shall not exceed values specified in Section 23 33 19 – Acoustics at 1-inch water gauge static pressure.

E. Terminal units shall be listed as a composite assembly per UL 1995.

1.05 SUBMITTALS

A. Submit manufacturer's leakage rating, certified airflow performance test data, sound performance test data and certified dimensioned drawings.

B. Submit materials of construction, assembly details and mounting details.

C. Submit actuators and linkages with control requirements specified.

D. Submit electric motor details including motor speed, voltage, efficiency and type.

E. Submit control diagrams including line voltage, low voltage and control air.

F. Certify compatibility between multi-point sensor, actuator and controls.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Variable Volume and Fan Powered Terminal Units: Titus, Price, Nailor Industries

2.02 VARIABLE-AIR-VOLUME TERMINAL UNITS – PRESSURE-INDEPENDENT ELECTRONIC CONTROL

A. Provide single duct, variable-volume terminal units of the sizes and capacities shown on the plans. Terminals shall be certified under the ARI Standard 880 Certification Program and carry the ARI Seal.

B. Provide pressure-independent electronic control capable of reset for airflow between zero and maximum airflow. Airflow limiters shall not be accepted.

C. At an inlet velocity of 2,000 feet per minute, the minimum static pressure required to operate any size of terminal unit shall not exceed 0.13 inches water gauge for the basic unit, or 0.25 inches water gauge with heating coil.

D. The airflow sensor shall be a differential pressure airflow device measuring total and static pressures and mounted to the inlet valve. Plastic parts shall be fire-resistant, complying with UL 94. Control tubing shall be protected by grommets at the wall of the airflow sensor's housing. The airflow sensor shall be furnished with total pressure sensing ports and static pressure sensing ports and shall include a center averaging chamber that amplifies the sensed airflow signal by an amplification factor greater than or equal to 2. After balancing, the airflow

sensor signal accuracy shall be plus or minus five percent throughout terminal operating range.

E. Shaft-mount the 24-volt reversible actuator without linkage and construct as an integral part of the electronic controller. The controller/actuator shall operate the terminal unit through the full airflow (cfm) range. The actuator shall apply a minimum of 35 inch-pounds of torque to the damper shaft. The damper shall stroke in a smooth and consistent progression, without dead spots.

F. The Control Contractor shall provide a DDC microprocessor-based controller with a minimum differential pressure control range of 0.004 to 1.5-inches water gauge to be installed by the terminal-unit manufacturer. The Controls Contractor shall set the maximum and minimum airflows in the field.

G. Construct the unit casing of 22-gauge galvanized steel, internally insulated. Insulation shall be a fiber-free product such as closed cell foam that complies with UL 181 and NFPA 90A for smoke and flame spread, mechanically fastened to the casing. Insulation shall be ½-inch thick, R-value of 2.0 and 1½ pound density. All cut edges of insulation shall be sealed from the airstream by use of sheetmetal nosings. Exposed fiberglass shall not be accepted. Seal casing to limit the maximum air leakage to 2 percent of the maximum rated airflow at 3-inch water gauge pressure differential. The discharge connection shall be slip and drive construction for attachment to metal ductwork.

H. Construct damper of 18-gauge metal, with solid metal shaft rotating in self-lubricating bearings. Nylon bearings are not acceptable. Engrave end of shaft to indicate the damper blade position. Provide a built-in stop to prevent overstroking. Damper shall seal against a synthetic material gasket, to limit close-off leakage to a maximum of 2 percent of the unit maximum rated airflow at 3-inch water gauge inlet static pressure, tested in accordance with ASHRAE 130.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Maintain service clearance for terminal unit controls and line voltage electrical components.

B. Stencil all terminal units with nametags on the bottom casing panel to match tags shown on the Drawings. Lettering/numbering shall be 3 inches high using red primer paint.

C. Terminal-unit manufacturer shall provide flow curves for the primary air sensors clearly labeled and permanently attached on the bottom or side of each terminal unit.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Air outlets
2. Air inlets
3. Accessories for air inlets and air outlets
4. Specialty air distribution devices
5. Refer to Architectural Drawings and Specifications for floor, wall and ceiling construction.

1.02 REFERENCE STANDARDS

A. ANSI – American National Standards Institute

1. ANSI S1.13 – Measurement of Sound Pressure Levels in Air

B. AHRI (ARI) – Air Conditioning and Refrigeration Institute Standards:

1. AHRI 885 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
2. AHRI 880 – Air Terminals

C. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers

1. ASHRAE 70 – Method of Testing the Performance of Air Outlets and Air Inlets
2. ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy
3. ASHRAE 113 – Method of Testing for Room Air Distribution

D. ASTM – American Society for Testing and Materials

1. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus
2. ASTM D870 – Standard Practice for Testing Water Resistance of Coatings Using Water Immersions
3. ASTM D2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
4. ASTM D3776 – Standard Test Methods for Mass per Unit Area (weight) of Fabric

E. NFPA – National Fire Protection Association

1. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilation Systems

1.03 QUALITY ASSURANCE

A. Air outlets and inlets shall be tested in accordance with:

1. AHRI 880 – Air Terminals
2. AHRI 885 – Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
3. ASHRAE 70 – Method of Testing the Performance of Air Outlets and Air Inlets
4. ASHRAE 55 – Thermal Environmental Conditions for Human Occupancy
5. ASHRAE 113 – Method of Testing for Room Air Distribution

B. All air inlets and outlets shall be factory-painted or -anodized. Paint or anodized finish shall pass a 100-hour ASTM B117 test. The finish shall pass a 250-hour ASTM D870 test and an ASTM D2794 impact test. Finish (pencil) hardness shall be minimum HB to H.

C. For all components provided with fiberglass acoustic lining, refer to Section 23 07 00: HVAC Insulation

1.04 SUBMITTALS

A. Submit manufacturer's performance data including air throw and drop, outlet velocities, total and velocity pressures and acoustic performance.

B. Submit manufacturer's specifications of construction including materials, installation instruction and adjustment data. Include "K" factors for balancing, if available.

C. Submit product accessories.

D. Submit samples, color and finish selections, schedule of sizes and model number for review by the Architect prior to fabrication.

E. Schedule of air outlets and air inlets indicating drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Drawings and schedules indicate specific requirements of air inlets and air outlets and are based on the specific requirements of the systems indicated. Other manufacturers' products with equal quality, appearance, finish and performance characteristics may be considered. Refer to Section 23 05 01 – HVAC General Provisions for alternates or substitutions.

B. Air Inlets and Outlets: Titus, Anemostat, Price, Krueger, Air Factors, Air Concepts, Trox, Halton, Acutherm, DuctSox, Seiho.

C. Accessories: Dampers, equalizing grids, turning vanes, extractors, plenums, hardware and frames shall be provided by the same manufacturers as the air inlets and air outlets provided.

2.02 GENERAL

A. Air distribution outlets as shown on the Drawings shall accommodate the air volume and throw indicated to maintain a maximum terminal velocity of 50 feet per minute in the occupied area. The overall noise level produced by all of the supply air outlets and exhaust or return air inlets in various rooms shall not exceed specified limits.

B. Refer to Architectural Drawings and Specifications for reflected ceiling plans, elevations, wall and ceiling types and construction. Air outlets and inlets in fire-rated ceilings or walls shall be all-steel construction. Coordinate frame and border types to accommodate the wall or ceiling specified or shown on the Architectural Drawings.

C. All dampers provided shall be operable from the face of the Air Inlet or Air Outlet.

2.03 AIR OUTLETS – SUPPLY CEILING DIFFUSERS (CD)

A. Square Ceiling Diffuser, Plaque Face:

1. Provide plaque face supply diffusers, all-steel construction with AG-75 steel opposed blade volume control damper.
2. The diffuser shall have a 22-gauge steel face panel that captures a secondary 22-gauge panel. The face panel is removable by means of four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners.
3. The face panel shall project ¼ inch below the outside border of the diffuser backpan. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. The diffuser neck shall have a minimum of 1¼-inch depth available for duct connection.
4. Sizes indicated on the Drawings are neck sizes.
5. Baked white enamel finish.
6. Type CD-A: 24-inch by 24-inch face size. Titus Model OMNI, Price SPD or approved equal.

2.04 INLET TYPES

A. Ceiling Perforated Return Register:

1. Provide all-steel construction with Titus model AG-75 steel opposed blade damper.
2. Flush perforated face shall be an exact match in construction, mounting type and appearance to the perforated face air outlets as specified.
3. Perforated face shall be easily unlatchable from the back pan.
4. Face area as shown on the Drawings.
5. Baked white enamel finish.
6. Type RG-A: 24-inch by 24-inch face size. Titus Model 350FL or approved equal.

B. Louvered Exhaust Grille:

1. Exhaust grille shall be used for ceiling exhaust. All-aluminum construction with one set of horizontal fixed blades, set at 45-degree fixed deflection, ¾-inch spacing.
2. Baked enamel finish.
3. Type EG-A: 24-inch by 24-inch face size. Titus Model 350RL or approved equal.
4. Type EG-B: 12-inch by 12-inch face size. Titus Model 350RL or approved equal.

C. Wall Mounted Exhaust Grille:

1. Exhaust grille shall be used for ceiling exhaust. All-aluminum construction with one set of horizontal fixed blades, set at 45-degree fixed deflection, ¾-inch spacing.
2. Baked enamel finish.
3. Type EG-C: 24-inch by 24-inch face size. Titus Model 350RL or approved equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Drawings indicate general arrangement of ducts, fittings, and accessories to achieve air volume, noise criteria, airflow pattern, throw, and pressure drop. Locations indicated on the Architectural drawings shall take precedence. For lay-in ceiling panels, locate in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

3.02 INSTALLATION

A. Install air outlet and air inlet with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

B. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

C. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions.

D. All visible interior surfaces of air inlets shall be factory-painted flat black.

E. All visible exterior surfaces of air inlets or outlets shall be factory-painted in a color as selected by the Architect.

END OF SECTION

SECTION 23 51 00
BREECHINGS, CHIMNEY, STACKS AND EMERGENCY GENERATOR EXHAUST

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. This section includes the following:

1. Pressure-Capable Double-Wall Stacks & Breeching
2. Type B Gas Vent

1.02 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Self-supporting high temperature chimney, and breechings, including all fittings, structural supports, fastenings, bracing, sealant, shop and field painting, clean-outdoors, ventilated wall, floor or roof thimbles, flashing, rain hood, guy wires, seismic restraints and any related items.
2. Double wall Type B gas vent pipe and fittings including supports, fastenings, bracing, draft hood connector, sealant, rain cap, ventilated wall, floor or roof thimbles, flashing, guy wires, seismic restraints and any related items.
3. Self-supporting steel gas vent, including all fittings, structural supports, fastenings, bracing, sealant, shop and field painting, roof terminations, flashing, wall terminations, guy wires, seismic restraints and any related items.
4. Calculations for vent sizing, seismic and thermal expansion design and associated details.

1.03 RELATED DOCUMENTS

A. Section 21 13 19 – Fire Protection Systems]

B. Section 22 33 00 – Domestic Water Heating Systems

C. Section 23 05 01 – HVAC General Provisions

D. Section 23 05 48 – Vibration Isolation and Seismic Restraints

E. Section 23 52 16 – Condensing Boilers]

1.04 REFERENCE STANDARDS

A. NFPA – National Fire Protection Association

1. NFPA 31 Standard for the Installation of Oil-Burning Equipment
2. NFPA 37 Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
3. NFPA 54 National Fuel Gas Code
4. NFPA 211 Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

1.05 QUALITY ASSURANCE

A. Units shall be UL Listed for use with heating equipment burning gaseous, solid or liquid fuels that do not exceed continuous operating flue gas temperature above 1,000 degrees F and not exceeding 1,400 degrees F under intermittent conditions as defined in NFPA 211.

B. Units shall be UL Listed for use with heating equipment burning gaseous fuels that do not exceed the requirements for Type B vent as defined in NFPA 211.

C. Units shall be UL Listed for use with heating equipment burning gaseous fuels that do not exceed continuous operating flue gas temperature above 550 degrees F as defined in NFPA 211.

D. The venting system shall develop a positive flow adequate to exhaust flue gases to the atmosphere without condensation within the vent or flue gas spillage. The design shall compensate for thermal expansion.

1.06 SUBMITTALS

A. Provide manufacturer chimney and vent draft calculations. Certify that the calculations are based on actual jobsite conditions and are coordinated with "released-for-construction" equipment submittal data, and that the complete stack and breeching systems stack draft range at equipment outlets are within the equipment manufacturer's recommended range.

B. Provide backpressure, draft and stack diameter calculations for all possible boiler firing combinations.

C. Submit certification that chimney and vent will withstand maximum system pressure developed by the burner blowers, combustion and the venting system.

D. Submit certified dimensioned shop drawings, construction details, mounting details, hardware and accessories.

E. Submit thermal expansion compensation calculations and compensator details.

PART 2 – PRODUCTS

2.01 PRESSURE-CAPABLE DOUBLE-WALL STACKS & BREECHING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Enervex, Inc.
2. Jeremias Inc.
3. Selkirk Inc.
4. Security Chimneys

B. General: The manufacturer shall provide factory-built modular chimney system tested and listed by Underwriters Laboratories Inc. (UL) for use with five (5) different UL standards ranging from building heating appliances chimneys (pressure stacks) to low temperature oil-fired appliances. UL Listings shall include:

1. UL 2561 Standard, 1400˚F Chimney.

    a. 1400˚F continuous and 1800˚F intermittent.
    b. Gaseous, solid, or liquid fuels as described in NFPA 211.

2. UL 103 Standard, Building Heating Appliance Chimney.

    a. 1000˚F continuous and 1400˚F intermittent.
    b. Gaseous, solid, or liquid fuels as described in NFPA 211.

3. UL 103 Additional Positive Pressure Test (60”W.C.)

C. Construction

1. The chimney system shall be constructed of stainless steel. The materials and construction of modular sections and accessories shall be as specified by the terms of the product’s UL listing.
2. The inner wall material shall be Type 316L-PCM, Type 444 stainless steel or equivalent.
3. The outer jacket material shall be stainless steel.
4. The insulation between the inner wall and outer jacket shall be a minimum of two-inch (2”) thick ceramic fiber insulation.
5. The entire system, including all accessories (connectors, hardware, anchor plate supports, guides, drains, and terminals), shall be stainless steel.
6. Inner wall shall have an overlapping male/female socket that protects the rolled flange with sealant against condensate and high-pressure cleaning. The joints shall be secured with overlapping band on the inner and overlapping locking band on the outer jacket.
7. System shall be designed to compensate for all temperature induced thermal expansion, installed to be gastight, and thus prevent leakage of combustion products into a building.
8. Detailed manufacturer’s submittal drawings shall be provided for approval prior to installation of the chimney system.
9. All tees shall 45-degree (lateral) tees; boot tees and 90-degree tees are not acceptable. In the event that physical constraints do not permit, connection to stack shall be made utilizing 90° manifold tee section.
10. Provide automatic isolation damper in each appliance’s connector. Acceptable isolation dampers include US Draft Co. Model SB (up to 14”ID) or US Draft Co. Model OBD (16”ID or larger).

D. Execution

1. Installation

    a. When installed according to the manufacturer’s installation instructions, the chimney system and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions of the system.
    b. The chimney system shall be installed according to the manufacturer’s instructions and shall conform to all applicable state and local codes.

c. Provide all modular straight sections, fittings, supports, guides, expansion joints, drain lengths, drains, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars and code-compliant terminations as required to provide a complete system per the manufacturer's instructions.
d. The entire chimney system from the appliance outlet to the termination point, including all accessories, except as noted, shall be from one manufacturer.
e. The vertical termination shall be no less than three feet above any portion of the building within ten feet of the stack penetration. Follow all pertinent national, state, and/or local codes where applicable.
f. Roof penetrations shall be suitable for the specified roof construction and shall comply with the manufacturer's instructions.

2. Technical Services:

a. Provide a factory trained representative for on-site training of HVAC Contractor personnel on the recommended installation procedures for the system. Duration of training section shall be determined by Manufacturer and HVAC Contractor. Factory trained representative shall provide periodic site visits to inspect exhaust system throughout the installation period. An inspection report shall be submitted to the Architect/Owner/Engineer for each visit. Defects discovered during the site visit shall be reported to the HVAC Contractor/Owner/Architect along with recommendations to correct defects.
b. At the conclusion of the installation and prior to heating appliance start-up, Manufacturer's Representative shall provide a final inspection report and a signed letter certifying proper installation and condition of the system to the HVAC Contractor/Owner/Architect.

E. Warranty

1. The chimney system shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of 15 years from date of installation.
2. The inner diameter of the chimney system shall be verified by the manufacturer's venting computations. The computations submitted shall follow ASHRAE calculation methods and shall incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact operating characteristics of all appliances to the factory representative.
3. The manufacturer shall provide "to scale" drawings depicting the actual layout. The chimney system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer's warranty.
4. The chimney system shall be furnished by a vendor organization that assures design, installation and services coordination. As well as, providing "in-warranty" and "post-warranty" unified responsibility for owner, architect, consulting engineer and contractor.

2.02 TYPE B GAS VENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hart & Cooley, Inc.
2. DuraVent
3. Metal-Fab, Inc.
4. Selkirk Inc.

B. General; Provide factory-built modular stack and breeching system that is tested and listed by the Underwriters' Laboratories, Inc. for use with building heating equipment and appliances.

1. Stack & breeching system shall be UL-441 and NFPA-211 for neutral/negative pressure tested and listed.
2. Stack & breeching system design for heating equipment and appliances which produce exhausted flue gases at a temperature not exceeding 480°F under continuous operating conditions for TYPE B vent and a temperature not exceeding 550°F under continuous operating conditions for TYPE BW vent.
3. Compliance with standard/specification shall be confirmed by a statement on the safety certification label attached to the product.
4. Manufacturer of the stack & breeching system shall also manufacture a complete line of stack & breeching components and accessories required for a complete and operational system.

C. Construction

1. Double wall air space insulated stack and breeching sections designed for neutral/ negative pressure applications with natural gas, LP gas & Propane

1. Gas vent joint design for assembly (inner and outer pipes)

a. Slip-in snap-lock for vents 3 to 8 inches
b. Slip-in with sheet metal screws for vents 10 inch and larger. Number of screws as per manufacturer's recommendation evenly spaced around perimeter but not less than 6 screws.

2. Inner Pipe; ASTM B 209 Type 1100 aluminum alloy. Inner pipe material thickness shall be as required for the diameter of the stack and breeching and the vertical stack height but in no case less than:

a. Manufacturer's standard material thickness sizes 3 thru 8 inches.
b. 0.016 inches vent sizes 10 thru 14 inches
c. 0.020 inches vent sizes 16 thru 24 inches
d. 0.025 inches vent sizes 26 inches and larger

3. Outer Pipe; G90 Galvanized steel with pipe groves joint connections. Outer pipe thickness shall be as required for the diameter of the stack and breeching and the vertical stack height but in no case less than:

a. Manufacturer's standard material thickness sizes 3 thru 8 inches.
b. 0.021 inches vent sizes 10" thru 16 inches
c. 0.027 inches vent sizes 18 inches and larger

4. Insulation; 1 inch air space for vent sizes 3 through 8 inches; ½ inch air space for sizes 10 inch and greater.
5. Horizontal breeching shall be provided with cleanouts as required by State and Local Codes having jurisdiction for the project.
6. Manufacturer shall provide lateral and vertical support systems and guides for full length of stack and breeching (horizontal and vertical). Support system installation shall be in accordance with manufacturer's recommendation.

D. Accessories components, each bearing factory applied UL label, for a fully operational stack and breeching system shall be manufactured by the stack and breeching manufacturer and shall include but not be limited to:

1. Expansion device and associated anchors and guides
2. Fittings for directional change
3. Rain Cap
4. Draft hood Adapter Kit
5. 90° Manifold Tee Section
6. Roof flashing assembly, storm collar and insulated thimble where required
7. Guy section and guy tensioner
8. Floor and wall Support and guide assemblies
9. Monitoring and Test Ports as required by State and Local authorities having jurisdiction.
10. Barometric Damper, as necessary

E. For multiple heating appliance installations, 45° lateral tee section shall be utilized to connect individual heating appliances to breechings.

F. Connection of breeching to vertical stack shall be made with a 90° manifold tee section.

G. Manufacturer shall review and approve stack and breeching size based on approved equipment and final system routing through building. If based on manufacturer's review stack and breeching size requires adjustment, installation shall be based on manufacturer's recommended size at no additional cost to Owner. Manufacturer shall obtain from heating appliance manufacturer through HVAC Contractor operating characteristics of the heating appliance for developing system configuration and parameters. Operating characteristics shall include flue gas flow rate, temperature, pressure capabilities, velocity and available external static pressure at heating appliance outlet, at maximum and minimum levels of burner turndown range. The inner diameter for stack & breeching shall be calculated by the manufacturer based on the operating characteristics of final approved heating appliance and the coordinated shop drawings of the final routing of the stack and breeching system. Manufacturer shall submit detailed breeching design diagrams to architect, and shall provide supervision of the installation to the HVAC Contractor. Calculations shall be submitted as part of the Shop drawings.

H. The Stack and Breeching System shall be warranted against functional failure due to defects in material and workmanship for a period of ten (10) years from date of activation of heating appliance. Functional failure is defined as any failure of the system or a component to perform its intended function without adverse leakage. During this period any defective system or component shall be repaired or replaced.

2.03 SPECIAL GAS VENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Enervex, Inc.
2. Heatfab
3. Jeremias Inc.
4. Metal-Fab Inc.
5. Security Chimneys

B. General: The manufacturer shall provide factory-built modular special gas vent system tested and listed by Underwriters Laboratories Inc. (UL) to UL 1738 Standard, Venting Systems for Gas-Burning Appliances, Categories II, III, and IV.

C. Construction

1. The special gas vent system shall be constructed of stainless steel. The materials and construction of modular sections and accessories shall be as specified by the terms of the product's UL listing.
2. The inner wall material shall be AL 29-4C, Type 316L-PCM, or Type 444 stainless steel. Other stainless steels are prohibited.
3. The outer jacket material shall be stainless steel.
4. The air space between the inner wall and outer jacket shall be a minimum of f two-inch (2") thick ceramic fiber insulation.
5. The entire system, including all accessories (connectors, hardware, anchor plate supports, guides, drains, and terminals), shall be stainless steel.
6. The complete special gas vent system, from appliance outlet to termination, shall be designed to eliminate on-site welding through the use of a slip fit, rigid connection with reinforcing ribs, built-in mechanical locking clips and a Viton® O-ring. For 26 to 36"ID, V-bands and Viton® sealant shall be accepted in lieu of built-in mechanical locking clips and Viton® O-ring. Silicone gaskets and silicone sealant at section joints are not acceptable due to adverse reactions with carbonic acid.
7. System shall be designed to compensate for all temperature induced thermal expansion, installed to be gastight, and thus prevent leakage of combustion products into a building.
8. Detailed manufacturer's submittal drawings shall be provided for approval prior to installation of the vent system.
9. All tees shall 45-degree (lateral) tees; boot tees and 90-degree tees are not acceptable. In the event that physical constraints do not permit, connection to stack shall be made utilizing 90° manifold tee section.
10. Provide automatic isolation damper in each appliance's connector. Acceptable isolation dampers include US Draft Co. Model SB (up to 14"ID) or US Draft Co. Model OBD (16"ID or larger).

D. Execution

1. Installation

a. When installed according to the manufacturer's installation instructions, the vent system and its supporting system shall resist side loads at least 1.5 times greater than the weight per foot of the piping for both horizontal and vertical portions of the system.
b. The vent system shall be installed according to the manufacturer's instructions and shall conform to all applicable state and local codes.
c. Provide all modular straight sections, fittings, supports, guides, expansion joints, drain lengths, drains, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars and code-compliant terminations as required to provide a complete system per the manufacturer's instructions.
d. The entire vent system from the appliance outlet to the termination point, including all accessories, except as noted, shall be from one manufacturer.
e. The vertical termination shall be no less than three feet above any portion of the building within ten feet of the stack penetration. Follow all pertinent national, state, and/or local codes where applicable.
f. Roof penetrations shall be suitable for the specified roof construction and shall comply with the manufacturer's instructions.

2. Technical Services:

a. Provide a factory trained representative for on-site training of HVAC Contractor personnel on the recommended installation procedures for the system. Duration of training section shall be determined by Manufacturer and HVAC Contractor. Factory trained representative shall provide periodic site visits to inspect exhaust system throughout the installation period. An inspection report shall be submitted to the Architect/Owner/Engineer for each visit. Defects discovered during the site visit shall be reported to the HVAC Contractor/Owner/Architect along with recommendations to correct defects.
b. At the conclusion of the installation and prior to heating appliance start-up, Manufacturer's Representative shall provide a final inspection report and a signed letter certifying proper installation and condition of the system to the HVAC Contractor/Owner/Architect.

E. Warranty

1. The vent system shall be warranted against functional failure due to defects in material and manufacturer's workmanship for a period of 15 years from date of installation.
2. The inner diameter of the vent system shall be verified by the manufacturer's venting computations. The computations submitted shall

follow ASHRAE calculation methods and shall incorporate the specific flow characteristics of the inner pipe. The contractor shall furnish the exact operating characteristics of all appliances to the factory representative.

3. The manufacturer shall provide “to scale” drawings depicting the actual layout. The chimney system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer’s warranty.
4. The vent system shall be furnished by a vendor organization that assures design, installation and services coordination. As well as, providing “in-warranty” and “post-warranty” unified responsibility for owner, architect, consulting engineer and contractor.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Comply with local codes, UL Listing, NFPA 211 and factory installation requirements. Coordinate chimney and vent requirements with boiler or appliance listing.

B. Support breeching from structure. Breeching shall not impose load on appliance or chimney.

C. Install breeching and chimney with positive slope back to the appliance. Provide easily accessible condensate drainage connection, configured to prevent condensation from entering the boiler.

D. All branch fittings shall be 45-degree long radius sweep elbow connections in the direction of flue gas flow. All 90-degree elbows shall be long radius.

E. Transitions to increase breeching diameter shall be with an increaser fitting angle of 10 degrees maximum. Increase common breeching manifolds at each branch, and locate the connection within the 10-degree fitting as a “wye” connection.

F. Coordinate exact dimensions and other requirements of floor, roof, wall and partition penetrations with all other subcontractors.

G. Roof penetrations shall be suitable for the roof construction shown and shall follow manufacturer’s installation instructions and local codes.

H. Maintain clearance to combustible or non-combustible construction in compliance with the vent listing.

I. For condensing gas vents, install vent with ¼-inch per foot slope back to the appliance from the vertical riser. If the vent is a horizontal vent to a wall termination, slope from the boiler or appliance down to the wall termination. Provide manufacturer’s condensate drainage connection, configured to prevent condensation from entering the boiler unless boiler is provided with internal condensate drainage as part of its construction and listing.

J. Whenever Excessive Pressure Relief Valves are required, install where indicated on the drawings and where human contact is avoided and away from flammable

or combustible materials. Provide a shroud specifically designed for the system as necessary or as identified on the drawings.

END OF SECTION

SECTION 23 52 16
CONDENSING BOILERS

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to the following:

1. Boilers
2. Controls and boiler trim
3. Hot water and drain connections
4. Fuel connections
5. Electrical connections
6. Breeching connection
7. Fuel vent connections and piping to outside
8. Factory-authorized boiler start-up and inspection
9. Condensate Neutralization Tank

1.02 RELATED DOCUMENTS

A. Section 22 21 01 – Hydronic Systems Specialties

B. Section 22 63 00 – Natural Gas Systems

C. Section 23 05 01 – HVAC General Provisions

D. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

E. Section 23 05 20 – Meters, Gauges and Thermometers for HVAC

F. Section 23 05 23 – General-Duty Valves for HVAC Piping

G. Section 23 05 29 – Hangers and Supports for HVAC

H. Section 23 05 48 – Vibration and Seismic Controls for HVAC

I. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

J. Section 23 09 23 – Direct Digital Control System for HVAC

K. Section 23 09 93 – Sequence of Operations for HVAC Controls

L. Section 23 21 13 – Hydronic Piping

M. Section 23 21 23 – Hydronic Pumps

N. Section 23 25 00 – HVAC Water Treatment

O. Section 23 31 00 – HVAC Ducts and Casings

P. Section 23 33 19 – Acoustics

Q. Section 23 51 00 – Breechings, Chimneys and Stacks

R. Division 26 – Electrical Specifications

1.03 REFERENCE STANDARDS

1. AGA – American Gas Association
2. ANSI – American National Standards Institute
3. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers
4. ASME – American Society of Mechanical Engineers
5. ASME CSD-1 – Controls and Safety Devices for Automatically Fired Boilers
6. NBS – National Bureau of Standards
7. NFPA – National Fire Protection Association
8. IBC – International Building Code
9. UL – Underwriters Laboratories Inc.
10. Local Codes
11. Local Air Quality Management District Regulations
12. Local utility company rules

1.04 QUALITY ASSURANCE

A. Provide factory-run tests and inspect to check construction, controls and operation of units.

B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

D. ASHRAE 90.1: Boiler to meet all requirements and efficiencies as required by the latest version of ASHRAE 90.1 utilized for the project, or the versions used for the project, whichever is most stringent.

E. Equipment performance scheduled on the Drawings is minimum capacity required.

F. Electrical capacity scheduled on the Drawings shall be considered as maximum available.

1.05 SUBMITTALS

A. Submit the following for review:

1. Manufacturer’s installation instructions.
2. Certified dimensioned shop drawings, materials of construction, thickness of tubes, shell, boilerplate and insulation, manufacturer’s descriptive literature, operating instructions, operating characteristics, furnished specialties, accessories, safety devices, controls, and maintenance and repair data.
3. Boiler factory inspection report and fire test report of all firing ranges.
4. Boiler start-up report to verify performance.
5. Warranty certificate.
6. Efficiency Data Points: Data shall be submitted per ASHRAE 155 Method of Testing for Rating Commercial Space Heating Boiler Systems.

This data shall cover steady state thermal efficiency, part load efficiency, and idling energy input rate. Efficiency data not supported by a third party published test standard shall not be permitted.

7. Warranty: Standard warranty specified in this Section.
8. Wiring Diagrams: Power, signal, and control wiring.
9. Performance:

    a. Fuel efficiency at 100 percent, 75 percent, 50 percent and 20 percent of rated capacity at incoming water temperatures from 80°F to 160 °F. Test protocols shall conform to manufacturer standards.
    b. Blower motor electrical efficiencies
    c. Blower fan curve(s)
    d. Minimum and maximum gas pressure at burner
    e. Maximum stack backpressure boiler can overcome
    f. Percent of oxygen at 100 percent, 75 percent, 50 percent, and 20 percent of rated capacity
    g. Percent NO_x at 100 percent, 75 percent, 50 percent, and 20 percent of rated capacity
    h. Pressure drop curve. Submit pressure drop curve for flows ranging from 0 GPM to full flow.

        (1) If submitted material is different from that of the design basis, boiler manufacturer shall incur all costs associated with reselection for necessary pumps. Possible differences incurred but are not limited to, the pump type, pump pad size, electrical characteristics and piping changes.

10. ASME Certification Stamp
11. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

1.06 WARRANTY

A. Ten (10) year non-prorated pressure vessel/heat exchanger warranty against leakage due to defective materials or workmanship.

B. Ten (10) year non-prorated warranty against failure due to thermal stress or condensate corrosion

C. Heat exchangers/pressure vessel are warranted against thermal shock for the lifetime of the boiler.

D. The burner shall carry a five (5) year limited warranty against defective material or workmanship from the date of shipment.

E. All other components shall carry a one year limited warranty from date of boiler start up.

F. Certification from contractor, boiler manufacturer and stack/breeching manufacturer that the boiler(s) will perform as specified under all possible operating conditions with the flue/stack configuration as installed.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Lochinvar Crest (Basis of design)

B. Aerco International, Inc. – Benchmark Series

C. Cleaver Brooks Clearfire CFC

2.02 GENERAL DESCRIPTION

A. Each unit shall be a condensing fire tube design type with a modulating forced draft power burner and positive pressure vent discharge complete with boiler fittings and automatic controls. The boiler assembly, with all piping and wiring, shall be completely factory-assembled as a self-contained unit. Each boiler shall be thoroughly tested and packaged for shipping. Boiler design and construction shall be in accordance with Section IV of the ASME Code for hot water heating boilers. Boiler venting shall be AGA approved as a direct vent boiler, comply with ASME CSD.

2.03 BOILER SIZE AND EFFICIENCY RATINGS

A. The capacity of each unit shall be as scheduled on the Drawings.

B. Minimum 90 percent overall fuel-to-water efficiency with inverse efficiency curve for 92 to 96 percent plus thermal efficiency.

2.04 BOILER DESIGN

A. Boiler modules shall be gas-fired, condensing fire tube design with a modulating forced draft power burner and positive pressure vent discharge. Each boiler module shall be capable of a 25:1 turndown of firing rate without loss of combustion efficiency; the thermal efficiency shall increase as the firing rate decreases. Heat exchanger/combustion chamber shall incorporate a fire tube design that shall be self supporting, baffle free, and warranted to withstand thermal shock. Unit shall have an ASME approved relief valve with a setting of 150 psig (maximum). Exhaust manifold shall be of corrosion-resistant porcelain enameled cast iron with a round external flue connection. Exhaust manifold shall have a gravity drain for the elimination of condensation with collecting reservoir.

B. Heat Exchanger: The heater exchanger shall bear the ASME “H” stamp for 160 psi working pressure and shall be National Board listed. The heat exchanger shall be constructed of a fully welded 316L stainless steel interior with a carbon steel shell and of fire tube design. The top and bottom tubesheets shall have a minimum thickness = ¼” (sizes 1000-2000) or 3/8” (sizes 2500 - 6000). There shall be no overlapping welds with the tubes to tubesheet welds. The heat exchanger shall be designed for a single-pass water flow to limit the water side pressure drop. There shall be no banding material, bolts, gaskets or “O” rings in the heat exchanger design. Cast iron, aluminum, or copper tube or water tube boilers will not be accepted.

C. Condensate Collection Basin: Fully welded 316L stainless steel.

D. Intake Filter and Dirty Filter Switch: Boiler shall include an intake air filter with a factory installed air pressure switch. The pressure switch will alert the end user on the screen of the boiler that the intake filter is dirty and needs to be changed.

E. Burner:

1. Natural gas, forced draft single burner premix design. Operation of the burner shall not exceed that of 5.7% oxygen level or 40% excess air.
2. The burner shall be high temperature stainless steel with a woven Fecralloy outer covering to provide modulating firing rates. The burner shall be capable of the stated gas train turndown without loss of combustion efficiency.
3. The burner shall be removable from the boiler without removing the gas/air manifold.
4. The burner shall employ a perforated flame injection tube extending the entire length of the heat exchanger.
5. The burner shall be capable of firing at both a complete blue flame with maximum gas and air input as well as firing infrared when gas and air are reduced.
6. Burner shall be capable of firing at 100 percent of rate output when supplied with natural gas at 4 inches water column of inlet pressure.
7. The burner shall fire in a 360-degree pattern resulting in uniform heat transfer across the entire heating surface.
8. A viewing port shall be provided, permitting visual observation of burner operation.

F. Blower:

1. Boiler shall be equipped with a pulse width modulating blower system to precisely control the fuel/air mixture to provide modulating boiler firing rates for maximum efficiency.
2. The burner firing sequence of operation shall include pre-purge, firing, modulation, and post-purge operation.
3. The boiler shall operate between 25 percent and 100 percent of rated output.
4. The combustion air blower shall operate for a pre-purge period before burner ignition and a post-purge period after burner operation to clear the combustion chamber

G. Gas Train: The boiler shall be supplied with a dual body gas valve with regulator and shall be capable of the specified minimum turndowns:

H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision. Boilers using a pilot for ignition and/or UV scanners for flame supervision shall be deemed unacceptable.

I. High Altitude: The boiler shall operate at altitudes above sea level. US installations above 2,000 feet shall reference NFPA 54 for de-rate information.

J. Casing:

a. Jacket: Heavy gauge primed and painted steel jacket with snap-in closures. Jacket panels shall be fully removal; the front door and side panels shall not require tools for removal. The jacket

shall be mounted on a steel base with a minimum thickness = ¼".

b. Control Compartment Enclosures: NEMA 250, Type 1A.

c. Insulation: Minimum ½ inch thick, mineral fiber insulation surrounding the heat exchanger.

d. Combustion-Air Connections: Inlet and vent duct collars.

e. Clearances: Boilers shall feature zero (0) clearance to combustibles. Boilers shall have the ability to be placed side by side in multiples with no clearance in between if necessary. Local codes should be considered.

K. Rigging and Placement: Boiler shall include lifting lugs and fork truck accessibility for rigging.

L. Oxygen Sensor An O_2 sensor shall be standard equipment with this boiler.

M. Pressure Gage: Minimum 3-1/2 inch diameter. Gage shall have normal operating pressure about 50 percent of full range.

N. Drain Valves: Minimum NPS 3/4 or nozzle size with hose-end connection.

O. Condensate Trap: Factory supplied condensate trap with condensate trap blocked drain sensor.

P. The boiler shall be configured and designed to accept return water as low as 50 degrees F.

Q. The boiler shall be equipped for condensing operation with an integral secondary circulating pump wired for intermittent operation. Secondary circulators shall operate intermittently to prevent radiant heat loss due to water circulation through boiler modules in the off mode.

R. External convection and radiation heat losses to the boiler room from the boiler shall be less than 0.5 percent of the rated input. The boiler shall not contain any refractory or refractory lined furnace or firebox.

S. The flame monitoring system shall incorporate a UL-recognized combustion safeguard system utilizing interrupted spark ignition and a rectification type flame sensor. An electro-hydraulic double seated safety shut-off valve shall be an inherent part of the gas train.

T. Each boiler module shall incorporate electric probe type low water cut-off and dual over-temperature protection including a manual reset in accordance with ASME Section IV and CSD-1. Remote fault alarm contacts, sensor failure detection, and auxiliary contacts shall be provided.

U. Provide a condensate neutralization tank. Connect the boiler condensate drain to the inlet of the tank using corrosion resistant piping. The inlet and discharge of the tank must be at a lower elevation than the boiler condensate trap outlet.

2.05 BOILER VENTING

A. The boiler shall be AGA Approved as a Direct Vent Boiler. Conventional chimney or stack shall not be required. Direct venting shall be accomplished with

a stainless steel, double wall vent pipe installed in accordance with applicable national and local codes. Refer to Section 23 51 00 – Breechings, Chimneys and Stacks.

B. Intake piping for all models must be of approved material as listed in the Installation and Operations manual. Boilers intake pipe length must be able to extend up to 150 equivalent feet.

C. Boiler venting and intake piping configuration shall be installed per one of the approved venting methods shown in the Installation and Operation manual. Refer to manufacturer's Installation and Operations manual for detailed venting instructions and approved vent manufacturers.

D. Boiler shall come standard with a flue sensor to monitor and display flue gas temperature on factory provided LCD display.

E. Vent tee drain connections shall be provided on all boiler modules. Pipe drains to an acid neutralizer.

F. If multiple boiler flues are combined into a single flue, the contractor shall follow the boiler manufacturers flue vent requirements including but not limited to the use of a backdraft dampers, fans, and boiler sequencing.

2.06 BOILER MANAGEMENT

A. The boilers shall be provided with a complete boiler management system.

B. The boiler control system shall be Underwriters Laboratories recognized.

C. 10" LCD capacitive touch screen display with 1280 x 800 resolution displaying status, modulation percentage, setpoints, and sensor data at a minimum on the home screen. Additional information such as history and parameters can be accessed via the touchscreen display without the need for navigation buttons. A screen saver mode shall be available with the display

D. The control panel shall consist of six individual circuit boards using state-of-the-art surface-mount technology in a single enclosure. These circuit boards shall include:

1. A display board incorporating LED display to indicate temperature and a vacuum fluorescent display module for all message enunciation
2. A CPU board housing all control functions
3. An electric low-water cutoff board with test and manual reset functions
4. A power supply board
5. An ignition /stepper board incorporating flame safeguard control
6. A connector board. Each board shall be individually field replaceable.

E. The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.

F. The control panel hardware shall support both RS-232 and RS-485 remote communications.

G. The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities.

H. The boiler management system must include at a minimum the following capabilities:

1. Variable Speed Boiler Pump Control: Boiler may be programmed to send a 0-10V DC output signal to an ECM or VFD boiler pump to maintain a designed temperature rise across the boiler heat exchanger.
2. Password Security: Boiler shall have a password security code for the Installer to access adjustable parameters.
3. Outdoor air reset: Boiler shall calculate the set point using a field installed, factory supplied outdoor sensor and a 4 point adjustable reset curve.
4. Pump exercise: Boiler shall energize any pump it controls for an adjustable time if the associated pump has been off for a time period of 24 hours.
5. Ramp delay: Boiler may be programmed to limit the firing rate based on six limits steps and six time intervals.
6. Boost function: Boiler may be programmed to automatically increase the set point a fixed number of degrees (adjustable by installer) if the setpoint has been continuously active for a set period of time (time adjustable by installer). This process will continue until the space heating demand ends.
7. Domestic hot water priority: Boiler shall make the domestic hot water call for heat a priority over any space heating call and adjust the boiler setpoint to the domestic hot water boiler setpoint.
8. Domestic hot water modulation limiting: Boiler may be programmed to limit the maximum domestic hot water firing rate to match the input rating of the indirect tank coil.
9. Domestic hot water night setback: Boiler may be programmed to reduce the domestic hot water tank set point during a certain time of the day.
10. PC port connection: Boiler shall have a micro USB port allowing the connection of PC boiler software.
11. Time clock: Boiler shall have an internal time clock with the ability to time and date stamp lock-out codes and maintain records of runtime.
12. Service reminder: Boiler shall have the ability to display a yellow colored service notification screen based upon months of installation, hours of operation, and number of boiler cycles. All notifications are adjustable by the installer.
13. Five pump control: Boiler shall have the ability to control the boiler pump, system pump, domestic hot water pump, domestic hot water recirculation pump, and the bypass pump.
14. Anti-cycling control: Boiler shall have the ability to set a time delay after a heating demand is satisfied allowing the boiler to block a new call for heat. The boiler will display an anti-cycling blocking on the screen until the time has elapsed or the water temperature drops below the anti-cycling differential parameter. The anti-cycling control parameter is adjustable by the installer.
15. Night setback: Boiler may be programmed to reduce the space heating temperature set point during a certain time of the day.
16. Freeze protection: When the boiler water temperature falls below 37 degrees the boiler will automatically turn on. Boiler and pumps will turn off when the boiler water temperature rises above 43 degrees.

17. Isolation valve control: Boiler shall have the ability to control a 2-way motorized control valve. Boiler shall also be able to force a fixed number of valves to always be energized regardless of the number of boilers that are firing.
18. BMS integration with 0-10V DC input: The Control shall allow an option to Enable and control set point temperature or control firing rate by sending the boiler a 0-10V input signal.
19. Data logging: Boiler shall have non-volatile data logging memory including last 10 lockouts, hours running, recycling reporting, and ignition attempts and should be able to view on boiler screen.
20. Interior service light: Boiler shall feature an LED service light to provide additional illumination to the interior of the boiler.
21. System start temperature feature
22. Pump delay timer
23. Auxiliary start delay timer
24. Auxiliary temperature sensor
25. Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate
26. Remote interlock circuit
27. Delayed interlock circuit
28. Fault relay for remote fault alarm

I. The boiler shall have a built in controller to sequence and rotate lead boiler to ensure equal runtime while maintaining modulation of up to 8 boilers of different btu inputs without utilization of an external controller. The factory installed, internal controller shall include:

1. Lead lag: The Control module shall minimize the number of boilers firing to achieve the heating load.
2. Efficiency optimization: The Control module shall allow multiple boilers to fire at minimum firing rate in lieu of Lead/Lag.
3. Front end loading: The Control modulate shall have the ability to communicate with other boilers. This allows for a combination of units that feature condensing and non-condensing operation if so desired.
4. Rotation of lead boiler: The Control module shall change the lead boiler every hour for the first 24 hours after initializing the Cascade. Following that, the leader will be changed once every 24 hours.
5. Redundancy: The Control module shall have a built in feature to continue operating with follower boilers if the Lead boiler is not operational.

J. Each boiler shall include an electric, single-seated combination safety shutoff valve/regulator with proof of closure switch in its gas train. Each boiler shall incorporate dual over-temperature protection with manual reset, in accordance with ASME Section IV and CSD-1.

K. Each boiler shall have an oxygen monitoring system that will measure the oxygen content of the exhaust gasses in real-time. Output of O2 information shall be displayed on the C-More control panel.

L. Each boiler shall have integrated Boiler Sequencing Technology (BST), capable of multi-unit sequencing with lead-lag functionality and parallel operation. The system will incorporate the following capabilities:

1. Efficiently sequence 2-to-8 units on the same system to meet load requirement.
2. Integrated control and wiring for seamless installation of optional isolation valve. When valves are utilized, the system shall operate one motorized valve per unit as an element of load sequencing. Valves shall close with decreased load as units turn off, minimum of one must always stay open for recirculation.
3. Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load in an effort to equalize unit run hours.
4. Designated master control, used to display and adjust key system parameters.
5. Automatic bump-less transfer of master function to next unit on the chain in case of designated master unit failure; master/slave status should be shown on the individual unit displays.
6. Designated master control, used to display and adjust key system parameters.

M. Boiler operating controls shall include the following devices and features:

1. Set-Point Adjust: Set points shall be adjustable.
2. Operating Pressure Control: Factory wired and mounted to cycle burner.
3. Sequence of Operation: Factory installed controller to modulate burner firing rate to maintain system water temperature in response to call for heat.
4. Sequence of Operation: Electric, factory-fabricated and factory-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature.
5. High Temperature Limit: Automatic and manual reset stops burner if operating conditions rise above maximum boiler design temperature. Limit switch to be manually reset on the control interface.
6. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manually reset on the control interface.
7. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
8. High and Low Gas Pressure Switches: Pressure switches shall prevent burner operation on low or high gas pressure. Pressure switches to be manually reset on the control interface.
9. Proof of Closure Valve: Proof of closure valve (POC) shall prevent the boiler from firing if the POC valve seat is detected open. Upon a call for heat, once the POC valve seat is proven to be closed, the pre-purge cycle will begin and the POC valve will begin to open.
10. Blocked Drain Switch: Blocked drain switch shall prevent burner operation when tripped. Switch to be manually reset on the control interface.
11. Low air pressure switch: Pressure switches shall prevent burner operation on low air pressure. Switch to be manually reset on the control interface.
12. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for any lockout conditions.
13. Building Automation System Interface: Factory installed Modbus and BACnet IP gateway interface to enable building automation system to monitor, control, and display boiler status and alarms.

14. Software Update: The control shall have the ability to receive updates in the field without hardware component replacement. This update can be performed via USB flash drive, internet connection, or via wireless connection. This service shall be provided at no additional and/or annual cost to the owner.
15. Remote Connectivity: Integral remote connectivity technology that allows a mobile device to monitor and control boiler functionality. Wi-Fi or hardwired Ethernet connection. This service shall be provided at no additional and/or annual cost to the owner.
16. Boiler shall provide real time trimming of O2 while the boiler is operational. Free air calibration of the sensor shall occur after every combustion cycle. The O2 value shall also auto correct for conditions such as barometric pressure, air temperature, fuel content, and altitude. O2 information shall be displayed in real time via a gauge on both the boiler touchscreen as well as the Remote Connectivity Application.

    a. The following methods of fuel/air trim shall be integrated into the system:

        (1) Feed Forward: Temperature and Barometric pressure shall be measured to determine the appropriate atmospheric conditions present.
        (2) Commissioned Trim: When commissioning the unit 9 pre-set points will be fine-tuned by the installer. These settings will be used to optimize the fuel/air ratio across the operation range of the boiler. In addition, a separate ignition point will be commissioned as well to ensure proper fuel/air mix.
        (3) Learned Trim: As the boiler operates the controls will log the air temperature and barometric pressure along with the target fuel/air ratio. As these air temperature and barometric pressure settings reoccur the controls will initially return to the optimal setting based on its learned trim.
        (4) Feed Back: Once all of the above methods have taken place the O2 sensor shall provide “feedback” to confirm if the optimal fuel/air ratio has been reached.

    b. The boiler shall use the direct wet O2 measurement as the feedback loop. Boilers that use a dry O2 reading or a 0-10V signal to control the fuel/air ratio are not permitted.
    c. Boiler shall have the ability for the user to adjust combustion system to optimal fuel/air ratio via the on-board touchscreen. Boilers that utilize an external display to calibrate the combustion system shall not be permitted.
    d. Systems that utilize only a feedback operation to accurately trim the O2 shall not be permitted.

N. For boiler plants greater than 8 units, the Boiler Manufacturer shall supply as part of the boiler package a completely integrated Boiler Control System (BCS) to control all operation and energy input of the multiple boiler heating plant. The BCS shall be comprised of a microprocessor based control utilizing the MODBUS protocol to communicate with the Boilers via the RS-485 port. One BCS controller shall have the ability to operate up to 32 boiler modules.

The controller shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The BCS shall control the boiler outlet header temperature within +2ºF. The controller shall be a PID type controller and uses Ramp Up/Ramp Down control algorithm for accurate temperature control with excellent variable load response. The BCS controller shall provide contact closure for auxiliary equipment such as system pumps and combustion air inlet dampers based upon outdoor air temperature.

The BCS shall have the following anti-cycling features:

1. Manual designation of lead boiler and last boiler.
2. Lead boiler rotation at user-specified time interval.
3. Delay the firing/shutting down of boilers when header temperature within a predefined deadband.

When set on Internal Setpoint Mode, temperature control setpoint on the BCS shall be fully field adjustable from 50ºF to 190ºF in operation. When set on Indoor/Outdoor Reset Mode, the BCS will operate on an adjustable inverse ratio in response to outdoor temperature to control the main header temperature. Reset ratio shall be fully field adjustable from 0.3 to 3.0 in operation. When set on 4ma to 20ma Temperature Control Mode, the BCS will operate the plant to vary header temperature setpoint linearly as an externally applied 4-20 ma signal is supplied.

When set on MODBUS Temperature Control Mode, the BCS will operate the plant to vary header temperature setpoint as an external communication utilizing the MODBUS protocol is supplied via the RS-232 port. The BCS controller shall have a vacuum fluorescent display for monitoring of all sensors and interlocks. Non-volatile memory backup of all control parameters shall be internally provided as standard. The controller will automatically balance the sequence of operating time on each boiler by a first-on first-off mode and provide for setback and remote alarm contacts. Connection between central BCS system and individual boilers shall be twisted pair low voltage wiring, with the boilers ‘daisy-chained’ for ease of installation.

O. Each boiler shall utilize an electric single seated safety shut-off valve with proof of closure switch in its gas train and incorporate dual over temperature protection with manual reset and dual low water protection with manual reset.

2.07 EMISSIONS

A. The boiler(s) shall operate with CO emissions less than 50 parts per million corrected to 3 percent O_2 and shall operate with NO_x emissions less than 30 parts per million corrected to 3 percent O_2 over the entire burner turn-down range.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Complete structural, mechanical, piping and electrical connections in accordance with manufacturer’s installation instructions.

B. Install boilers as specified and as indicated on the Drawings.

1. Provide code-required electrical services clearance for all electrical components.
2. Provide sufficient maintenance and service clearance for replacing boiler tubes, cleaning, and servicing of components.
3. Provide steel channel base of suitable rigidity and strength for attachment of vibration isolators, seismic restraints and anchor bolts.
4. Install equipment on 4” concrete housekeeping pad.
5. Install gas-fired boilers according to NFPA 54.
6. Assemble and install boiler trim.
7. Install electrical devices furnished with boiler but not specified to be factory mounted.
8. Install control wiring to field-mounted electrical devices.
9. Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.

C. Boiler Trim:

1. Provide drain valves for:

   a. Water level controls
   b. Water columns
   c. Low water cutoffs

2. Pipe drain valves to nearest floor drain. Piping shall be at least full size of connection.
3. Pipe safety relief valves discharge full size to nearest floor drain.
4. Extend gas valves and control relief vents to outside air in a location acceptable to the Architect.

3.02 TESTS AND START-UP

A. All testing and start-up required shall be executed using each fuel type specified.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing

C. After installation is completed:

1. Test boilers hydrostatically to specified working pressure in accordance with ASME recommendations.
2. Test operating and safety controls by firing boiler and raising water temperature and lowering water level.

D. Provide services of factory representative of boiler and burner manufacturers to:

1. Supervise installation of boilers, burners and controls.
2. Start up and adjust burners and controls for single and multiple boiler operation.
3. Test individual burner controls for proper operation.
4. Test safety controls for proper operation.
5. Set burner firing rates for specified conditions including all possible combinations of multiple boiler operation and lead-lag operation.
6. Adjust burners for optimum fuel-air ratio over entire operating range.

7. Test boiler safety (or relief) valves.
8. Test combustion efficiency over full operating range by means of carbon dioxide analysis and exit gas temperature.
9. Test for NO_x emissions.

E. Submit written report by boiler-burner manufacturer confirming that safety and operating controls and burners have been properly installed, calibrated and adjusted and certify that air pollution control standards are being met and NO_x is less than 30 parts per million.

F. Manufacturer shall offer an annual inspection and maintenance program. Scope of work shall include inspecting key components, cleaning filters and burner, and reviewing findings with the property owner. Service shall be offered as an additional program.

G. Instruct Owner's designated personnel in operation of equipment for a minimum period of two eight-hour days.

END OF SECTION

SECTION 23 74 13
COMMERCIAL PACKAGED ROOFTOP AIR CONDITONING UNITS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:
   1. Mixed-Air Rooftop Air Conditioning Unit

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions, and other Division 01 specification sections, apply to this section.

1.03 SUMMARY

A. The rooftop air conditioning unit shall be the manufacturer's standard or custom version as required to meet the criteria as shown in the Contract Documents, inclusive of specifications, drawings, and reports.

B. Furnish and install commercial packaged roof top air conditioning units as herein specified and as indicated on the Drawings including the following:
   1. Provide manufacturer's factory representative services including coordination, installation supervision, and startup and testing supervision.
   2. Independent review and approval of all acoustical mockup tests and/or independent laboratory tests by the Project Acoustical Consultant.
   3. Operating, maintenance and service instructions and manuals.
   4. Factory mounted variable frequency drive(s) and direct digital control systems.

1.04 REFERENCE STANDARDS

A. All commercial packaged roof top air conditioning units shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
   1. NFPA Compliance: Units and components shall be designed, fabricated and installed in compliance NFPA 90A.
   2. UL Compliance: Electrical components used shall be listed and labeled by UL.
   3. NEMA Compliance: All motors shall comply with applicable NEMA standards.
   4. AMCA Compliance: All plenum fans shall bear the AMCA seal for sound and air performance. FC DWDI fans shall bear the AMCA seal for air performance.
   5. ARI Compliance: Coil shall be rated in accordance with ARI standard 410

and bear the ARI seal.

6. Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
7. AHRI Compliance: Air to air energy recovery components shall comply with AHRI 1060.
8. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
9. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
10. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
11. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.
12. All systems installed within New York City are to comply with The NYC Fire Code limitations on system power that preclude the need of a refrigeration system operating engineer. Each system shall be limited to 15 horsepower or less or the kilowatt equivalency.

1.05 QUALITY ASSURANCE

A. Deliver equipment to the job site with all exposed openings temporarily closed off with plywood, sheet metal or shrink-wrap. All equipment intended for indoor use must be shrink-wrapped prior to shipment.

B. The Subcontractor shall thoroughly check the equipment upon arrival at the Project Site and verify the condition and compliance with the Contract Documents and final reviewed submittals.

C. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.

D. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.

1.06 SUBMITTALS AND PROPOSALS

A. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, gauges and types of materials, ratings, fan performance, filter information, factory supplied accessories, control sequences, electrical characteristics and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.

B. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.

C. The submittal shall include a specification compliance review report with the Subcontractors' bid proposal. The compliance review will be a paragraph-by-paragraph review of the specifications with the following designations "C", "D" or "N/A" marked in the right hand margin beside each paragraph.

1.07 WARRANTY

A. General Warranty:

1. Provide manufacturer's parts warranty on the entire unit and all components contained within for one (1) year. The warranty period begins at start up or six (6) months after shipment, whichever occurs first. The manufacturer must submit a written warranty agreeing to repair or replace components that fail in materials or workmanship within the specified warranty period. The warranty does can exclude parts associated with routine maintenance, such as belts, air filters, etc.
2. Five (5) year non-prorated parts warranty for the compressors. The warranty period begins at start up or six (6) months after shipment, whichever occurs first.
3. A ten (10) year non-prorated parts warranty is provided for all energy recovery heat exchangers (both flat plate and wheels). The warranty period begins at start up or six (6) months after shipment, whichever occurs first.
4. A twenty (20) year non-prorated parts warranty shall be provided for all furnace heat exchangers. The warranty period begins at start up or six (6) months after shipment, whichever occurs first.

1.08 EXTRA MATERIALS

B. Furnish extra material described below that match the product installed, are packaged with protective covering for storage, and are identified on the shipping bill of lading:

1. Filters: Furnish one (1) spare set of pre-filters for each pre-filter bank provided.
2. Heat Wheel Belts: Furnish one (1) spare set for each wheel provided.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. If it complies with these Specifications, commercial packaged roof top air conditioning units manufactured by one of the following manufacturers will be acceptable:

1. Aaon
2. Trane
3. York

B. Alternate manufacturers must be pre-approved and are subject to compliance with all the requirements listed in this specification.

C. Project is based on the specified equipment. Any additional re-engineering or installation costs associated with using alternate manufacturer's equipment shall be borne by the installing contractor.

2.02 COMMERCIAL PACKAGED ROOF TOP AIR CONDITIONING UNITS

A. Configuration of interior walls, interior components and inlet and discharge points for the scheduled units shall be as indicated on the Contract Documents. The outdoor air-cooled condensing units shall be located within the enclosure.

B. Provide adequate service space and NEC code clearances for electrical equipment in each section of the unit.

C. General:

1. Construct unit as specified herein. Single wall construction is unacceptable and will be rejected. Frame and panel construction must be used with no individual panel exceeding 36" width. All panels on the unit must be fully removable without the use of cutting tools. All internal components must be removable without dismantling the structural framing of the unit. Unit shall be suitable for outdoor installation as detailed on the plan drawings.
2. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, gas heaters, exhaust fans, and unit controls.
3. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet.
5. Thermal break construction: The entire casing, including doors, must be built such that no member on the exterior of the unit, excluding fasteners, has through metal contact with any member on the interior of the unit, excluding fasteners.
6. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
7. Unit components shall be labeled, including refrigeration system components, and electrical and controls components.
8. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
9. Installation, Operation, and Maintenance manual shall be supplied within the unit.
10. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged

access door.

11. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

D. Base:

1. Construct base of minimum 10 ga. welded structural steel with cross supports and integral lifting lugs. Bolted bases are unacceptable. Coat base exterior with 2 part epoxy primer and urethane modified enamel top coat. Removable lifting lugs are provided.
2. Base shall have a minimum 4" overhang over the top of a roof curb to prevent water infiltration.
3. There shall be no penetrations through the floor of the unit within the perimeter of the curb except for duct openings and utility chases.
4. Penetrations through the floor shall have a ½" raised rib around each opening.

E. Framing:

1. Frame is constructed of structural tube members designed to support flush-mounted double-wall panels. Vertical framing members must be easily removable, without the use of specialty tools or torches, for replacement of large internal components. Welded framing is not acceptable. A closed-cell polyvinyl foam gasket with a thickness of 3/16" or greater must be applied between all framing members and panels.

F. Flooring:

1. Floor shall be 2" thick double-wall, foam injected panel construction, with a minimum of 18 gauge galvanized steel walk on surface, and 22 gauge galvanized steel underside of paneled floor. Floor panels shall be foam injected for optimal support strength. Maximum deflection of the floor shall be L/500 (L=span in inches), and the maximum point load on the floor shall be 800 lbs (over 1 square foot). Floor shall be of a fastener free design, bonded to the unit base with an industrial adhesive, with all seams finished with an adhesive sealant providing a water tight floor system. Use of tack welding, caulk or screws penetrating the entire floor panel anywhere in the floor is unacceptable. The floor shall have a smooth and flat walk-on surface. A minimum 1" lip must be provided around all floor penetrations. Walk-on grating must be provided over all accessible floor mounted duct connections.
2. Flooring Option #1: Walk on floor material shall be a minimum of 16 ga. galvanized G90 steel.
3. Flooring/Base Option #2: Units installed on roof curbs shall include an additional subfloor beneath flooring panel. A minimum 22 ga. galvannealed G90 steel bottom liner shall be welded to the base frame; weep holes provided in base channels to exterior of curb.

G. Panels:

1. Unit shall have non-load bearing, fully-removable, heavy gauge 2" double-wall panels.

2. Exterior Materials: Exterior skin shall be galvanized G90 steel for unpainted equipment. Exterior skin shall be galvanized G60 steel or galvanealed steel for painted equipment.
    a. A textured polyester paint (gray color) shall be provided. Coating shall be salt spray tested per ASTM B117 for a minimum of 2,500 hours and have no blistering or red rust on the face when the testing is completed.
3. Interior Materials: Interior skin shall be galvanized G90 steel.
    a. Perforated liner shall be provided in the fan sections for additional sound attenuation. The perforated liner is incorporated into the standard panel design providing a completely flush inner surface. The insulation behind the perforated metal must be non-porous, fiber-free and include an EPA-registered antimicrobial agent for protection against mold, fungal and bacterial growth.

H. Casing Ratings:
1. Maximum casing panel deflection shall not exceed L/250 at the design total static pressure (where L is the longest panel span on the unit).

I. Insulation:
1. All interior walls, floor, and ceiling shall be double wall and insulated with polyurethane injected foam insulation having a minimum R-13 thermal value.
2. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
3. No insulation shall be exposed to the air stream. Fiberglass or non-injected foam insulation is not acceptable and will be rejected.

J. Access Doors:
1. Provide double wall doors with the same insulation and inner/outer wall material as the rest of the air handler. Doors shall be full height (up to 72”) with industrial stainless steel hinges. Bi-directional compression latches with integral roller cam and hex-screw locking assembly must be provided. An EPDM type gasket must be provided in accordance with ASTM D 2000. Supply and exhaust air streams shall not be covered by a single door. Access panels in lieu of access door are unacceptable. Rain gutters are provided over all access doors that are not the full height of the unit casing. All doors that open with pressure shall be provided with a pressure relief safety latch. Provide doors for access to any area requiring routine maintenance.
2. Access doors shall be provided with aluminum door tie backs
3. Access doors shall be thermal broken design
4. All access doors shall open against pressure
5. A mechanical interlink shall be provided such that all door handles can be opened by only using one handle.
6. Kill switches are provided on the fan access doors.

K. Weather hoods:
1. Provide weather hoods with expanded aluminum bird screens over all

exposed inlets and outlets. Hoods may ship loose for installation in the field.

L. Louvers:

1. Provide 6063T5 extruded aluminum high performance drainable blade louvers with expanded aluminum bird screens over all exposed inlets and outlets. All louvers must be AMCA certified for water penetration and air performance.

M. Roof:

1. Provide roof with standing seam construction which allows removal of individual sections for inspection purposes without removal of the entire roof.
2. A double wall foam injected panel must be provided below the roof liner creating 3 layers of metal between the conditioned air tunnel and ambient air.
3. Pitch roof with sufficient slope to ensure water drainage. Units over 137” wide require double sloped roof designs. Roof overhang to be provided around complete perimeter of the unit. No penetrations can be made to the roof.

N. Heat Recovery:

1. Enthalpy Wheel (if specified on drawings):
    a. The heat transfer media shall be 200 mm deep. Non-standard depths shall be unacceptable. The heat transfer media shall be made out of corrugated aluminum foil with a high surface area per volume and laminar flow to assure that no fouling occurs on the internal heat transfer surface. Dry particles up to 900 microns shall pass freely through the media. This material shall be supplied with a "Balanced Sieve" (4Å or 3Å Molecular Sieve) hygroscopic solid desiccant coating for selective adsorption of water vapor and equal sensible and latent heat transfer. The media shall have a flame spread of 0 and a smoke developed of 5 or less when rated in accordance with ASTM E84-09. All edges shall have an anti-corrosion epoxy coating.
    b. External tapered roller bearings with double set screw locking collars shall be provided. The structural frame and casing shall be designed and manufactured so as to allow a maximum rotor deflection of 1/32 inch, as measured at the outer radius, during maximum rated airflow condition.
    c. External tapered roller bearings with double set screw locking collars shall be provided and sized for a minimum L-10 life of 1,000,000 hours of operation and shall be changeable without a complete disassembly of the rotor. Shaft journals shall be machined to proper tolerance as specified by the bearing manufacturer. Shaft shall be machined as to provide a shoulder against the bearings for a positive locked position to eliminate any lateral movement of the rotor due to axial bearing loads. Grease fittings shall be easily accessible.
    d. The rotor media shall be provided in segments. Each media segment shall be machined to fit in the spoke system and the outside rim. Each segment of media shall be compressed evenly during the assembly process without causing any angular deformation and resulting misfits between the spokes and media parts, and to provide a wheel with a flatness of +/- 1/32 inch.

e. The seals shall be of a maintenance free non-contact type with a 4-pass labyrinth "turbine" for optimum performance and designed to eliminate wear and excessive drag. The seals shall be adjustable and set to within 0.05 inch of the rotor surface and shall be bolted to the frame with stainless steel hardware to eliminate seal movement. The seal system shall withstand a pressure difference up to 12 in. W.C.

O. Blower / Motor

1. Supply & Exhaust blower: AF, BI or BC blade direct drive plenum fans shall be provided with fan blades continuously welded to the wheelback. Fan wheels shall be constructed of aluminum or painted steel. Fans shall be certified to bear the AMCA seal for air and sound performance. Fan brake horsepower shall not exceed the scheduled brake horsepower at the total static pressure and airflow scheduled. Provide the number of fans scheduled, no exceptions. Fan motors must be selected to run at 90 Hz maximum at design conditions. Any fan/motor combination selected to run at a higher frequency will be rejected due to decreased motor life.
2. Motors shall be 3 phase TEFC with a NEMA frame, cast iron construction and a 1.15 service factor. Motor brake horsepower shall not exceed scheduled values. Fan brake horsepower shall not exceed 90% of motor horsepower. All motors shall be premium efficiency with class F insulation. Shaft grounding will be provided on all VFD controlled motors 10 HP and larger.
3. Isolation: Blower and motor shall be dynamically balanced and mounted on a unitary base with 1” housed seismic rated spring isolators.
4. Accessories:
    a. Door kill switch / inlet screens shall be provided.
    b. Variable frequency drives: Provide variable speed drive for fan(s). VFDs shall be factory provided and installed on the exterior of the unit in NEMA 3R enclosure.
    c. VFD options required:
    d. Airflow probes shall be provided at the fan inlet cone. Probes shall be provided by the fan manufacturer to ensure accurate airflow measurement & zero resistance to airflow. Flow monitoring station shall not use air restricting probes that reduce fan performance or create additional fan sound.
    e. A motor removal rail will be provided above the fan section. Trolley and hoist are provided by a separate party.

P. Dampers

1. Motorized dampers shall be low leakage type with aluminum construction, airfoil blades, vinyl edge seals, metal jamb seals, and synthetic bearings. Gravity dampers shall have aluminum frame, aluminum blades, extruded vinyl edge seals, and synthetic bearings.
2. Contractor to review the project drawings, control diagrams, and/or sequences and provide units with dampers as required.
3. A minimum outside air damper/flow monitor shall be provided equivalent to the Greenheck AMD-33. A controller shall be provided with the damper to

provide a 0-10VDC feedback for airflow, temperature, and position.

4. Airflow measurement probes shall be provided across the outside air hood for flow measurement. All electronics and controls for airflow measurement are provided by the unit manufacturer.

Q. Filters

1. Outside air filter: Provide 2" MERV 8 filter bank at the outside air inlet. Mount in a galvanized steel side access slide rack and size for 500 fpm maximum face velocity. Filters must be rated per U.L. standard 900.
2. Return air filter: Provide 2" MERV 8 filter bank at the return air inlet. Mount in a galvanized steel side access slide rack and size for 500 fpm maximum face velocity. Filters must be rated per U.L. standard 900.
3. Cartridge filter: Provide 12" MERV 13 cartridge filter bank in location shown on unit drawing. Mount in a galvanized steel front access rack and size for 500 fpm maximum face velocity. Filters must be rated per U.L. standard 900.

R. Refrigeration System

1. Unit shall be factory charged with R-410A refrigerant.
2. Compressors shall be scroll type with thermal overload protection.
3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
4. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.
6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.
7. Unit shall include variable capacity scroll compressors on all refrigeration circuits which shall be capable of modulation from 10-100% of their capacity.
8. Each refrigeration circuit shall be equipped with a liquid line sight glass.
9. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.
10. The factory installed controls shall include a 3 minute off delay timer to prevent compressor short cycling. The controls shall also include an adjustable, 20 second delay timer for each additional capacity stage to prevent multiple capacity stages from starting simultaneously and adjustable compressor lock out.

S. Cooling

1. DX coil: Provide fully-interlaced coil rated in accordance with AHRI 410-2001 with 0.025" thick seamless copper tubes, galvanized, and 0.01" thick aluminum fins. All refrigerant connections must remain inside the unit cabinet

and run directly to the condensing section. Maximum face velocity is 500 FPM. Each coil is water immersion tested to 450 PSI prior to shipment

2. Cooling coil drain pan: All cooling coils must be provided with stainless steel IAQ drain pans that begin at the entering air side of the coil face and extend a minimum of 12" past the leaving air side of the coil face. Entire underside of the drain pan, including the piping run to the casing exterior, must be coated with no less than 2" of spray foam insulation to ensure no sweating occurs below. Coil must sit on "walk-on" stainless steel supports spaced a maximum of 6" apart to allow full access to the coil face without damage to the drain pan. The drain pan must be sloped in a minimum of 2 directions to ensure proper drainage.
3. Integral air cooled condensing section: Provide integral air cooled condensing system factory piped, wired, charged, and tested. Entire condensing section must be assembled by the unit manufacturer. Skid mounting another manufacturers condensing unit is not acceptable.
    i. Refer to the schedule for the minimum condensing section or unit EER requirements. Equipment with EER's less than what is scheduled will be rejected.
    ii. Modulating head pressure control must be provided to keep system operational and optimize efficiency of the compressors.
    iii. Provide hermetic scroll type compressors with suction and discharge schrader ports, reverse rotation protection, sight glass, oil level adjustment, filter drier, anti-cycle timers and high/low pressure switches. Independent circuits shall be provided completely tested, dehydrated, and fully charged with R-410A and oil.
        1. The compressors shall provide modulating control from 100% down to 10% of the full refrigeration system capacity. Staged control is not acceptable and will be rejected. Hot gas bypass is not an acceptable method of capacity control and will be rejected. Independent circuits shall be provided completely tested, dehydrated, and fully charged with R-410A and oil.
    iv. Provide condenser coil with 0.025" thick seamless copper tubes and 0.01" thick aluminum fins, galvanized casing. Each coil is water immersion tested to 450 PSI prior to shipment.
    v. Provide vandalism screens over all condenser coils.
    vi. Condenser fans shall be direct drive with fan guards.
    vii. Drains must be provided in the base of each condensing section to eliminate standing water.

T. Air-Side Economizer:

1. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return sensible temperature activated fully modulating

enthalpy activated fully modulating actuator. Unit shall include outside air opening bird screen, outside air hood, and relief dampers.

U. Electrical:

1. Wire units according to NEC and ETL list the entire unit. ETL listing of electrical panel only is unacceptable. All major electrical components shall be UL listed. Factory wire unit for single point power connection. Enclose all power wiring in conduit.
2. Provide non-fused disconnect, fan motor starters/protectors, contactors, control transformer, control circuit fusing, service switch, and terminal block. Units supplied with VFDs shall have individual branch fusing per drive. A motor protector shall be provided if equipment manufacturer's manual bypass is required.
3. Provide all electrical components in a NEMA 3R enclosure (control panel/VFD/disconnect).
4. Factory test wiring and controls before shipment.
5. A phase protection relay shall be provided for each unit. Upon sensing a loss of phase the unit shall be de-energized.
6. A door safety kill switch shall be provided on all blower section access doors. The door safety kill switch shall de-energize the blower motor if the access door is opened. The kill switch shall prevent motor startup if the blower section access door is open.
7. Lights: Provide IP67 rated LED light strips in all access sections. Wire lights to a single light switch. Mount light switch near the electrical panel and wire switch to a terminal strip in the electrical panel. Separate 120V power must be provided to the switch for indoor mounted equipment. A transformer will be provided to provide power to the lighting circuit for outdoor mounted equipment.
8. Convenience Receptacles: Provide a GFCI duplex receptacle mounted near the electrical panel and wire receptacle to a terminal strip in the electrical panel. Separate 120V power must be provided to the receptacle for indoor mounted equipment. A transformer will be provided to provide power to the circuit for outdoor mounted equipment.
9. Dirty filter indicators: Provide differential pressure switches across all filter racks. Wire pressure switches to terminal block in main electrical panel.
10. Air-source heat pump shall include an optimized start defrost cycle to prevent frost accumulation on the outdoor coil during heat pump heating operation and to minimized defrost cycle energy usage. If the temperature of the outdoor heat exchanger and/or the suction line is less than a predetermined value, a deferred defrost cycle is initiated wherein the defrost cycle starts after a variable, continuously optimizing, time interval has elapsed. The defrost cycle is terminated when the relative temperatures of the outdoor heat exchanger and/or the suction line indicate that sufficient frost is melted from the heat exchanger to ensure adequate time between successive defrost cycles for optimizing the efficiency and reliability of the system, or after a predetermined time interval has elapsed, whichever condition occurs first. During defrost cycle all compressors shall energize, reversing valves shall de-energize, and auxiliary heat shall energize.

V. Controls:

1. A refrigeration safety controller shall be included on any product containing compressors.
2. Manufacturer must provide a stand-alone programmable digital control system for complete temperature & humidity control of the delivered air. The manufacturer will provide a standard sequence of operation for the type of equipment provided per this specification. This sequence shall be updated by the manufacturer to meet the specific control sequence as outlined in the Engineer's drawings, schedule sheets, and specifications
3. The controller will communicate with the BAS through a Bacnet IP / Bacnet MSTP interface card provided by the equipment manufacturer. Points list necessary to control the equipment will be provided.
4. The contractor shall coordinate all the points required to achieve the sequence of operations and ensure that they have been included with the project.
5. See Engineer's drawings, schedule sheets, and specifications for control sequences to be incorporated for the project.
6. At a minimum, the contractor and manufacturer shall ensure that the Building Management and Control System will monitor the following outputs from the unit controller:
    i. Supply fan(s) status.
    ii. Return fan(s) status.
    iii. Supply fan speed(s).
    iv. Return fan speed(s).
    v. Minimum outside air flowrate.
    vi. Return air CO2.
    vii. Compressor status, one per compressor.
    viii. Economizer mode.
    ix. VFD alarm(s).
    x. Outside air temperature.
    xi. Outisde air enthalpy.
    xii. Return air temperature.
    xiii. Return air enthalpy.
7. At a minimum, the contractor and manufacturer shall ensure that the Building Management and Control System shall control the following inputs to the unit controller:
    i. Unit start/stop control.
    ii. Supply fan static pressure setpoint.
    iii. Return fan exhaust plenum static pressure setpoint.
    iv. Exhaust damper return riser pressure setpoint.
    v. Minimum outside air damper flowrate setpoint.

vi. Return air CO2 reset limits.

vii. Economizer enable/disable setpoint limits.

W. Accessories:

1. Roof curb: A 16" prefabricated insulated roof curb will be provided for the unit. The curb will be suitable for the roof to where it shall be installed (flat/sloped). Curbs shall be fully gasketed between the curb top and unit bottom with the curb providing full perimeter support, cross structure support and air seal for the unit. Curb gasket shall be furnished within the control compartment of the rooftop unit to be mounted on the curb immediately before mounting of the rooftop unit. The curb will be shipped disassembled.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Installation, Operation, and Maintenance manual shall be supplied with the unit.

B. Contractor shall NOT use the units to provide temporary heating, cooling or ventilation to the building during construction.

C. All commercial packaged roof top air conditioning units shall be installed in accordance with the latest industry standards, per the manufacturer's written recommendations, and as indicated on the Drawings.

D. Equipment installation shall include unloading, receiving, storing, relocating, handling, uncrating, inspection, checking, assembling, rigging and installing equipment in its proper location, complete with ancillaries, in satisfactory operational condition.

E. Unloading, handling, and moving of equipment shall be performed in accordance with best rigging practices to preclude damage to equipment and building facilities. Equipment shall be moved without dismantling; where this is not possible, dismantle the equipment as required and reassemble same at final location.

F. Equipment shall be protected from the elements, dirt and other damage from the time it is removed from the point of receipt or storage until final system acceptance by Owner.

G. Equipment shall not be slid without the benefit of metal skid plates or wooden skids. In areas with finished floors, equipment shall be moved by means of rollers, dollies or shall be trucked clear of the floor.

H. Equipment shall include the component parts thereof; such as motors, drives, guards, baseplates and like items necessary to satisfactory and safe operation of item.

I. Replace the filters used during the construction phase.

J. The means employed for performing various classes of Work shall be subject to requirements specified elsewhere herein, the manufacturer's specific assembly and installation procedures and instruction, requirements of Federal, State and local regulations and acceptance of Owner.

K. Supports: Provide supports and miscellaneous steel members for equipment and be responsible for coordinating this Work and setting equipment in place.

L. Field Quality Control:

1. After the equipment is installed, the manufacturer's representative shall inspect the installation and recommend any corrective actions. Do not startup the equipment until the following operations are completed:
    i. All controls are installed and fully operational.
    ii. Power is connected to the unit.
    iii. Shipping materials have been removed.
    iv. Filtration media is installed and clean.
    v. Piping and duct connections are installed and operational.
    vi. Leak checks are completed on all water connections.
    vii. All wiring, refrigerant piping, gasketing and hardware are properly installed on any multiple section units.
    viii. All adjustable frequency drive driven components including motor, sheaves, belts and fans must have vibration levels checked at all speeds between two and one hundred (2 - 100%) percent of the driven unit's design rpm. Vibration must be checked at fan shaft bearings in radial (vertical and horizontal) and axial directions. If excessive vibration is found at any frequency, special balancing and structural changes must be provided to minimize harmonic vibrations.
    ix. Lubrication:
        1. Lubricate all equipment installed up to time of acceptance by Owner.
        2. Lubricants shall be of grade and quality specified by equipment manufacturers, whose literature shall contain said data or written specifications provided with equipment delivered.

M. Demonstration:

1. The manufacturer or manufacturer's representative shall instruct the owner's personnel in the proper use, operation and maintenance of the equipment.
2. The manufacturer or manufacturer's representative shall train the owner's personnel in normal procedures to be followed in case of an operation failure or equipment malfunction.
3. 4 hours of on-site training shall be provided and coordinated to take place immediately after equipment start up.

END OF SECTION

SECTION 23 82 05
SPACE TERMINAL HEATING UNITS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include, but is not limited to, the following:

1. Convectors
2. Radiators
3. Unit heaters
4. Cabinet heaters
5. Thermostatic control valves

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

C. Section 23 05 16 – Expansion Fittings and Loops for HVAC Piping

D. Section 23 05 23 – General-Duty Valves for HVAC Piping

E. Section 23 05 48 – Vibration and Seismic Controls for HVAC

F. Section 23 21 16 – Hydronic Piping Specialties

G. Section 23 82 16 – Air Coils

1.03 REFERENCE STANDARDS

A. AMCA – Air Movement and Control Association

B. ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers

1. ASHRAE 102 Methods of Testing Non-Electric, Non-Pneumatic Thermostatic Radiator Valves

C. ASTM – American Society for Testing and Materials

1. ASTM B743 Standard Specification for Seamless Copper Tube in Coils

D. NEMA – National Electrical Manufacturers Association

E. NFPA – National Fire Protection Association

1. NFPA 70 National Electrical Code

F. OSHA – Occupational Safety Hazard Association

G. UL – Underwriters Laboratories Inc.

1. UL 486A-486B Wire Connectors

1.04 QUALITY ASSURANCE

A. Electric heating units shall be UL- or ETL-rated and bear certifying label.

B. All components within the air stream shall conform to the NFPA 90A Standard for Flame/Smoke/Fire contribution of 25/50/0. Dampers, electrical enclosures, and housing shall be metal.

C. All units shall be the product of a single manufacturer who is regularly engaged in the production of floor air distribution system.

D. Units shall be specifically designed for installation in floor and shall be furnished complete with all necessary controls and wiring to provide operation according to manufacturer's recommendations.

E. Equipment shall be listed under and conform to appropriate sections of U.L., CSA, E.T.L. and other testing laboratory requirements as required by local building codes.

F. Hydronic heating units shall be rated and tested for pressure as shown on the Drawings.

1.05 SUBMITTALS

A. Submit dimensioned drawings, construction details, color samples for architect review, performance and product data for approval. Include listing of discharge and radiated sound power levels. Data shall include all wiring diagrams, control sequences and power requirements as applicable to the product and coordination with other systems.

1.06 DELIVERY, STORAGE, AND HANDLING

A. All equipment shall be shipped, stored, and handled per the manufacturer's recommendations.

1.07 WARRANTY

A. All equipment shall be provided with an equipment warranty for a duration of three (3) years from installation and acceptance.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Hydronic Cabinet Heaters and Unit Heaters: Trane, Modine, York, Vulcan

B. Electric Cabinet Heaters and Unit Heaters: Trane, Markel, Brasch

C. Hydronic Radiators and Convectors: Zehnder Rittling, Vulcan, Sterling, Trane

D. Electric Radiators and Convectors: Trane, Vulcan, Markel, Brasch

E. Panel Radiators: Runtal or approved equal

F. Thermostatic Control Valves: ISTA

2.02 RADIATORS

A. Provide radiators of types, sizes and capacities as shown on the Drawings.

B. Mounting brackets shall be of the slide-cradle type to permit for expansion and contraction.

C. Hydronic Heating Units: Provide copper tube/aluminum fin heating elements. Arrange for access to valves and accessories by means of doors or removable sections two feet in length, maximum. Provide expansion compensators as required.

D. Electric Heating Units: Provide tubular heaters with aluminum fins 0.01-inch thick, mechanically crimped in place, and helically coiled resistance wire, mounted centrally within ⅜-inch diameter aluminum or steel sheath, insulated from sheath with magnesium oxide; with a watt density of 100 watts per foot to 300 watts per foot.

E. Provide baked enamel prime-coated minimum 20-gauge zinc-coated steel enclosure of sizes shown on the Drawings.

2.03 CONVECTORS

A. Provide cabinet convectors of type, size and capacity shown on the Drawings.

B. Construct cabinet enclosure of formed steel, 16-gauge side and front panels, 20-gauge rear panel, for free standing, wall hung, partially or fully recessed installation as required. Provide access in cabinet to controls. Provide baked enamel prime coat and finish coat of paint. Finish color shall be selected by the Architect from a full selection of standard and non-standard colors.

C. Hydronic Heating Units: Provide copper tube/aluminum fin heating elements. Provide access in cabinet to valves.

D. Electric Heating Units: Provide sheathed nickel-chromium wire elements expanded into aluminum fins, suspended between junction boxes; provide integral thermal cut-outs.

2.04 UNIT HEATERS – PROPELLER FAN TYPE

A. Provide propeller type unit heaters with heater elements, motor-driven propeller type fans, all installed in a minimum 20-gauge formed steel casing, finished with baked enamel paint.

B. Motor speeds shall not exceed 1,500 high-speed revolutions per minute. Remove and replace any unit heaters, which are objectionably noisy.

C. Provide an “On/Off” switch, overload protection and a 120-volt thermostat.

D. The heaters shall be controlled automatically by means of thermostats, to start and stop the fans. The thermostats shall be adjustable and designed to operate on a 3-deg F differential over a temperature range of approximately 20 degs F to 75 degs F.

E. Each unit heater shall be properly isolated and supported from building construction and be provided with seismic restraints to prevent sway.

F. Hydronic Heating Units: Provide copper tube/aluminum fin heating elements. Install an aquastat in the supply connection to each heater, wired to prevent the fan from operating when there is no heat available. Unit heaters shall be supported independently of the piping to which they are connected.

G. Electric Heating Units: Provide heating elements of sheathed nickel-chromium wire.

2.05 CABINET HEATERS – CENTRIFUGAL FAN TYPE

A. Provide cabinet heaters of type shown on the Drawings with integral 120-volt thermostats controlling the unit fan. Also provide an On/Off switch with overload protection.

B. Hydronic Heating Units: Provide copper tube/aluminum fin heating elements. Install an aquastat in the supply connection to each heater, wire to prevent the fan from operating when there is no heat available. Valves shall be installed within the enclosure. Provide hand access doors for access to valves.

C. Electric Heating Units: Provide heating elements of sheathed nickel-chromium wires.

D. Construct enclosures of formed steel, rigidly braced throughout and fabricated of not less than 16-gauge steel. Where the cabinet heater is shown to be recessed or semi-recessed, provide neat, close-fitting metal trim strips to form a permanent bond between the unit heater and the wall.

E. Provide all enclosures and trim strips with baked enamel prime coat and finish coat of paint. Finish color shall be selected by the Architect from a full selection of standard and non-standard colors.

2.06 THERMOSTATIC CONTROL VALVES

A. Provide self-contained, non-electric temperature-regulating valves with temperature range from 40 degs F to 80 degs F. The actuator shall have freeze protection marked and a positive shut-off position marked. The temperature sensor element expands or contracts with the room temperature. This movement adjusts the valve opening, which increases or decreases the flow of hot water. This continual modulation maintains even temperature levels in each separate heating zone of plus or minus 1 deg F.

B. Valves shall be designed for very low flow sound level and minimum expansion noise. Valve stems and balancing spring shall be stainless steel and the valve disc shall be EPDM (Ethylene-Propylene-Dienemonomer Material). Provide tool to exchange the entire valve insert (O-rings, disc, etc.) without draining or stopping the heating system. All thermostatic valves (0.5-inch, 0.75-inch, 1-inch, 1.25-inch straight, angle or horizontal angle) shall have the same size valve insert to accommodate any type of thermostatic actuator.

C. Service:

1. Maximum Temperature: 248 degs F
2. Maximum Pressure: 150 psi – hot water
3. Valves shall meet ASHRAE 102-1983 Revised 1989

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide shut-off and isolation valves, balancing cocks and manual air vent for each radiator, convector, cabinet/unit heaters or finned tube element.

B. Install radiators, convectors and cabinet/unit heaters as detailed on the architectural drawings and follow manufacturer's instructions.

C. All piping and control valves serving radiators, convectors and cabinet/unit heaters shall be concealed or installed within empty sections of radiator cabinet.

END OF SECTION

SECTION 23 82 16
AIR COILS

PART 1 – GENERAL

1.01 WORK INCLUDED

A. The work of this Section shall include the furnishing and installation of all hydronic cooling and heating coils.

1.02 RELATED DOCUMENTS

A. Section 23 05 01 – HVAC General Provisions

B. Section 23 05 93 – Testing, Adjusting and Balancing for HVAC

C. Section 23 21 16 – Hydronic Piping Specialties

D. Section 23 36 00 – Air Terminal Units

E. Section 23 74 13 – Packaged Outdoor Central-Station Air-Handling Units

F. Section 23 74 24 – Packaged Makeup-Air Units

G. Section 23 75 13 – Custom-Packaged Outdoor Central-Station Air-Handling Units

H. Section 23 81 23 – Computer-Room Air-Conditioners

I. Section 23 82 05 – Space Terminal Heating Units

1.03 REFERENCE STANDARDS

A. AHRI (ARI) – Air-Conditioning and Refrigeration Institute Standards

1. AHRI 410 Forced-Circulation Air-Cooling and Air-Heating Coils

B. ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

1. ASHRAE 33 Methods of Testing Forced Circulation Air Cooling and Air Heating Coils

1.04 QUALITY ASSURANCE

A. Test, rate and certify hydronic coil performance and characteristics in accordance with AHRI and ASHRAE.

1.05 SUBMITTALS

A. Submit in accordance with Division 1 and Section 23 05 01 – HVAC General Provisions.

B. Product Data: Hydronic coils size, weight, materials of construction, mounting details, and arrangement data.

C. Certified performance data at AHRI conditions and scheduled performance conditions.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Hydronic Coils: Aerofin, Trane, Carrier, York, McQuay, Heatcraft

B. Reheat Coils at VAV Terminal Units: Titus, Krueger, Trane, Nailor

2.02 HYDRONIC COILS

A. Duct, VAV terminal unit and fan coil mounted coils shall be continuous tube coils without headers, ½-inch minimum O.D. seamless copper tubes and "U" bends of 0.025 inch minimum wall thickness, aluminum fins with maximum 12 fins per inch, and hot-dipped galvanized steel casing. Test at 250 pounds per square inch air pressure. Provide size, arrangement and performance as indicated on the Drawings. Provide tubes mechanically expanded into minimum 0.010 inch thick fins.

B. Selection Criteria: Number of tube rows, air- and water-pressure drops, and accessory features as cleanability, drainability, same- or opposite-end connections, supports and venting; same as for type specified.

C. All coil performance shall be certified by the American Refrigeration Institute (AHRI) standard 410.

D. VAV terminal unit coils shall be selected for the scheduled maximum pressure drop at maximum (cooling) airflow.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Provide connections to coils as shown on the Drawings.

B. Provide suitable supports as required to properly mount coils. For built-up coil banks, each coil section shall be removable without removing other sections. Provide structural frame to support coil sections.

C. Install per manufacturer's recommendations.

D. Each hydronic coil section in a bank of coils shall have separately valved supply and return connections.

E. Crushed or dented return bends or fins shall be repaired to the satisfaction of the Architect or the entire coil shall be replaced.

F. Arrange for counter-flow airflow with respect to hydronic flow.

G. For built-up coil banks, see the Drawings.

H. Install all welded Type 316 stainless steel double-wall insulated drain pans pitched to drain under each cooling coil section extending minimum 9 inches upstream and 15 inches downstream of each coil. Trap and drain each pan. In built-up coil banks, intermediate drain pans may be piped from pan to lower main drain pan. Refer to Related Documents in Paragraph 1.02 for additional drain pan requirements.

I. Install coils with ½-percent minimum pitch in two directions to the connection end at coil to facilitate complete draining of coil. Size of drain connection shall be based on requirements.

J. Cooling coils shall be capable of operating at face velocities of up to 600 feet per minute without moisture carryover.

END OF SECTION

SECTION 26 00 00
ELECTRICAL TABLE OF CONTENTS

Section No.	Title
26 00 00	Electrical Table of Contents
26 05 01	Electrical General Provisions
26 05 02	Equipment Connections and Coordination
26 05 04	Firestopping
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26 05 73	Electrical Power System Study
26 12 19	Medium Voltage Liquid Filled Pad Mounted Transformer
26 24 13	Switchboards
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26 27 14	Electrical Submetering System
26 27 26	Wiring Devices
26 28 13	600V Fuses
26 28 16	Disconnect Switches
26 31 00	Solar Photovoltaic System
26 32 13	Engine Generator System
26 36 13	Automatic Transfer Switches
26 41 00	Lightning Protection System
26 43 13	Surge Protection Devices
26 50 00	Luminaires and Accessories
28 31 00	Fire Alarm System

END OF SECTION

SECTION 26 05 01
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Electrical General and Supplementary Conditions are a part of the requirements for the work under this Division of the Specifications.

B. Prior to Bid submission, examine all bidding documents such as drawings, specifications, clarifications, addenda, alternates, and special conditions of all Division Sections. Confirm all site governing field conditions and become fully informed as to the extent and character of the work required to complete all systems installations. A Bid Submittal is an agreement that this Contract includes all Contract Document requirements and considerations will not be allowed for any future claims.

C. Submittal of a bid is deemed a representation by the Bidder that it is qualified in all respects to properly perform the work for which it is bidding and has experience with similar work. Bidders are deemed to be aware of materials and methods which maybe required in the discharge of their responsibilities, even though unspecified.

D. Indemnify the Owner and the Architect/Engineer against loss, liability, damage, or expense, including attorneys' fees, in connection with any claim resulting from damage which may be asserted by any third party.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 WORK INCLUDED

A. Provide labor and materials required to install, test, and place into operation the electrical systems as indicated in the Contract Documents, and in accordance with all applicable laws, codes, rules, ordinances, and regulations.

B. Provide labor, materials and accessories required to provide complete operating electrical systems. Labor, materials, or required accessories not specifically called for in the Contract Documents, but necessary to provide complete operating electrical systems shall be provided without additional costs to the Owner.

C. Fully indemnify the Owner and the Architect/Engineer against loss, liability, damage, or expense, including attorneys' fees, in connection with any claim resulting from damage which may be asserted by any third party.

D. This Contractor shall accept delivery of the pre-purchased equipment at the site, retain responsibility and warranty for the equipment; inspect the equipment upon delivery for damage; and install the equipment for a complete functioning system.

This shall be provided regardless of who purchased the equipment.

1.04 QUALITY ASSURANCE

A. Comply with the current applicable laws, codes, rules, ordinances, and regulations of the Authorities Having Jurisdiction (AHJ), the rules, regulations, and requirements of the utility companies serving the project and the Owner's insurance underwriter. The Contractor shall secure and pay all necessary permits and licenses related to the electrical scope of this Division until the successful completion of the project. The Electrical Contractor shall be a licensed in Westchester County, NY.

B. Multiple codes or standards are referenced, the current enforced edition and applicable portions apply, unless noted otherwise.

C. Drawings, specifications, codes, and standards are minimum project requirements. Should requirements differ, apply the most stringent as part of the base bid.

D. Should any change in the Contract Documents be required to comply with any governing regulations, notify the Architect/Engineer prior to submitting a bid.

E. All electrical equipment, materials, devices, and installations shall meet or exceed minimum requirements of ADA, ANSI, ASTM, IEEE, IES, NEC, NEMA, NETA, NFPA, OSHA, SMACNA, UL, and the County Fire Inspector.

F. Perform all work in strict accordance with the best industry practices of the trades in a thorough, substantial, workpersonlike manner by competent workpeople. Provide a competent, experienced, full-time Electrical Superintendent who is authorized to make decisions on behalf of the Contractor.

G. Equipment shall meet the NY State Energy Code.

1.05 ABBREVIATIONS AND DEFINITIONS

A. Abbreviations:

ADA	Americans with Disabilities Act
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
ASA	Acoustical Society of America
ASTM	American Society for Testing and Materials
BIL	Basic Impulse Level
CBM	Certified Ballast Manufacturers
DEP	Department of Environmental Protection
ECC	Engineer's Control Center
EIA	Electronic Industries Alliance
ETL	Electrical Testing Laboratories, Inc.
FCC	Fire Command Center
FM	Factory Mutual
FS	Federal Specifications
IBC	International Building Code
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IPCEA	International Power Cable Engineers Association
LED	Light Emitting Diode

LEED	Leadership in Energy and Environmental Design
MSDS	Material Safety Data Sheet
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NRTL	Nationally Recognized Testing Laboratory
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
SCC	Security Control Center
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
TIA	Telecommunications Industry Association
UL	Underwriters Laboratories

B. Definitions:

1. Where it is stated in these specifications to submit to the Engineer for review, refer to the Architectural General and Supplementary Conditions for proper procedures.
2. AS DIRECTED: is defined as directed by the Architect/Engineer, or the respective representative.
3. COMMISSIONING AUTHORITY: The entity identified by the Owner as responsible for implementing the Commissioning Process.
4. CONCEALED: is defined as embedded in masonry or other building construction, installed behind wall furring or within drywall partitions, or installed within hung ceilings, or raised floor cavities.
5. CONSTRUCTION DOCUMENTS: All documents associated with the project, including all drawings and specifications of all trades.
6. FURNISH: is defined as to supply/purchase all materials, labor, equipment, handling, testing apparatus, controls, tests, and all accessories required for the proper operation and complete application.
7. INSTALL: is defined as to join, unite, fasten, link, attach, set up, or otherwise connect before testing and turning over to the Owner, complete and ready for regular operation.
8. PROVIDE: is defined as FURNISH and INSTALL.
9. SUPPLY: is defined as to purchase, procure, acquire, and deliver complete with related accessories.
10. SUBMIT: is defined as submit to the Architect/Engineer for review and action as specified herein.
11. WORK: Includes labor, materials, equipment, services, and all related accessories necessary for the proper and complete installation of complete electrical systems.

1.06 GUARANTEE

A. Submit a single guarantee stating that all portions of the work are in accordance with the Contract Documents. Guarantee work against faulty and improper material and workmanship for a period of two (2) years from the date of final acceptance by the Owner, except that where guarantees or warranties for longer terms are provided or specified herein, the longer term shall apply. Correct any deficiencies which occur during the guarantee period, within 24 hours of notification, without additional cost to the Owner, to the satisfaction of the Owner. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

B. Guarantee that the materials and workmanship supplied under this division will be the best quality currently available, that the apparatus will be erected in a practical manner and in accordance with best industry practices, that it will be complete in operation, nothing being omitted in the way of labor and material required to make this so, although not specifically shown or mentioned herein, and that it will be delivered in proper working order, complete and perfect in all respects with additional cost, whether or not shown in detail on the Contract Drawings or described in detail in the specifications.

1.07 USE OF THE ARCHITECT'S AND ENGINEER'S DRAWINGS

A. Upon request, the Contractor shall obtain, at the Contractor's expense, from the Architect or Engineer a set of digital data files in Autodesk REVIT compatible format architectural and engineering design drawings on electronic media where desired by the Contractor and/or required by the Specifications for use in preparing the shop drawings, coordination drawings, and record drawings.

B. The Contractor acknowledges and agrees that the electronic files are the sole property of the Engineer. Except for use as electronic files for the drawings on this project, the files may not be duplicated, may not use the files on any other projects, or allow them to be used by other persons. Use of these files is granted only for the preparation of drawing submittals by the Electrical Contractor on this subject project. The Engineer is acknowledged as the Author, retaining all common law, statutory and other reserved rights, including copyright.

C. The Contractor shall provide to the Architect and Engineer a written release of liability acceptable to the Architect and Engineer prior to receiving the electronic media files. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the A/E from and against all claims, damages, losses, and expenses including attorney's fees, directly or indirectly arising out of, or alleged to arise out of, or resulting from the use of the computer files, including but not limited to all claims, damages, losses, or expenses which may be attributable to bodily injury, sickness, or death, or to injury to or destruction of tangible property.

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. Provide products and materials that are new, clean, free of defects, and free of damage and corrosion. Provide products and materials as specified within the Contract Documents. Provide premium, first-class products and materials if not specifically specified herein. Any work or products which are provided that are less than the specified quality, the respective materials and work shall be replaced at no additional cost to the Owner, as directed by the Architect/Engineer.

B. Products and materials proposed for this project shall not contain any materials that are considered hazardous by the Environmental Protection Agency or any Authorities Having Jurisdiction. Should the Contractor encounter any hazardous materials during the project, this Contractor shall halt work and notify the Owner of such.

C. Provide name/data plates on all major components of equipment with the manufacturer's name, model number, serial number, capacity data, and electrical

characteristics.

D. Only Qualified Trades People shall install the materials and equipment on this project.

E. The Contract shall maintain standardization of manufacturers for equipment used in similar applications and sizes throughout the project.

F. Applicable equipment and materials shall be listed by Underwriters Laboratories and manufactured in accordance with IEEE, NFPA, or ANSI standards, and as approved by the Authorities Having Jurisdiction.

G. Fully lubricate equipment prior to operation, where required, in accordance with the manufacturer's requirements.

H. Follow the manufacturer's instructions for installing, connecting, and adjusting all equipment. Provide a copy of such instructions during the equipment installation and in the O+M documents.

I. The Contractor shall provide equipment factory testing to visually review the respective performance. The Engineer and Owner's representatives may choose to attend or are required to witness such testing, associated travel costs and subsistence shall be paid for by the Contractor.

J. Equipment capacities, ratings, etc., are scheduled or specified for the job site operating conditions. Equipment sensitive to altitude shall be derated with the method of derating identified on the submittals.

K. Enclosures for electrical equipment installed in mechanical equipment rooms shall be NEMA Type 1 gasketed. Enclosures for electrical equipment installed outdoors shall be NEMA Type 4X.

L. All floor mounted equipment shall be installed on a 4" high concrete housekeeping pad which shall be coordinated with the final equipment being purchased. The pads shall be reviewed and approved by the Structural Engineer; and shown on all coordination drawings and be fully coordinated with all trades. Concrete work shall be provided by others.

2.02 ALTERNATIVE EQUIPMENT AND MATERIALS

A. Contract Documents are based on the materials specified and per the equipment manufacturers indicated. Acceptance of alternative equipment manufacturers does not relieve the Contractor of the responsibility to provide equipment and materials which meet the quality and performance as stated or implied in the Contract Documents.

B. Equipment manufacturers listed in individual sections are acceptable for this project, subject to the requirements of Contract Documents.

C. Submit proposals to supply alternate materials or equipment, in writing, with sufficient lead time for review prior to the date equipment must be ordered to maintain the project schedule. Reimburse the Owner for costs associated with the review of the proposed alternatives whether the alternatives are accepted or rejected.

D. Include revisions required to adapt alternatives in such proposals, including revisions by other trades. No increase in the contract price will be considered to accommodate the use of alternative equipment.

E. Wherever quality standards (such as serviceability, longevity, and durability) and operating results (such as noise levels and energy efficiency) are specified or scheduled, or when the manufacturer and size of equipment, for which such operating results are published or determined, is specified, the substitution being proposed must conform to the quality and quantities specified or implied. The substitution must fit into available space conditions and must function properly in coordination with the rest of the system.

F. When making an alternative equipment or material request, the Contractor:

1. Represents that the Contractor has personally examined the Contract Documents and has determined that the proposed substitution is appropriate for the use intended in the Contract Documents and is equal to or superior in all aspects to that specified.
2. Represents that the substitution has received the necessary approvals of the Authorities Having Jurisdiction.
3. Will coordinate the installation of the accepted substitution into the work, making such changes as may be required for the work to be complete in all aspects. This includes changes required by other Divisions.

G. Proposed changes and substitutions of systems, equipment, and manufacturers shall be submitted and include the following information with the proposal:

1. A description of the differences between the existing contract requirements and that proposed, the comparative features of each, and the effect of the change on the final resulting performance. Include the impact of all changes on other Contractors and acknowledge the inclusion of additional costs to other trades. A line-by-line specification review indicating compliance of the proposed substitution with the project specifications. All deviations and exceptions from the project specifications shall be clearly indicated.
2. Schematic drawings and details to supplement the description. If accepted, the Contractor shall be responsible for the full complete design and resulting impacts of the proposed equipment/system.
3. A list of the contract requirements that must be revised if the change is accepted, including any specification revisions.
4. Complete list of materials and equipment proposed for use in the change.
5. Include a description and estimate of costs the Owner may incur in implementing the change, such as additional space requirements, permits, architectural and aesthetic impact, design costs, tests, permit evaluation, operating, and support costs.
6. A projection of any effects the proposed change would have on collateral costs and schedule to the Owner.
7. A statement of the time by which a contract modification accepting the change must be issued, noting any effect on the contract completion time or the delivery schedule.
8. A statement indicating the reduction to the contract price if the Owner accepts the change. Be responsible for appropriate modifications to all trades.

PART 3 - EXECUTION

3.01 FEES AND PERMITS

A. The Contractor shall provide and obtain all necessary permits, inspections, licenses, and certifications in accordance with all applicable codes, regulations, and Authorities Having Jurisdiction. This shall include the following:

1. Arrange and pay all required fees.
2. Pay royalties or fees in connection with the use of patented devices and systems.
3. Provide controlled or witnessed inspections.
4. Arrange for all final inspections and related fees.

3.02 SUBMITTALS AND REVIEWS

A. Submit shop drawings, manufacturer's product data sheets, samples, and test reports as specified on the Contract Documents.

B. After receiving notice to proceed from the Owner, or after execution of the Owner/Contractor Agreement, the Contractor shall provide:

1. A complete list of all electrical equipment manufacturers and material suppliers for the equipment proposed to be provided on this project, as well as names of all subcontractors, shall be submitted.
2. A comprehensive list of all submittals for the project, each with unique submittal identification number which is cross-referenced to Contract Documents shall be submitted.
3. Prepare complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all subcontractors, for all materials and equipment specified herein. All data and details of such materials and equipment shall be submitted for review.
4. Certify that the shop drawings, product data, and samples follow the Contract Documents prior to submission to the Engineer.
5. The Contractor shall be responsible for inspecting all materials and equipment upon their job site arrival and verifying their complete compliance with the Contract Documents.
6. The Contractor shall be responsible for modifying or replacing any work, at no cost to the Owner, which proceeds prior to receiving accepted shop drawings as required to comply with the Contract Documents and the shop drawings.

C. Submittal reviews are for general compliance with the design concept and the Contract Documents. Comments or absence of comments shall not relieve the Contractor from compliance with the Contract Documents. The Contractor shall remain solely responsible for all details and accuracy, for confirming and correlating all quantities and dimensions, for selecting fabrication processes, for all construction means and methods, for performing the work in a safe manner, and for coordinating the work with that of other trades.

D. Equipment shall not be ordered, procured, started in the shop or in the field until all relevant shop drawings and samples for that portion of the work have been submitted, reviewed, and returned with either "No Exceptions Noted" or "Exceptions Noted" marked on the submittal, as indicated below.

E. Submittals labeled FOR RECORD or RECORD ONLY shall not be reviewed by the Engineer.

F. The Contractor shall include in the construction schedule a minimum period of ten (10) working days, exclusive of transmittal time, for the Engineer's review of each submitted shop drawing, product data, and/or samples.

G. Submit all required shop drawings and manufacturer's product submittals in electronic Portable Document Format (PDF) through a file sharing website or as required by the Owner's Representative or Architect. Review comments will be marked up electronically in the submittals and returned to the Architect or Construction Manager, per the established project procedures. Hard copy paper submittals will not be accepted. Electronic submittals shall be provided with the following information and format:

1. Provide each submittal as a complete indexed file incorporating all requirements of the specific submittal section being submitted for review.
2. Name file with project identifier, submittal number, and revision number.
3. Include the following minimum information as metadata in the electronic PDF file:

    a. Date of Submittal
    b. Project Name
    c. Specification Section Number and Title
    d. Drawing/Detail Reference Numbers (as appropriate)
    e. Manufacturer Name
    f. Product Name

4. Each submittal shall include the following, as applicable:

    a. Accurately identify by means of underlining, use of arrow or placing a box around all equipment ratings, model numbers, options, etc. The identification shall be in color to clearly indicate what is included in the submittal.
    b. Any irrelevant information shall be crossed out.
    c. All technical and dimensional data.
    d. Initial installation and service connection requirements.

5. Incomplete or inadequate submittals will not be reviewed by the Engineer and will be returned to the Contractor for their action and resubmission.
6. Provide electronic transmittal form with the following information:

    a. Project Name
    b. Date Initiated and Date Due
    c. Contact Details for Owner, Architect and Engineer
    d. Name of Contractor, Sub-Contractor, Manufacturer, and/or Supplier
    e. Type of Submittal
    f. Specification Section Number and Title
    g. Drawing/Detail Reference Numbers (as appropriate)
    h. Indication of Partial or Full Submittal
    i. Stamp Page for Submittal Stamps

H. All submittals will be stamped with the following actions:

Stamp	Interpretation
No Exceptions Noted	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents.
Exceptions Noted [ ] Resubmit for Record [ ] No Resubmission Required	Fabrication, manufacture, or construction may proceed providing submittal complies with the Contract Documents and the Engineer's notations are complied with.
Revise and Resubmit	The submittal does not comply with the Contract Documents; do not proceed with fabrication, manufacture, or construction. The work and shop drawings are not permitted at the job site. Resubmit appropriate shop drawings.

I. The Contractor shall be responsible to maintain on site a complete set of reviewed and stamped shop drawings and product data.

J. The Contractor shall prepare and submit the following for review and acceptance at the time of the respective equipment submittal:

1. Plan and elevation layout shop drawings indicating the electrical equipment in the exact location in which it is intended to be installed. These plans shall be of a scale not less than ¼ inch = 1'-0" and shall be prepared in the following manner:

    a. Identify the space physical boundaries of space including door swings and ceiling types and heights.
    b. Document all proposed electrical equipment to be contained therein, including top and bottom elevations; front and rear code mandated clearance requirements; concrete pads and curbs; dunnage; and all equipment maintenance clearances. The submittal shall utilize the dimensions contained in the individual equipment submittals marked No Exception or Exceptions Noted.
    c. Clearly indicate all other equipment located in the same space such as conduits, detectors, sensors, luminaries, ducts, registers, pull boxes, wireways, structural elements, etc.
    d. Indicate the heat release (BTU/hr.); maximum allowable operating temperature; and operating weight of each piece of equipment.
    e. Equipment installation and removal routes. Indicate on the floor plans the complete routes with directional arrows. Equipment weights shall be indicated to assure structural integrity.

K. The Contractor shall prepare a detailed submittal clearly identifying all major conduit rack feeder routes with associated pull boxes and support points. The submittal shall be coordinated with all trades and shall indicate required wall or floor penetrations.

These drawings shall be submitted for review by the Engineer and Structural Engineer prior to any work.

L. The work described in shop drawing submissions shall be carefully checked by all trades for clearances (including those required for maintenance and servicing), field conditions, maintenance of architectural conditions and coordination with other trades on the job. Each submitted shop drawing shall include a certification that related job conditions have been checked by the Contractor and each Subcontractor and that conflicts do not exist.

M. The Contractor is not relieved of the responsibility for dimensions or errors that may be contained in submittal submissions, or for deviations from the requirements of the Contract Documents. Understand clearly that the Engineer's noting some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the shop drawings, product data and samples, the Contract Documents govern the work and are neither waived nor superseded in any way by the review of shop drawings, product data, and samples.

N. Indicate the following on the lower right-hand corner of each shop drawing and on the front cover of each product data brochure cover: The submittal identification number; title of the sheet or brochure; name and location of the project; names of the Architect, Engineer, Contractor, Subcontractor, manufacturer, supplier, and vendor; the date of submittal; and the date of each correction, version, and revision. Number all pages and drawings in product data brochures consecutively from beginning to end. Unless the above information is included, the submittal will be returned for resubmission. Resubmittals of product data or brochures shall include a cover letter summarizing the corrections made in response to the review comments.

O. The distribution equipment, short circuit and coordination study, and room layout submittals shall be submitted concurrently. Failure to submit concurrently may result in the immediate return of the submittal marked REVISE AND RESUBMIT.

P. All shop drawings shall be prepared utilizing Revit 3D software.

3.03 COORDINATION OF WORK

A. The Contract Documents establish scope, materials and quality but are not detailed installation instructions. Contract Drawings are diagrammatic.

B. Coordinate work with related trades and furnish, in writing, any information necessary to permit the work of related trades to be installed satisfactorily and with the least possible conflict or delay.

C. The Contract Documents show the general arrangement of equipment and distribution. Follow these drawings as closely as the actual construction and the work of other trades will permit. Provide offsets, fittings, and accessories, which may be required to suit field conditions but may not be shown on the Contract Drawings. Investigate the site, and review drawings of other trades to determine conditions affecting the work and provide such work and accessories as may be required to accommodate such conditions.

D. The locations of lighting fixtures, outlets, panels, and other equipment indicated on the Contract Documents are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the

work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions, or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

E. All panels, outlets, switches, remote drivers, etc. locations shall be reviewed and approved by the Architect before proceeding with the installation.

F. The Contract Drawings show only the general run of raceways and approximate locations of outlets. Any significant changes in the location of outlets, cabinets, etc., required to meet field conditions shall be brought to the immediate attention of the Architect for review before such alterations are made. Modifications shall be made at no additional cost to the Owner.

G. Verify with the Architect the exact location and mounting height of outlets and equipment not dimensionally located on the Contract Drawings.

H. Circuit tags in the form of numbers are used where shown to indicate the circuit designation numbers in electrical panels. Show the actual circuit numbers on the as-built Record Drawings and on the associated typed panelboard directory card. Where circuiting is not indicated, provide required circuiting in accordance with the loading indicated on the Contract Drawings and/or as directed.

I. The Contract Drawings generally do not indicate the number of conductors in the conduit for the branch circuit wiring of fixtures and outlets, or the actual circuiting. Provide the correct wire size and quantity, including ground conductor, as required by the indicated circuiting, the control intent, referenced wiring diagrams (if any), the specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC.

J. Carefully check space requirements with other trades to ensure that equipment can be installed in the spaces allotted.

K. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that they have the information necessary so that they may professionally install the necessary connections and equipment. Identify items (remote drivers, pull boxes, etc.) requiring access in order that the ceiling trade will know where to install access doors and panels. All access door quantities and locations shall be reviewed and approved by the Architect prior to any work. Where requested to consolidate access needs with other Trades, the Contractor shall adjust without any additional cost to the Owner.

L. Furnish all required access doors – minimum size of 24” x 24”. Provide color marking buttons on the door for the respective systems: Electrical – Blue; Fire Alarm – Red; and Data/Low Voltage – Yellow.

M. Consult with other trades regarding equipment so that, wherever possible, motor controls and distribution equipment are of the same manufacturer.

N. Furnish and install sleeves for passage of electrical risers through structural masonry and concrete walls and floors and elsewhere as required for the proper protection of each electrical riser passing through building surfaces. Sleeves shall extend 2” beyond both sides of the surfaces. The Contractor shall fireproof the penetrations as required.

O. Provide firestopping around all conduits, sleeves, etc., which pass through rated walls, partitions, and floors in strict accordance with the manufacturer's published approval listing and rating.

P. Provide detailed information on openings and penetration required in precast members for electrical work and coordinate with the Structural Engineer

Q. Provide required supports and hangers for conduits and equipment, designed so as not to exceed allowable loadings of structures.

R. Conduits shall not be installed under Tenant areas beneath slab-on-grade. Where this is not achievable and has been approved by the Owner's representative, conduits installed under Tenant areas beneath slab-on-grade shall have minimum depth of 18" from the top of conduit to the bottom of slab-on-grade. Provide poured concrete cap on top of conduits or encase in concrete duct bank.

S. Examine and compare the Contract Documents with the drawings and specifications of other trades and report any discrepancies between them to the Architect and obtain written instructions for any necessary changes. Install and coordinate the work in cooperation with other related trades. Before installation, make proper provisions to avoid interference.

T. Wherever the work is of sufficient complexity, prepare and submit additional detail scaled drawings to coordinate the work with the work of other trades. Detailed work shall be clearly identified on the shop drawings. At completion include a set of these drawings with each set of Record Drawings.

U. Furnish the services of an experienced Electrical Superintendent, who shall be in constant charge of all work, and who shall coordinate work with the work of other trades. No work shall be installed before coordinating with other trades.

V. Coordinate with the County utilities serving the building as to their requirements for service connections and provide all necessary metering provisions, grounding, materials, equipment, labor, testing, and appurtenances. Obtain County approval of service entrance termination prior to ordering and installing the equipment. Coordinate with the County representative prior to the installation of equipment and service conduits. Install utility service conduits in strict accordance with the County and NEC requirements for minimum depth of cover, bend radii, and separation from other systems.

W. Before commencing work, examine adjoining work on which this work is in any way affected and report conditions, which prevent performance of the work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

X. Adjust location of conduits, panels, equipment, etc., to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each conduit prior to fabrication.

1. Right-of-Way: Lines which pitch have the right-of-way over those which do not pitch. For example: condensate, steam, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have right-of-way over lines whose elevations can be changed.
2. Provide offsets, transitions, and changes in direction of conduit as required

to maintain proper headroom and pitch on sloping lines.

Y. In case of doubt as to the work intended, or in the event of need for explanation, request supplementary instructions from the Architect.

3.04 CONTRACTOR'S COORDINATION DRAWINGS

A. The Contractor shall coordinate the efforts of all trades and shall furnish (in writing, with copies to the Architect) any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. The Contractor and all trade Contractors shall prepare a complete set of construction Coordination Drawings indicating the equipment purchased and the exact routing for all lines such as conduit, piping, ductwork, etc. The Coordination Drawings shall be submitted completely to the Architect and the Engineer in compliance with the construction schedule for the project. The sheet metal drawings, at a scale of not less than 1/4 inch to 1 foot shall serve as the base drawings to which all other Contractors shall add their work. Each separate trade Contractor shall draw their work on separate layers with different color assignments to facilitate coordination. Each Coordination Drawing shall be completed and signed off by the other Trade Contractors and the Contractor prior to the installation of the HVAC, plumbing, electrical and fire sprinkler work in the area covered by the specific drawing. The Contractor's work shall be installed according to the shop drawings and coordination drawings signed off by all trade Contractors. If the Contractor allows any trade to install their work before coordination with the work of other trades, the Contractor shall make all necessary changes to correct the condition at no additional cost to the Owner.

C. The Contractors' Coordination Drawings shall indicate structural loads at support points for racked conduits, suspended HVAC, plumbing, and electrical equipment. Submit to the Structural Engineer for review and approval. The elevation, location, support points, static, dynamic, and expansion forces and loads imposed on the structure at support and anchor points shall be indicated. All beam penetrations and slab penetrations shall be indicated and sized and shall be coordinated. Work routed underground or embedded in concrete shall be indicated by dimension to column and building lines and shall be coordinated. Coordination Drawings shall document all required structural penetrations for initial construction. Penetrations shall be dimensioned for walls, floors, and roofs. These structural coordination requirements require review and approval by the Structural Engineer prior to completion and submittal of the drawings.

D. This requirement for Coordination Drawings shall not be construed as authorization for the Contractor or trade Contractors to make any unauthorized changes to the Contract Documents. Contract Document space allocations shall be maintained such as ceiling height, designated clearance for future construction and flexibility, chase walls, equipment room size, unless prior written authorization is received from the Architect to change them.

E. Prior to final acceptance of the Work, the Contractor shall submit the Coordination Drawings as part of the Record Drawings submittal. Coordination drawings shall not be reviewed by the Engineer.

F. All coordination drawings shall be prepared utilizing Revit 3D software.

3.05 EXAMINATION OF SITE

A. The Contract Documents do not make representations regarding the character or extent of the sub-soils, water levels, existing structural, mechanical, and electrical installations, above or below ground, or other sub-surface conditions which may be encountered during the work. Evaluate existing conditions, which may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for the satisfactory completion of the work.

B. Evaluate existing conditions that may affect methods or cost of performing the work, based on examination of the site or other information. Failure to examine the Drawings or other information does not relieve the Contractor of responsibility for satisfactory completion of the work.

3.06 EXCAVATION WORKS

A. Provide excavation for the work of this Division. Excavate all material encountered, to the depths indicated on the Contract Drawings or as required. Remove from the site excavated materials not required or suitable for backfill. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water which accumulates. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.

B. Provide trenches of widths necessary for the proper execution of the work. Grade the bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Except where rock is encountered, do not excavate below the depths indicated. Where rock excavations are required, excavate rock to a minimum depth of four (4) inches below the trench depths indicated on the Drawings or required. Backfill over depths in the rock excavation and unauthorized over depths with loose, granular, moist earth, thoroughly machine tamped to a compaction level of at least 95% to standard proctor density or 75% relative density or as specified by the Architect. Whenever unstable soil that is incapable of properly supporting the work is encountered in the bottom of the trench, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel, or other suitable material.

C. Excavate trenches for utilities that will provide the following minimum depths of cover from existing grade or from indicated finished grade, whichever is lower, unless otherwise specifically shown or as required by Utility company (minimum of 3 feet for electric and communication).

D. Trenches shall not be placed within ten (10) feet of foundation or soil surfaces, which must resist horizontal forces.

E. Provide yellow warning tape within the trench backfill.

F. Do not backfill trenches until all required tests have been performed and successfully passed; and the installation observed by the Architect/Engineer. Prior to filling in the completed work, photo documentation and as-built drawings shall be prepared. All work shall be videotaped and turned over to the Owner. Comply with the requirements of other sections of the Specifications. Backfill shall consist of non-expensive soil with limited porosity. Deposit in six (6) inch layers and thoroughly and carefully tamp until the work has a cover of not less than one (1) foot. Backfill and

tamp remainder of trench at 1-foot intervals until complete. Uniformly grade the finished surface to match surrounding areas.

3.07 TEMPORARY POWER AND LIGHTING

A. The Electrical Contractor shall furnish, install, operate, protect, and maintain the temporary services for the construction light and power. The Contractor shall extend the temporary wiring throughout the project work areas, properly insulated, and installed in accordance with the NEC and OSHA.

B. The Electrical Contractor shall coordinate the installation with the Owner and provide metering in accordance with County Standards and Guidelines.

C. The scope of the responsibility shall include providing all necessary metering, distribution panels, transformers, cabling, conduits, ground fault interrupter protection, fixtures, fusing, LED lamps, and all other ancillary materials and equipment required to provide all the required construction power and lighting.

D. The power distribution shall be inclusive of all motors, tools, and equipment used by all the Contractors during construction.

E. Operate all equipment during all project working hours.

F. Maintain and repair all equipment and lamps during the duration of construction.

G. Upon completion of the project, all temporary equipment shall be disconnected and removed from the site. Coordinate all work with the County.

3.08 CUTTING, PATCHING, AND PAINTING

A. Coordinate all required cutting and patching with other Divisions of these specifications prior to any work.

B. Where cutting, channeling, openings, chasing or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for the proper installation, support or anchorage of conduit or other equipment, layout the work carefully in advance. Where such work is not provided, the Contractor shall provide accordingly. Repair any damage to the building, piping, equipment or surrounding finished spaces using skilled tradespeople of the trades required at no additional cost to the Owner.

C. Prior to any cutting, chasing, or drilling masonry, tile, etc., obtain written permission from the Architect and perform such work per the Architect’s details and direction.

D. Patch all cutting, chases, and openings created to allow the installation of this Contractor’s work.

E. Where conduits or equipment are mounted on a painted finished surface, or a surface to be painted, paint shall match the surface as directed by the Architect.

3.09 MOUNTING HEIGHTS

A. Mounting heights of electrical equipment shall conform to ADA requirements.

B. Verify exact locations and mounting heights with the Architect before installation.

C. Electrical and data outlets shall be mounted not lower than 15 inches above finished floor to the outlet bottom and not higher than 48 inches above the finished floor to the device top.

D. Wall mounted electrical switches or sensors shall be mounted not lower than 36 inches above finished floor to the device center and not higher than 48 inches above finished floor to the device center.

E. Fire alarm manual pull stations shall be mounted 48 inches above the finished floor to the device center.

F. Wall mounted data outlets shall be installed to conform to ADA mounting height requirements.

G. Fire Alarm Audio/Visual Devices: Mount not less than 80 inches to the center of the device or 6-inches below the finished ceiling, whichever is lower.

H. Wall Mounted Exit Signs: 2 inches above top of the door frame to bottom of the sign.

I. Stairwell and utility corridor wall mounted light fixtures shall be mounted 8 feet 6 inches above the finished floor or 1 foot below the ceiling or structure above, whichever is lower.

3.10 CONTINUANCE OF EXISTING SERVICES

A. The Engineer makes no representations, regarding the character or extent of the subsoils, water levels, existing structural, mechanical, or electrical installations, above or below grade, or other subsurface conditions which may be encountered during the work. This Contractor shall provide an evaluation of these existing conditions which may affect methods or cost of performing the work, based on the Contractor's own examination of the facility/site or other information. Failure to examine the Contract Documents or other information does not relieve the Contractor of his responsibility for satisfactory accomplishment of the work.

B. Existing electrical services not specifically indicated to be removed or altered shall remain as they presently exist.

C. Where existing services interfere with new construction, alter, or reroute such existing equipment to facilitate new construction after obtaining written permission from the Architect. Notification in writing giving two (2) weeks' advance notice of planned alteration is required. All shutdowns shall be pre-approved by the Owner in writing a minimum of two (2) weeks prior to the scheduled work.

D. Preserve continuity of service of existing facilities (related to damage or alteration due to new construction). Unauthorized alteration to existing equipment shall be corrected without additional cost to the Owner.

E. Construction power shall be the responsibility of this Contractor who shall coordinate this with the County. This Contractor shall provide all equipment, permits, metering, distribution, and fees throughout the duration of the project.

F. The Contractor shall exercise careful site logistical reviews to ensure that fire

hydrants, fire alarm equipment, and all other life safety equipment is not blocked, and full access is maintained throughout construction. Assure all egress paths are maintained and free of debris.

G. The Contractor shall maintain power continuity to the existing chimney FAA lights and controls; and the existing feeder to the adjacent building. Provide temporary power to support these loads via a temporary generator as required.

3.11 DEMOLITION WORKS

A. The Contractor shall include in the bid proposal all costs associated with the removals and relocations of electrical work as described in the Contract Documents with allowances for expected and unforeseen difficulties when concealed work has been opened. No claims for additional work associated with demolition will be accepted. Examine the site to observe the existing conditions prior to submitting a bid.

B. The Contractor shall remove and/or relocate all existing electrical work which interferes with the new construction in full coordination with the architectural demolition drawings. All systems which are no longer required to function shall be de-energized and disconnected at the power supply source.

C. The Contractor shall perform demolition and removal work with minimum interference with functioning electrical systems. All demolition shall be scheduled in advance.

D. All raceways which become exposed during the alteration work shall be removed and rerouted concealed behind finished surfaces.

E. Reconnect circuits serving equipment required to remain in service to other panelboards or other appropriate distribution equipment. Provide additional appropriate distribution equipment where there is insufficient available capacity in the remaining existing equipment for reconnection.

F. Remove existing conduit and wiring back to the panelboard or other distribution source.

G. Where a circuit is interrupted by removal of a device or fixture from that circuit, provide additional conduit and wiring to restore service to the remaining devices and fixtures on that circuit.

H. Electrical equipment to be removed that is in good working order shall be carefully removed and offered to the Owner. Items rejected by the Owner shall be removed from the project site and properly disposed of, along with all other demolition materials.

I. Update panelboard directories affected by the alteration work.

3.12 SITE CLEANLINESS

A. Avoid accumulation of debris, boxes, loose materials, crates, etc., resulting from the delivery and installation of this work. Remove from the premises each day all debris, boxes, etc., and keep the premises clean and free of dust and debris.

B. Clean all fixtures and equipment at the completion of the project. Wipe clean exposed lighting fixture reflectors and trim pieces with a non-abrasive cloth just prior to occupancy.

C. Maintain full operation of all sensors and fire alarm devices during construction. Assure these devices are free of dust and debris and operate without any nuisance tripping or alarms.

D. All electrical equipment shall be thoroughly vacuumed and wiped clean prior to energization and at the completion of the project. The use of compressed air for cleaning purposes is unacceptable. Equipment shall be opened for observation by the Architect/Engineer as required.

3.13 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, foundation walls, and the like. If such penetration is necessary, make penetration prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Architect and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Contract Drawings. All sleeves shall extend beyond the finished surfaces by 2-inches.

B. Penetrations to exterior walls and roofs shall be properly capped and caulked at all times, except when being worked on, to avoid flooding from exterior sources. The Contractor shall provide final permanent waterproof sealing and caulking in a manner approved by the Architect.

C. Restore waterproofing integrity of walls or surfaces after they have been penetrated without additional cost to the Owner. Waterproofing materials shall be as specified by the Architect.

3.14 ELECTRICAL SUPPORTS

A. Support electrical work in accordance with the best industry practice. Provide supports, hangers, auxiliary structural members, and supplemental hardware required for supporting of the work. All outdoor supports shall be NEMA 4X rated or rigid galvanized steel type.

B. Provide supporting frames or racks extending from the floor slab to the ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. Provide such supports for freestanding equipment, equipment in electric closets, roof, and mechanical equipment rooms.

C. Supporting frames or racks shall be of standard angle, standard channel, or specialty support system steel members, rigidly bolted, or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

D. Adequate support of equipment (including outlet, pull, and junction boxes and fittings) shall not depend on electric conduits, raceways, or cables for support. Conduits less than 1” shall be permitted to support from black iron and ceiling hanger cables.

E. Electrical equipment shall not rest on or depend for support on suspended ceiling

media (tiles, lath, plaster, as well as splines, runners, bars, and the like in the plane of the ceiling). Provide independent support of electrical equipment. Do not attach support provided for ductwork, piping, or work of other trades. Conduits or junction boxes shall not be permitted to be supported to ductwork or piping systems.

F. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of the structure. Electrical equipment and support shall not come in contact with the work of other trades.

3.15 EQUIPMENT FASTENINGS

A. Fasten all equipment to the building structure in accordance with the best industry practice.

B. Where equipment is applied to the attachment points is 100 pounds or less, conform to the following as a minimum:

1. Wood: Wood screws.
2. Concrete and solid masonry: Bolts and expansion shields.
3. Hollow construction: Toggle bolts.
4. Solid metal: Machine screws in tapped holes or with welded studs.
5. Steel decking or sub-floor: Fastenings as specified below for applied weights which exceed 100 pounds.

C. Where equipment is applied to the building attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following as a minimum:

1. At concrete slabs provide 24-inch x 24-inch x ½ inch steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the top of slab screed line, where no fill is to be applied.
2. Steel decking or sub-floor for all fastenings, provided through bolts or threaded rods. The tops of bolts or rods shall be set at least one (1) inch below the top fill screen line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or sub-floor manufacturer produces specialty hangers to work with their decking or sub-floor such hangers shall be provided.

D. Where equipment is applied to building attachment points exceeds 300 pounds, coordinate with, and obtain the approval of Architect and conform to the following as a minimum:

1. Provide suitable auxiliary steel channels or angle irons bridging between the building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Provide threaded rods or bolts to attach to bridging members.

E. For items, which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary steel channels or angle irons bridging tying to the building structural elements.

F. Wall mounted equipment may be directly secured to wall by means of steel bolts. Groups or arrays of equipment may be mounted on adequately sized steel angles, channels, or bars. Prefabricated steel channels manufactured by Kindorf or Unistrut are acceptable.

3.16 EQUIPMENT IDENTIFICATION

A. Identify electrical equipment with permanently attached black phenolic nameplates with ½ inch high white engraved lettering. Identification shall include equipment name or load served as appropriate, voltage, and designation for each device or equipment from where the power originates. Nameplates for equipment connected to the emergency power system shall be red with white lettering. Nameplates shall be attached with cadmium plated screws; peel and stick tape or glue on type nameplates are not allowed.

B. Cable tags shall be flameproof secured with flameproof non-metallic cord.

C. Provide an engraved nameplate for each switch controlling loads, which are not local to the switch.

D. Wherever raceways for future use are terminated outside of the building, stake the location with a 2 foot long, 1 inch x 1-inch clear heart redwood stake.

E. See individual specification sections for additional identification requirements.

3.17 PROHIBITED MARKINGS

A. In all public areas, tenant areas, and similar locations within the project, the inclusion or installation of any equipment or assembly which bears on any exposed surface any name, trademark, or other insignia which is intended to identify the manufacturer, the vendor, or other sources from which such object has been obtained, is prohibited.

B. Required UL Labels shall not be removed, nor shall identification specifically required under the various technical sections of these specifications to be removed.

3.18 EQUIPMENT PADS AND MOUNTING

A. Provide concrete pads under all floor mounted electrical pieces of equipment. Equipment housekeeping pads shall conform to the shape of the piece of equipment it serves with a minimum 2-inch margin around the equipment and supports. Pads shall be a minimum of 4-inches high and constructed with a minimum 28-day, 2500 PSI concrete reinforced with 6-inch x 6-inch 6/6-gauge welded wire mesh. Trowel tops and sides of pad to smooth finishes, equal to those of the floors, with all external corners bullnosed to a ¾ inch radius. Shop drawings stamped NO EXCEPTIONS NOTED shall be used for dimensional guidance in sizing pads.

B. Provide 6-inch-tall concrete waterproof curbs around all vertical floor penetrations. The Contractor shall coordinate exact dimensions of all slab penetrations and curbs with the equipment manufacturer and the Structural Engineer.

C. Provide galvanized anchor bolts for all equipment placed on concrete equipment pads, inertia blocks, or on concrete slabs. Provide bolts of the size and number recommended by the manufacturer of the equipment and locate them by means of suitable templates. Equipment installed on vibration isolators shall be secured to the isolator. Secure the isolator to the floor, pad, or support as recommended by the vibration isolation manufacturer.

D. Provide seismically restrained concrete housekeeping pads where required and

coordinate the work with the Structural Engineer.

E. Where equipment is mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and securely attach to the partition studs. As an alternative, the mounting screws may pass through the gypsum board and be securely attached to 6 inches square, 16-gauge galvanized metal backplates, which are attached to the gypsum board with an approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions are not allowed. Submit all loads imposed to the Architect for review.

F. Maintain fire integrity and rating of all walls where equipment is mounted.

3.19 DELIVERY, DRAYAGE, AND HAULING

A. The Contractor shall be responsible for delivering and installing all equipment to match the construction schedule. The Contractor shall provide drayage, hauling, hoisting, shoring, and placement of all equipment in the building. If any item of equipment is received prior to the time that it is required, the Contractor shall be fully responsible for any costs and for its proper storage and protection, per the manufacturer's requirements, until the time it is required. The Contractor shall assure all manufacturer's warranties and guarantees are unaffected by early deliveries or storage.

B. If equipment is not delivered or installed at the project site in a timely manner as required by the project construction schedule, the Contractor shall be responsible for resulting disassembly, reassembly, manufacturer's supervision, shoring, general construction modification, delays, overtime costs, etc. at no additional cost to the Owner. The Contractor shall assure all manufacturer's warranties and guarantees are unaffected by this work.

3.20 EQUIPMENT AND MATERIAL PROTECTION

A. Protect the work, equipment, and material of other trades from damage by work or personnel of this trade, and correct damage caused without additional cost to the Owner.

B. Take responsibility for work, materials, and equipment until finally inspected, tested, commissioned, and accepted. Protect work against theft, injury, or damage, and carefully store material and equipment received on site, which is not immediately installed. Close open ends of equipment and materials with temporary covers or plugs during construction to prevent entry of obstructing material. Cover and protect equipment and materials from damage due to water, spray-on fireproofing, construction debris, etc. Store equipment to avoid moisture damage in dry, heated spaces.

C. Provided adequate means for fully protecting finished parts of materials and equipment against damage from whatever causes during the progress of the work until final acceptance. Protect materials and equipment in storage and during construction in such a manner that no finished surfaces will be damaged or marred, and moving parts are kept clean and dry. Do not install damaged items; take immediate steps to obtain replacement.

D. Light fixtures shall be installed with factory mounted plastic protective coverings around the assembly. Remove protective coverings just prior to occupancy.

E. Do not install any piping in any electrical, data, or elevator equipment room. Installation is strictly prohibited when it violates the Code requirements. Provide drip pans with leak detection under any piping if installed in these rooms in accordance with the NEC. Pans shall be fully watertight and shall be equipped with a drainpipe to the nearest floor drain or service sink outside of the electrical spaces. Drip pans shall be equipped with a hardwired leak detection system and interfaced with the BMS. This shall be reviewed by the Engineer prior to any work.

3.21 ELECTRICAL SYSTEMS TESTING

A. Comply with the project construction schedule for the date of final performance, acceptance testing, commissioning, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing prior to occupancy and Contract closeout. Complete any adjustments and/or alterations, which the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. Refer to individual specification sections for extent of testing and commissioning required, testing procedures, and testing documentation.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when field pre-testing and final testing will be performed. Allow time for re-testing should any systems or equipment not perform during initial testing. Submit completion schedule for review within six (6) months after the notice to proceed by Owner's Representative has been given. Update this schedule periodically as the project progresses.

C. Prior to the testing, submit in writing proposed test procedures, forms, and schedule of equipment to be tested for the Engineer's and Owner's review.

D. Prior to the startup of any electrical equipment or systems, the Contractor shall provide confirmation that the respective areas are fully enclosed from the exterior environment and that the required mechanical ventilation systems are operational.

E. The Contractor shall be responsible for securing and providing all necessary temporary load banks, cables, and connections required to perform all testing as part of this Contract. Load bank locations and routing of the temporary cables shall be carefully coordinated by the Contractor and the Construction Manager prior to any work.

F. Coordinate all work with the Owner's Commissioning Authority and Commissioning Agent. Provide the required standby and support services to the Commissioning Authority and Agent until all equipment is successfully commissioned.

G. Provide all necessary Personal Protective Equipment (PPE) per OSHA requirements when working in areas with live electrical equipment.

3.22 DATE OF COMPLETION AND TESTING OF ELECTRICAL SYSTEMS

A. Comply with the project construction schedule for the date of final performance and acceptance testing, and complete work sufficiently in advance of the Contract completion date to permit the execution of the testing and commissioning prior to occupancy and the Contract closeout. Complete any adjustments and/or alterations that the final acceptance tests indicate as necessary for the proper functioning of all equipment prior to the completion date. See individual sections for the extent of testing required.

B. Provide a detailed schedule of completion indicating when each system is to be completed and outlining when tests and commissioning will be performed. Update this schedule periodically as the project progresses.

3.23 OPERATING INSTRUCTIONS AND OPERATOR TRAINING

A. Provide the services of factory trained specialists to provide an operating instructions seminar for equipment and systems. The seminar shall be conducted over a five-day (consecutive) period. Instruction time is defined as straight time working hours and does not include nights, weekends, or travel time to and from the project.

B. Submit seminar agenda, schedule, and list of representatives to the Owner for approval thirty days prior to suggested date of seminar. Do not commence seminar until the Owner has issued a written acceptance of the starting time and attendees. Confirm attendance of seminar by written notification to participants.

C. Instruct Owner’s operating personnel in proper starting sequences, operation, shutdown, general maintenance, and preventative maintenance procedures, including normal and emergency procedures.

D. Submit final copies of Record Drawings and Operating and Maintenance Manuals to the Owner at the seminar.

E. All operating instructional session shall be video recorded and submitted to the Owner.

F. Submit a written record of minutes and attendees of the seminar to the Owner.

3.24 OPERATING AND MAINTENANCE (O+M) MANUALS

A. Provide Operating and Maintenance Manuals for equipment and materials furnished under this Division. Manuals shall be available at the operations training seminar.

B. Submit a draft copy of the operating and maintenance manuals in PDF format for review at least ten (10) weeks before the completion date. Assemble data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item.

C. After the Architect's and Engineer's review, and any required Contractor revisions, the operating and maintenance manuals shall be delivered to the Owner as three (3) hard paper copies in a binder as described below and separately on electronic media in PDF format.

D. Heavy-duty, three-ring, vinyl-covered, post-type binders sized to hold 8.5-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

1. Identify each binder on the front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on

each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Supplementary Text: Prepared on 8.5-by-11-inch white bond paper.
4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

   a. If drawings are too large to be used as foldouts, fold, and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

E. Manual Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system.

F. All maintenance information shall include complete lubrication, cleaning, and servicing data compiled in a clear and easily understandable format. Indicate all model and serial numbers of each piece of equipment, complete lists of replacement parts, capacity ratings, and actual loads.

G. Provide the following information where applicable:

1. Identifying equipment name
2. Vendor and service provider contact information.
3. Equipment Locations.
4. Complete nameplate data.
5. Certified Record As-built Drawings and Final Reviewed submittals.
6. Equipment parts list.
7. All warranty and guarantee documents.
8. Performance curves and data.
9. Wiring diagrams.
10. Manufacturers recommended operating and maintenance instructions.
11. List of spare parts recommended for normal service requirements.
12. Assembly and disassembly instructions with exploded view drawings.
13. Test reports – factory and field.
14. Trouble shooting diagnostic instructions where applicable.

3.25 RECORD DRAWINGS

A. The Contractor shall maintain daily at the Project site a complete set of Record Drawings. The Record Drawings shall initially consist of a set of prints or REVIT files of the Contractor's Coordination Drawings. The prints shall be marked, or the REVIT files electronically updated to show the precise location of all buried or concealed work and equipment, including embedded conduit, raceways and boxes, and all changes and deviations in the Electrical work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite written instructions from the Architect or Engineer. The updated Coordination Drawings shall be used to produce the final Record Drawings that shall be delivered to the Owner in REVIT electronic format media upon Project completion.

B. Record dimensions clearly and accurately to delineate the work as installed. Suitably identify locations of all equipment by at least two (2) dimensions to

permanent structures. Provide record drawings of the following items as a minimum:

1. Dimensional changes to the Contract Drawings.
2. Revisions to details shown on the Contract Drawings.
3. Locations and depths of underground utilities.
4. Revisions to routing of conduits.
5. Locations and sizes of conduits and pull boxes.
6. Actual equipment locations and sizes.
7. Locations of light fixtures, wiring devices, and fire alarm devices.
8. Locations of concealed internal utilities.
9. Changes made by Change Order.
10. Field records for concealed conditions.
11. Record information on the Work that is shown only schematically in the Contract Documents

C. The Contractor and Subcontractor shall mark all in-progress Record Drawings on the front lower right-hand corner with a stamp impression similar to the following:

RECORD DRAWING

To be used for recording Field Deviations and Dimensional Data Only

D. Upon completion of the work, the Contractor and subcontractors shall certify all Record Drawings on the front lower right-hand corner adjacent to the above marking with a stamp impression similar to the following:

RECORD DRAWING
CERTIFIED CORRECT

(Printed Name of General Contractor)

Date:

(Printed Name of Subcontractor)

Date:

E. Prior to final acceptance of the Work of this Division, the Contractor shall submit properly certified Record Drawings to the Architect and Engineer for review and shall make changes, corrections, or additions as the Architect and/or Engineer may require to the Record Drawings. After the Architect's and Engineer's review, and any required Contractor revisions, the Record Drawings shall be delivered to the Owner on electronic media in REVIT format. The Architect and Engineer do not assume any responsibility for the accuracy or completeness of the Record Drawings.

F. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with the Architect. After reviewing, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Architect will furnish Contractor one (1) set of digital data files of the Contract Drawings for use in recording information.
4. Architect will provide data file layer information. Record markups in separate layers.

3.26 CERTIFICATIONS

A. Any certifications required by the Specifications, in addition to those required for shop drawings, product data, equipment and other items, are to be certified in writing by the Owner, a Partner, or a Corporate Officer of the firm required to provide the Certification, or by another person duly authorized to sign binding agreements for and on behalf of the Owner, Partner, or Corporation.

3.27 FINAL REVIEW

A. At a time designated by the Owner, the entire electrical system shall be reviewed for compliance with the Contract Drawings and Specifications. Be available at all times during these reviews.

B. Demonstrate to the Owner and/or the Architect's personnel prior to the Final Review that systems and equipment have been thoroughly tested and adjusted and follow the requirements of the Contract Documents. After these demonstration tests are satisfactorily completed, but prior to the Final Review, submit a written certification that attests to the Contract Document compliance for this project.

C. Prior to the final review, the Contractor shall confirm the following items regarding the status of key elements of the work. Negative responses to any of the items indicate that the construction is not substantially complete, and the building is not ready for a final review. The Contractor shall confirm the following in writing:

1. All distribution equipment is completely installed, commissioned, and operating.
2. Emergency system equipment including generator, automatic transfer switches, panels are completely installed, commissioned, operating, and tested for transfer from normal to emergency and emergency to normal under building load.
3. Lighting control systems including related control devices such as occupancy/vacancy sensors, photocells, controllers, drivers, lighting modules, etc., are installed, commissioned, and operating as stated in the sequence of operations.
4. Building systems have been cleaned.
5. Seismic restraints have been inspected as specified. Any required special inspections have been completed.

6. Fire alarm system is installed, commissioned, and operates as stated in the sequence of operations.
7. Building fire and life safety systems have been tested and accepted by the local authorities. Any required special inspections have been completed.
8. There are no deviations or non-compliance with the Contract Documents; otherwise, provide a detailed account of all deviations or non-compliance.
9. All items on field review reports have been responded to in writing and are resolved to the satisfaction of the Owner.
10. All outstanding items on submittals and shop drawings have been addressed in writing and are resolved to the satisfaction of the Owner.
11. Schedule the final review only after providing written confirmation of all items above. Provide a minimum of ten (10) days' notice.

D. Certificates and Documents required by the Contract shall be presented to the Architect at least two (2) weeks prior to the Final Review.

E. After the Final Review, any changes or corrections noted as necessary for the work to comply with the Contract Documents shall be accomplished without delay to secure final acceptance of the work.

3.28 PROJECT CLOSEOUT

A. At project closeout and prior to the final payment, this Contractor shall provide and submit the following for the Owner to review and sign off:

1. Review with the Owner and confirm that all field construction issues are resolved to the Owner's satisfaction.
2. Three (3) binder books with all electrical system testing reports, equipment certificates, and operation manuals as per these specifications.
3. All electrical load balancing and testing reports with the Engineer's review.
4. Provide the Owner with the required training as specified herein.
5. Provide all spare parts and equipment per these specifications.
6. All door access keys and panelboard keys to the Owner with proper tags.
7. Construction record as-built hard copies and digital sets with the A/E review stamp.
8. All proposals and all change orders are fully executed. Submit a certified statement that no additional change orders will be submitted after the project closeout.
9. Copies of the Authority's inspection and approval letters.

3.29 EARLY OCCUPANCY

A. All divisions are responsible for completing those systems which are necessary to allow partial occupancy of the building even if systems in the unoccupied areas are incomplete. Partial or early occupancy schedules will be developed by the Construction Manager. Specific attention is necessary for any areas involving special spaces such as security and technology areas, fire alarm systems, smoke control systems, generators, life safety systems, elevators, etc. which require early operation to allow occupancy to occur.

B. Verify and comply with requirements for temporary occupancy with the Building Department and Fire Inspectors.

END OF SECTION

SECTION 26 05 02
EQUIPMENT CONNECTIONS AND COORDINATION

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide equipment connections and coordination in accordance with the Contract Documents.

B. Refer to other divisions for the respective equipment specifications.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 SUBMITTALS

A. None required.

1.04 QUALITY ASSURANCE

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. American National Standard Safety Code for Elevators, Dumbwaiters, and Moving Walks (ANSI A17.1 through ASNI A17.6)
2. NY State Elevator Code
3. NFPA 70 and 101
4. NYS Building Code
5. NYS Fire Code
6. Authorities Having Jurisdiction (AHJ)

1.05 FIELD TESTING

A. The Electrical Contractor shall provide field testing of all electrical equipment and connections made to the equipment indicated on the Contract Documents. Testing shall be performed until all results meet the equipment manufacturer's specifications. This Contractor shall perform any remediation work required from testing results.

B. Submit all certified testing results and include in operational and maintenance manuals.

PART 2 – PRODUCTS

2.01 NOT APPLICABLE.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide equipment connections and coordination in accordance with the equipment manufacturer's recommendations and product submittals. The Contractor shall verify and coordinate the overcurrent protection device and circuit wiring and conduit required for the actual equipment submitted for the project, prior to rough-in and installation.

B. The Contractor shall be fully familiar with the entire Contract Document package which will require electrical connections. All such scope shall be included as part of the bid proposal.

C. Provide disconnect switches for all equipment. Where equipment requires fuse protection, provide fusible type disconnect switches with fuses rated in accordance with equipment manufacturer's requirements. Disconnect switches for single phase equipment shall be thermal overload type. Locate disconnect switches in coordination with the layout of the equipment and other trades. Provide support for a free-standing installation if required to allow access to the disconnect switch and in proximity to the equipment served. Motor and starter/disconnect symbols on the Contract Drawings are diagrammatic and do not represent exact locations. The Contractor shall coordinate with the other trades and provide exact locations of the disconnect switches and starters, including providing appropriate mounting hardware/structures for free standing installations, or wall mounted installations, and conduit/wiring from the disconnect/starter to the motor connection.

D. Coordinate the location and mounting details of all disconnects, starters, controllers, VFDs, and associated equipment with other Trade Disciplines prior to installation. This equipment shall be fully coordinated and drawn to scale on the coordinated MEP trade shop drawing submittals and within the BIM model, including any manufacturer required access clearance zones.

E. Provide final connections to hard wired equipment with a minimum of 18" of liquid tight flexible metal conduit.

F. Verify the requirements of cord and plug equipment and provide receptacles, branch circuiting, and branch circuit overcurrent protection to match. Receptacle types shown on the Contract Drawings are for bidding purposes only.

G. Where equipment is supplied from a conduit installed under or within the floor slab, extend the conduit to a junction box mounted on a two-foot stubbed up of rigid steel conduit. Provide suitable bracing support on the conduit stub up location.

H. Where equipment is fed from overhead, support the conduit on flanged type fittings connected to structure above.

3.02 EQUIPMENT CONNECTION TYPES

A. Provide equipment connection types as required by the equipment manufacturer and per the Contract Documents.

B. Equipment Connection Types:

1. Type DP: Duplex pump system with a controller provided under another Division. Provide connections to the controller and connections from the controller to the pumps in accordance with the controller manufacturer's installation instructions. Provide connections for local controls and alarms in accordance with the controller manufacturer's installation instructions.
2. Type TP: Triplex pump system with a controller provided under another Division. Provide connections to the controller and connections from the controller to the pumps in accordance with the controller manufacturer's installation instructions. Provide connections for local controls and alarms in accordance with the controller manufacturer's installation instructions.
3. Type FR: Fractional horsepower single phase motor. Provide thermal overload disconnect switch and motor connection.
4. Type FWS: Equipment furnished with a starter by another Division. Provide and install a disconnect switch. Install the starter and provide connections from the disconnect switch to the starter and connections from starter to the equipment.
5. Type SPC: Single point of connection. Provide single point of connection to the equipment provided with a factory mounted starter/controller listed for a single point of power connection. Provide fusible disconnect switch with fuses sized in accordance with equipment nameplate requirements.
6. Type VFD: Variable frequency drive furnished under another Division. Install the VFD and provide connections to the VFD and connections from the VFD to the equipment.

3.03 ELEVATORS

A. Locate equipment and points of connections in all elevator machine rooms and elevator pits in accordance with the requirements of the Elevator Contractor and the Authority Having Jurisdiction (AHJ).

B. The Electrical Contractor shall coordinate all elevator machine/control room equipment locations to ensure all Code clearances are maintained prior to any work.

C. The Electrical Contractor shall fully coordinate the location of all electrical equipment (receptacles, light fixtures, switches, disconnect switches, fire alarm devices, communication devices, etc.) with the Elevator Vendor/Contractor prior to any work.

D. Elevator feeders shall be copper conductors with copper connections. Do not locate any feeders or equipment in the elevator machine, control, or equipment rooms which do not serve the elevators. Utilize a minimum of 18" of flexible metal conduit for all electrical connections, which includes any connections to the hydraulic tank and relay panels.

E. Provide a heavy duty, lockable fused disconnect switch, dedicated 3 phase branch circuit, and emergency power connection for each elevator. Fused switches shall be located within the respective elevator machine/control room, adjacent to the entry door. Fuse ratings shall be in accordance with the elevator manufacturer's

requirements. Fuses shall be RK1 type or equivalent dual element time delay fuses. Coordinate the fused disconnect switch location with the AHJ prior to any work. Should these switches not be located in the line of sight from the motor, provide additional local disconnect switches at the motors.

F. Any transformers supplied with the elevators shall be provided with vibration isolation pads similar to Mason Industries ND mounts sized for .35-inch static deflection. Transformers greater than 150kVA shall be supported on spring isolators similar to Mason Industries type SLF with a minimum of 1-inch static deflection. Provide a loop in the flexible metal conduit and support resiliently with appropriate neoprene isolators. Do not wall support such equipment without any isolation.

G. Provide a minimum of one (1) No. 6 AWG ground conductor to bond each elevator controller, motor frame, and enclosure to the structural building steel as directed by the elevator vendor.

H. Provide a dedicated 120V, 20A emergency circuit with a lockable disconnect switch and connection to each elevator cab for elevator cab lighting, power, and ventilation. The location of all disconnect switches shall be inside the elevator machine/control room, adjacent to the entrance door. Label all switches accordingly.

I. Provide a dedicated 120V, 20A emergency circuit with a single pole disconnect switch and connect to the elevator system intercom in the elevator machine/control room. Label all switches accordingly.

J. Provide a minimum of two (2) dedicated 120V, 20A emergency circuits with single pole disconnect switches to each elevator controller for control power. Circuit rating and quantity shall be in accordance with the elevator vendor’s requirements. Label all switches accordingly.

K. Provide a dedicated 120V, 20A emergency circuit and single pole disconnect switch to the Elevator Management System and to the remote elevator monitoring system in the elevator machine/control room. Circuit rating and quantity shall be in accordance with the elevator vendor’s requirements. Label all switches accordingly.

L. Provide weatherproof, gasketed LED light fixtures with wire guards, light switches, and a 20A GFCI duplex receptacle within each elevator pit. All equipment covers shall be weatherproof “In-Use” rated. The light fixtures and receptacles shall be connected to separate dedicated emergency circuits and not connected to other base building circuits. A light switch shall be located adjacent to each pit door or service ladder. Provide light fixtures to ensure that the pit platform/floor achieves a minimum of 10 foot-candles.

M. For any machine room-less elevator, provide light fixtures (minimum of two (2) 4-ft LED vandal resistant fixtures), light switch, and a 20A GFCI duplex receptacle at the top of each elevator shaft for servicing of the motor equipment on the cab. The light fixtures and receptacles shall be on separate dedicated 120V emergency circuits and not connected to other base building circuits.

N. For each hoist way, provide light fixtures (minimum of two (2) 4-ft LED vandal resistant fixtures), light switch, and a 20A GFCI duplex receptacle at the top of each elevator shaft for servicing of the motor equipment on the cab. The light fixtures and receptacles shall be on separate dedicated 120V emergency circuits and not connected to other base building circuits.

O. Provide 20A GFCI duplex receptacles and LED light fixtures (with wire guards) within each elevator machine/control room and connect to separate dedicated emergency power circuits. The light fixtures and receptacles shall not be connected to other base building circuits. Locate the light switch and receptacle within 18” of the machine/control room door strike. Provide light fixtures to ensure that the machine room achieves a minimum of 20 foot-candles.

P. Provide lockable type circuit breakers for all lighting and receptacle circuits serving the elevator machine/control rooms. Label all breakers accordingly.

Q. Provide a dedicated data outlet for each elevator controller in the machine/control rooms. Provide an empty 1” raceway from each data outlet to the nearest data closet. Coordinate raceway sizes with the elevator vendor prior to any work and provide a labelled pull wire in each raceway.

R. Provide empty EMT raceways from each elevator shaft to the respective elevator control room and status panels. Size, quantity, and location of the EMT raceways shall be in accordance with the elevator vendor’s requirements. At a minimum, provide one (1) 2.5” EMT (power) conduit and one (1) 1.5” EMT (controls) conduit from each elevator shaft to the elevator control room. Coordinate exact conduit size and connection requirements with the elevator manufacturer’s shop drawings prior to installation and provide as required a fully functional elevator operating system. Provide labelled pull wire in each raceway.

S. Provide empty EMT raceways from each elevator controller to the Fire Alarm Control Panel. Size, quantity, and location of the EMT raceways shall be in accordance with the elevator vendor’s requirements. At a minimum, provide one (1) 2.5” EMT conduit. Coordinate exact conduit size and connection requirements with the elevator manufacturer’s shop drawings prior to installation and provide as required a fully functional elevator operating system. Provide labelled pull wire in all raceways.

T. Provide recall type smoke detectors in each elevator lobby, top of each elevator hoist way, each elevator machine/control room, and in each elevator pit.

U. Provide a fire alarm speaker within each elevator cab and connect to the fire alarm system interface in the elevator machine/control room.

V. Provide a firefighter’s telephone in each elevator cab and connect to the fire alarm system interface in the elevator machine/control room.

W. Provide 2HR rated conductors equipped with circuit integrity for all circuits/feeders serving the elevator. This includes all hoist way and machine/control room circuits.

X. Where an automatic return unit is included with the elevators that automatically returns the elevator cab to a landing when there is a power outage, provide auxiliary contact at the mainline fused disconnect switch that is positively opened when the main line disconnect is in the OFF position. Provide all associated wiring and conduit from the auxiliary contact to the controller.

Y. For elevator machine/control rooms that are sprinkled, provide a manual reset type shunt trip device for each feeder serving the elevator motors. Shunt trip devices shall not be installed within the elevator machine/control room and shall be installed at the distribution panel outside of the elevator machine/control room. Provide all associated wiring and conduit from the shunt trip device to the fire alarm system for

shutdown of the motor upon activation of the elevator machine room heat detector. The heat detectors shall be weatherproof rated and fixed at 135 degrees, which shall be installed within 18" of each sprinkler head in the elevator machine/control rooms, hoist ways, and pits.

Z. Provide multiple signal cabling and conduits between each of the elevator controllers and the automatic transfer switches (ATS) (serving the elevator loads) and make connections required for automatic recall and operation of the elevators from the emergency power distribution system in the event of normal power failure. The signals provide notification that the power source will transfer from emergency to normal source; and an adjustable time delay at the ATS to delay transfer from emergency to normal source. The daisy chaining of the signal cabling is unacceptable.

3.04 MECHANICAL, PLUMBING, AND FIRE PROTECTION EQUIPMENT

A. Provide electrical connections to all equipment and motors shown on Division 21, Division 22, Division 23, and Division 26 Contract Drawings and Specifications.

B. The Contractor shall verify and coordinate the overcurrent protection device and motor circuit wiring required for the actual equipment submitted for the project, prior to rough-in and installation. Install all equipment in strict accordance with the manufacturer's recommendations and submittal instructions.

C. Where motor controllers are furnished by others, install the controllers, and provide connections at the line and load sides of the controllers. Coordinate lug quantities and sizes prior to the installation of the feeder to the equipment.

D. Provide disconnect switches for each motor and each piece of equipment, if not provided as part of the motor controller. Provide time-delay fuse protection where the equipment nameplates indicate such.

E. Where reduced voltage, multiple speed, duplex, or other controller types are utilized, coordinate specific requirements of the motors and controllers, and provide the required wiring and conduit between the motors and controllers. Verify that the motor rotation is correct and adjust as required.

F. Receive all motor controllers from the other trades and install all on 4" high concrete pads and / or independent Unistrut or Kindorf steel supports.

G. Coordinate with the mechanical and plumbing trades and provide 120V circuits to control relay modules and other equipment controls appurtenances that require line voltage power. Assure that this power source (normal or emergency) is the same as the equipment being controlled.

H. Provide all necessary wiring, conduits, and connections for interlocking, remote, and automatic controls per the manufacturer's recommendations. Do not install control wiring in the same raceway as the power wiring.

I. Provide 120V connections and disconnect switches (1-pole motor rated toggle switches) for all control actuators and fire smoke dampers shown on the Division 23 and Division 26 Contract Drawings. Provide controls connections and appurtenances to monitor the presence of power downstream from the disconnect switch via the fire alarm system for any fire smoke damper that is part of the smoke

control management system for the building. Each damper shall be connected to the fire alarm system and be equipped with dedicated fire alarm addressable modules providing dedicated individual address. Grouping dampers on a single module is unacceptable.

J. At gas fired boilers, provide one (1) 120V, 20A grounded circuit per boiler for control relays. A means of manually disconnecting the control circuit shall be provided and controls shall be arranged so that when deenergized, the burner shall be inoperative. Such disconnecting means shall be capable of being locked in the OFF position and shall be provided with ready and immediate access. A remote control shall be provided to stop the flow of fuel and combustion air to any burner or fuel-burning internal combustion equipment. Such controls shall be provided along every means of egress from the room in which the equipment is located. Each remote control shall be located outside of, but as close as practicable to the equipment room itself and shall be labeled “remote control for burner.”

K. All motor circuits shall be copper conductors. Provide a separate ground conductor within the flexible metal conduit that will provide a continuous ground path. All equipment shall be grounded. All connections shall utilize a minimum of 18-inch length of liquid-tight, flexible metal conduit.

L. Where equipment is fed from under the slab, terminate the circuit at a junction box on a 24-inch rigid metallic conduit stub-up and make the final connection to the equipment in liquid-tight, flexible metal conduit. The conduit stub-up shall be equipped with knee braces.

M. Where condensate pumps or other equipment is installed above the ceilings, such equipment shall be hardwired using permanent wiring methods with a local disconnect switch. Use of a cord/plug and receptacle is not acceptable.

N. For electric water coolers, verify whether the equipment is hard-wired, cord and plug connected, or whether a remote chiller is provided. Provide circuiting and connections to match.

O. Coordinate with the Plumbing Trade and provide 120V circuit connections to all electronic trap primers shown on the Contract Drawings.

P. For rooftop mechanical equipment, electrical and fire conduit connections shall be through the unit curb without any additional roof penetrations. Coordinate work with the Mechanical Contractor prior to any work.

3.05 ELECTRIC FLOOR HEAT SYSTEMS

A. Description:

1. Provide a pre-formed electric floor warming system that is manufactured to fit the shape of the floor area (to provide evenly distributed warmth throughout the floor) in accordance with the Contract Documents.
2. The product thickness shall not exceed 1/8” and shall be protected by a 25-year warranty.
3. Provide floor sensing thermostat and required auxiliary controls with Class A Ground Fault Circuit Interruption (GFCI) protection per Code.

B. System Performance:

1. The products shall meet the following minimum requirements:

    a. Uniform consistent heating.
    b. Custom footprint by design.
    c. Produces 12 watts per square foot or 41 BTU per square foot.
    d. Consistent wire spacing to reduce site irregularities and eliminate cold spots.
    e. 120 VAC (16A max) 20A branch circuit or 208 VAC (24A max) 30A branch circuit - mat designs based on connected load.
    f. Mat to consist of 21.5 - 31 AWG insulated resistance wire with an Alloy 515 outer sheath.
    g. Porous nylon polyester blended fabric to keep wire spacing and heat consistent.
    h. Continuous stainless steel braided sheathing as a ground for all wires.
    i. Mat shall be approximately 1/8” thick and water resistant.
    j. Minimum 7-foot cold lead connection.
    k. Utilize GFCI circuit breakers for all electric mats, located in the respective panelboard.

2. Thermostat Control: For increased zone warming efficiency, thermostat shall, at a minimum, include the following:

    a. Programmable control features.
    b. Controllable temperature.
    c. Four (4) programs per day.
    d. Floor-sensor or thermo-coupler that ensures the power cycles once timer reaches temperature.
    e. Built in GFCI.
    f. Thermostat shall be wall mounted.
    g. Thermostats shall control a single room.

C. Installation:

1. General

    a. Comply with pertinent provisions of the referenced standards, except as otherwise directed by the Architect or as specified herein.
    b. Maintain minimum temperature limits and installation practices recommended by the materials manufacturers.
    c. Do not install tile floors over membrane until the membrane has been tested and accepted. To confirm the proper power consumption of your mat, the Contractor shall perform the resistance test. Ensure that the resistance reading is within the range of plus 10% to minus 5% of the resistance rating listed on the mat tag.
    d. To confirm that there is no short to ground in the mat, the Contractor shall perform the installation test. Mark test results on warranty card and ensure they match the manufacturer’s recorded information on the mat tag.
    e. The entire heater installation and electrical design shall conform to the manufacturer’s published specifications and guidelines.

2. Install in accordance with TCA installation methods and written instructions:

a. TCA #RH 130 EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar
b. TCA #RH 135 Cementitious Backer Units / Fiber Cement Underlayment
c. Floor Warming Systems UL 1693: NEC Article 424.

3. Subfloor – 19/32" exterior-glue plywood on joists at 16 on center. Gaps between plywood sheets shall be treated per setting material manufacturer's recommendations.
4. The Electrical Contractor shall wire the floor warming system to the power source in accordance with the manufacturer's recommendations and all applicable Codes.
5. Apply a coat of acrylic or latex modified thin set using ¼ inch square notched trowel to the subfloor. Roll the mat into the thin set material, using a grout float, smooth out all air bubbles or folds. Ensure the bond between the mat and the thin set conforms to at least 80% coverage.
6. Perform second resistance and insulation test on the mat prior to the installation of tile, or other hard surface flooring materials.
7. Lay out cold lead wires and install the thermostat sensor probe wire.
8. Install ceramic tile and/or marble according to architectural specifications sections.
9. Provide relays and contactors, as required, to allow a whole room to be controlled by a single thermostat. A signal from the thermostat shall close the contactor when heat is called upon causing all electric mats, connected to the relay, to turn ON at the same time. Daisy chaining of mats is unacceptable.

3.06 MECHANICAL EQUIPMENT CONTROL PANELS

A. Provide all mechanical equipment control panels (including but not limited to BMS panels and temperature control panels) a dedicated 120V, 20A circuit to the nearest emergency electrical panel. In addition to the control panel locations shown on the Contract Drawings, include and provide 120V circuits to the control panels shown on the Division 23 Contract Drawings and the final BMS vendor submittal. Because the vendor submittals are not available at the time of bid, the Contractor shall provide 120V circuiting allowance for a minimum quantity of panel connections as follows:

1. One (1) control panel at each mechanical equipment room.
2. One (1) control panel at each electrical room.
3. One (1) control panel at each IDF closet.

B. Where any type of mechanical equipment control panel serves equipment that is on the emergency system, provide the control panel with a 120V, 20A circuit from an emergency panel that is on the same emergency branch system as the equipment.

3.07 ELECTRIC FIRE PUMP CONNECTIONS

A. Coordinate specific requirements of the fire pump motor and ATS/controller and provide the required wiring between the motor and the ATS/controller.

B. Provide 2-Hour rated protection of the fire pump conductors and fire pump control conductors utilizing 2-Hour rated cable assemblies or installation in a minimum 3-inches of concrete cover.

C. Verify the termination lug requirements for the fire pump controller/ATS and provide the required lug sizes and quantities to match the feeder being installed. Where the fire pump controller requires two (2) sets of parallel conductors, provide the fire pump feeder utilizing two (2) parallel conduits with the required conductor size to match the parallel lug connections at the controller.

D. At locations where 2-Hour rated Mineral Insulated (MI) cable is utilized for the fire pump feeder, provide the required splice kit/pull box within the fire pump room as required to transition to conductors, sized to match the controller lug termination sizes.

E. For the service to the Fire Pump, provide a fused disconnect switch as shown on the Contract Drawings, tapped ahead of the main service switch and after the meter, and mounted in a separate enclosure a maximum of 6 feet from the main service switch. The disconnect switch shall be UL Listed for service entrance equipment and shall have lockable provisions to lockout in the closed position.

F. The fire pump service switch shall be painted red and labelled.

3.08 OWNER FURNISHED EQUIPMENT

A. Provide electrical connections, grounding, disconnect switches, and testing of Owner furnished equipment.

B. Receive and accept such equipment at the project site. Inspect all Owner furnished equipment for damage, defects, missing components, etc. Report deficiencies to the Owner immediately. Do not install or connect deficient equipment.

C. Provide supports, fastenings, and auxiliary hardware necessary for a complete installation in accordance with the finished building conditions.

D. Provide all field wiring required for a complete operable piece of equipment. Include and install new lamps, wiring, accessories, etc. per the equipment manufacturer's requirements. Provide testing of such equipment once fully installed.

3.09 HEAT TRACE EQUIPMENT CONNECTIONS

A. For each heat trace system required on the Division 22, 23, and 26 Contract Drawings, provide a complete electrical installation to support all equipment and connections associated with the heat trace cabling including power circuits, conduit for heat trace cabling to heat trace controller, controls conduits, heat trace controller installation, weatherproof (NEMA 4X) splice boxes, and all remote sensor controls conduit connections to the controller.

B. Provide electrical circuits in the quantity and voltage indicated to each heat trace cable power in-feed location. Provide GFCI type circuit breakers for each heat trace circuit.

C. For each heat trace cable connection, provide the required size conduit and wire from the underground end of heat trace line to the heat trace control panel location within the building. Provide splice boxes as required within walls or ceilings, above the underground power in-feed connection in order to transition from underground cable to overhead routing within building to the heat trace control panel.

D. Install all heat trace control panels within the building and provide line voltage connections to each panel.

E. Provide all required low voltage conduit from the heat trace controller to other heat trace control panels and to all remote sensors and related devices in order to provide a fully functional heat trace system.

3.10 PRE-ACTION FIRE PROTECTION SYSTEMS

A. Provide a 120V, 20A dedicated emergency branch circuit to each pre-action fire protection system control panel.

B. Connect the pre-action fire protection system to the building fire alarm system. Provide separate alarm zones and a separate system trouble zone for each pre-action fire protection system. Provide addressable modules for each system.

3.11 EMERGENCY POWER OFF (EPO) CONTROLS

A. Provide emergency power off controls for each individual computer and server rooms.

B. Provide controls, relays, contactors, conduit, and conductors for the following functions:

1. Activation of shunt trip breakers and contactors to disconnect power to equipment within the room.
2. Disconnection of UPS, including battery disconnect.
3. Shut down of air conditioning systems serving the room, including the closing of dampers to seal the room.
4. Interface wiring and conduit to the clean agent fire suppression system for air conditioning systems shut down on time-delay pre-alarm.
5. Release of electric door hold open devices.

C. Provide an emergency power off switch at each exit door of the room. Emergency power off switch shall be Allen-Bradley Bulletin 800T break-glass push button station NEMA Type 13 with break-glass kit or approved equal. Provide a legend plate for each unit with designation: POWER/AC SHUTDOWN.

END OF SECTION

SECTION 26 05 04
FIRESTOPPING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide firestopping systems for wall, ceiling, and/or floor electrical penetrations in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. All fire stopping materials shall be of the same manufacturer.

B. The Contractor shall be certified, licensed, and trained by the firestopping manufacturer to install the specified products.

C. All products shall be free of all volatile organic compounds and odor free.

D. The Owner shall engage a qualified independent inspection agency to inspect all through-penetration firestop systems.

1.04 STANDARDS

A. ASTM E814, ASTM E119, ASTM E84, & ASTM E2174

B. UL 1479, UL 263, & UL 723

1.05 SUBMITTALS

A. Product Data

1. Submit the manufacturer’s specifications and technical product data for each material including the composition and limitations, documentation of UL firestop systems proposed to be used and manufacturer's installation instructions.
2. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Manufacturer’s engineering judgment shall include both the project name and the Contractor’s name, who shall install the firestop systems as described in the submittal.

a. Manufacturer’s engineering judgement shall not be used in lieu of

tested systems when available.

b. The manufacturer's engineering judgement shall be based upon full knowledge of the elements of the construction to be protected and the understanding of the probable behavior of that construction and the recommended firestopping system protecting that construction if it was subjected to the appropriate Standard Fire test method for firestops for the rating indicated on the engineering judgement.

c. The manufacturer's engineering judgement shall be limited only to specific conditions and configurations upon which the engineering judgement was rendered and shall be based upon reasonable performance expectations for the recommended firestop system under those conditions.

The manufacturer's engineering judgement shall be accepted only for a single, specific job and project location and shall not be transferred to any other job or project location without thorough and appropriate review of all aspects of the next job or the location's circumstances.

3. Submit Material Safety Data Sheets (MSDS) provided with the product delivered to jobsite.

1.06 PERFORMANCE REQUIREMENTS

A. Provide products that upon curing, do not re-emulsify, dissolve, leach, break down, or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristics during and after construction.

B. Openings within walls and floors designed to accommodate cabling systems subjected to frequent cable changes shall be provided with re-enterable products specifically designed for retrofits.

C. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

D. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

E. Penetrations in Fire Resistance Rated Walls: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.

1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

F. Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.

1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
2. T-Rating: When a penetrant is located outside of a wall cavity, minimum of

1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.

3. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479 (when applicable).

G. Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with UL 1479 or ASTM E814.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at both ambient and elevated temperatures.

H. Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of one (1) or less as determined by ASTM G21.

PART 2 – PRODUCTS

2.01 FIRE SEAL PUTTY SYSTEM

A. System shall provide immediate fire seal, require no curing time, emit no hazardous or toxic fumes, require no special tools, and shall be capable of being installed from one (1) side.

B. No derating whatsoever is required of the wiring systems passing through the seals.

C. System shall be field modified for additions or deletions of raceways or cables.

D. Reusable materials to accommodate penetration changes.

2.02 MISCELLANEOUS FIRE SEAL PRODUCTS

A. Firestop devices: Factory-assembled steel collars lined with intumescent material sized to fit specific outside diameter of penetrating item.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of a polypropylene sleeve lined with an intumescent strip, an extended rectangular flange attached to one (1) end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Drop-In Firestop Device: Single component firestop steel device post-installed in pre-cast concrete with totally encapsulated, tamper-proof inner and outer intumescent material.

D. Smoke and Acoustic Sleeves (Non-rated assembly): Factory-assembled round metallic sleeve device for use with cable penetrations for non-rated walls, containing an integrated material enabling ease of re-penetration with the intent to significantly reduce sound transmission and preventing smoke passage.

E. Firestop Cable Collar: Factory-assembled collars formed from galvanized steel, completely filled with an intumescent material that can accommodate 0% up to 100% visual fill. Surface mounted device.

F. Firestop Board: Non-curing, re-penetrable materials used for large size/complex

penetrations.

G. Composite Sheet: Intumescent material sandwiched between a galvanized steel sheet and steel wire mesh protected with aluminum foil.

H. Firestop Cable Disk: For use with up to a 1" cable bundle, consisting of non-hardening dielectric, water-resistant putty; containing no solvents, inorganic fibers, or silicone compounds.

I. Fire Rated Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing individual cable penetrations.

J. Firestop Plugs: Re-enterable, foam plug impregnated with intumescent material for use in spare sleeves and sleeves with cables.

K. Firestop Putty: Intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers, or silicone compounds.

L. Firestop Putty Pads: Intumescent, non-hardening putty pads shall be installed on metallic electrical switch and receptacle boxes when horizontal separation between boxes is less than 24".

M. Wrap Strips: Single component intumescent elastomeric strips faced on both sides with a Latex Sealants single component latex formulation that upon cure do not emulsify during exposure to moisture.

N. Silicone Sealants: Moisture curing, single component, silicone elastomeric sealant for horizontal surfaces (pourable or nonsag) or vertical surfaces (nonsag).

O. Firestop Blocks: Intumescent flexible block suitable for reuse in re-penetration of openings. Blocks shall allow up to 12" of unreinforced annular space.

P. Firestop Pillows: Re-enterable, non-curing mineral fiber core encapsulated with an intumescent coating contained in a flame-retardant bag.

Q. Mortar: Portland cement based dry-mix product formulated for mixing with water at the project site to form a non-shrinking, water-resistant, homogenous mortar.

R. Silicone Foam: Multicomponent, silicone-based liquid elastomers, that when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

2.03 ACCEPTABLE MANUFACTURERS

A. Hilti

B. Dow Corning

C. Flamesafe

PART 3 – EXECUTION

3.01 PREPARATION

A. Examine areas and conditions under which work shall be performed and identify conditions detrimental to proper or timely completion.

B. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.

C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 GENERAL

A. Install all fire seals in accordance with the manufacturer’s requirements.

B. Place a minimum of 0.5-inches of putty around each penetrating item. When it is not possible build up cone around penetrating items, using second layer of putty. Slope cone at 30 degrees from the wall or floor.

C. Wall openings shall not have unsupported space of putty greater than 4-inches and floor openings an unsupported opening of 1.5 inches.

D. Provide ceramic wool temperature rated 2300°F in conjunction with the putty in accordance with the manufacturer's instructions.

E. Provide ceramic fiberboard temperature rated 2000°F in conjunction with the putty in accordance with the manufacturer's recommendation.

F. Coordinate location and proper selection of cast-in-place Firestop Devices with the trade responsible for the work. Ensure device is installed before placement of concrete.

G. Firmly anchor penetrating items prior to putty installation. Provide all necessary anchor bolts, fittings, etc. as necessary.

3.03 ADJUSTING AND CLEANING

A. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.

B. Clean all surfaces adjacent to sealed openings to be free of excess through-penetration firestop system materials and soiling as work progresses.

3.04 INSTALLATION

A. Provide fire seals at all cable and conduit penetrations through fire-rated walls, shafts, floors, ceilings, and where noted on the Contract Drawings. Coordinate with the architectural and structural drawings for locations and ratings of all fire-rated walls, floors, ceilings, and shafts.

B. Install firestop materials in accordance with the UL Fire Resistance Directory.

C. Comply with the manufacturer's instructions for the installation of through-penetration materials.

1. Seal all holes or voids made by penetrations to ensure an air- and water-resistant seal (where applicable).
2. Protect materials from damage on surfaces subjected to traffic.

END OF SECTION

SECTION 26 05 13
15KV CABLE

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide 15kV power cables in accordance with the Contract Documents. Provide all required splice kits, terminations, accessories, and supplementary items required for a complete and functioning installation.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Cables shall be installed by a Contractor with five (5) or more years demonstrated experience installing 15kV cables.

B. Cables shall be spliced, terminated, and tested by a Contractor specializing in 15kV cable splicing and terminations. The termination and splice Contractor shall have a minimum of three (3) years of documented experience in the installation of medium voltage splices and terminations. Prior to the installation of cable accessories, the Contractor shall be trained by splice/termination factory authorized personnel. Factory personnel may also be present at the initial cable accessory job site installation if requested by the Engineer. All terminations and splices shall be installed per the manufacturer's installation instructions. All terminations and splices shall be approved by the County prior to any work.

C. Certificates:

1. Workmen's Competency: Submit a 15kV cable Splicer/Terminator certification of competency and experience 30 days prior to any splices or terminations are made in any 15kV cables. Splicer/Terminator experience during the immediate past three (3) years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.

D. All cables and accessories shall be sourced from a single manufacturer.

1.04 STANDARDS

A. Provide in accordance with the latest editions of the following:

1. American Society for Testing and Materials (ASTM) Publication ASTM B-496.
2. Association of Edison Illuminating Companies (AEIC) Publication:

a. CS8-00: Specifications for Extruded Dielectric Shielded Power Cables Rated 5kV Through 46kV.

3. Institute of Electrical and Electronics Engineers (IEEE) Publications:

a. IEEE 48: Standard Test Procedures and Requirements for High - Voltage Alternating Current Cable Terminations.
b. IEEE 386: Separable Insulated Connection Systems for Power Distribution Systems above 600V.
c. IEEE 404: Standard for Cable Joints for use with extruded dielectric cable rated 5kV through 138kV, and cable joints for use with laminated dielectric cable rated 2.5kV through 500kV.

4. National Electrical Manufacturer Association (NEMA) Publication:

a. WC74/ICEA S-93-639: 5kV - 46kV Shielded Power Cable for use in the Transmission and Distribution of Electrical Energy.

5. International Electrical Testing Association (NETA) Publication:

a. ATS: Acceptance Testing Specifications

6. NFPA 70.
7. ASTM B3 and B8.
8. NRTL.

1.05 SUBMITTALS

A. Catalog Product Data: Submit the manufacturer's published descriptive literature and specification sheets, clearly identified, for the following:

1. Cables (all required sizes).
2. Cable terminations and splice kits including the following data:

a. Terminations: The manufacturer shall provide a test report demonstrating design-proof testing per IEEE 48. The manufacturer shall provide a test report demonstrating accelerated and real-time testing of weathering resistance including track and U.V. resistance as well as termination stability with time, temperature, and stress variation.
b. Splices: The manufacturer shall provide a test report demonstrating design-proof testing according to IEEE 404, and water submersion testing according to ANSI C119.2. The splice manufacturer shall provide an independent agency test report demonstrating qualifications of terminations and splices to MV-105 specifications for 105 deg. C. continuous operation and 140 deg. C. emergency operation.

B. Submit the Cable Manufacturer's AEIC qualifications.

C. Submit a notarized Certificate of Compliance to demonstrate that the Cables are in complete compliance with NEMA WC-8 Part 3.

D. Factory Testing:

1. Certified evidence shall be submitted that the cable manufacturer has made factory tests on each primary length of cable. Copies of the test data shall be submitted to the Engineer. Tests shall include conductor resistance, ionization, and high voltage withstand (corona test).
2. The results of these tests shall be submitted prior to shipment of the cable and shall be conducted in accordance with NEMA and AEIC standards.

E. Submit the Contractor's Splicer/Termination Certification of Competency.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipment of all cables shall be made on reels in such a manner that the cables will be protected from mechanical damage.

B. Each end of the cables shall be hermetically sealed with a heat shrinkable cable end sealing cap and securely attached to the reel.

C. The minimum diameter of the reel drum shall be 14 times the outside cable diameter.

D. Installations of materials and equipment shall be in strict conformity to the recommendations and instructions of the manufacturers of those items.

1.07 IDENTIFICATION

A. High-voltage cable identification tags shall be provided for all cables in each manhole, vault, sectionalizing boxes, and all exposed locations.

1. Tags shall be 1/8 inch thick, 1-1/2-inch x 7 inches, 3 ply weather-resistant rigid laminated phenolic as manufactured by Hemes Plastics, Inc. or equal. A 1/4" diameter hole shall be drilled 1-1/2 inch from each tag end to facilitate attachment of the tag to the cable.
2. Tags shall have red surface with white core bearing the name of the cable as designated.
3. Install an identification tag with cable designation on each conductor with nylon tie-wrap over the cable arc-proof wrapping. Tags shall be installed in each manhole, vault, sectionalizing box, transformer, switchgear termination and on all exposed locations. Phase letters shall be included in the cable designations.
4. Tags at sectionalizing boxes or cable junction points shall state the cable's origin or destination point (e.g., "TO US-BA," or "TO US-BB") along with the cable designations.

1.08 TESTING

A. General: Each test shall be recorded neatly on prepared forms providing complete identification, time, data, and signed witness. All test equipment and personnel shall be provided by the Contractor. All test results shall be submitted to the Engineer.

B. Cables shall be tested by an approved and independent testing service according to NEMA ICEA methods at specified stages of installation. Tests shall be the D.C. voltage test of the complete cable with insulation resistance values determined from this test. The Contractor shall sign all test reports.

C. Perform acceptance testing on all cables, including all terminations and joints, after the cable system installation and before the cable system is placed into service. In accordance with ANSI/IEEE 400, ICEA S-93-639/NEMA WC 74, ICEA S-94-649, and ICEA S-97-682, testing shall be performed by means of direct voltage, alternating voltage, partial discharge, or very low frequency (VLF). The selection shall be made only after an evaluation of the alternative methods. The test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Test voltages shall not exceed 80 percent of the cable manufacturer's factory test value or 65kV.

1. Ensure that the input voltage to the test set is regulated.
2. Current-sensing circuits in the test equipment, when available, shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.
3. Record wet and dry-bulb temperatures or relative humidity and temperature.
4. Test each cable section individually.
5. Test each conductor individually with all other conductors grounded. Ground all shields.
6. Terminations shall be adequately corona-suppressed by guard ring, field reduction sphere, or other suitable method, as necessary.
7. Ensure that the maximum test voltage does not exceed the limits for terminators specified in ANSI/IEEE 48, IEEE 386, or the manufacturer's specifications.
8. Raise the conductor to test voltage max of 65kV and hold for 15 minutes.
9. If performed by means of direct voltage, reduce the test set potential to zero, and measure residual voltage at discrete intervals.
10. Apply grounds for a time period adequate to drain all insulation stored charge.
11. Spliced Cables (New to Existing):

    a. When new cables are spliced into existing cables, the acceptance test shall be performed on the new cable prior to splicing in accordance with these specifications.
    b. After test results are approved for the new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice.
    c. After a satisfactory insulation-resistance test, a test in accordance with the types listed herein shall be performed on the cable utilizing a test voltage acceptable to the Owner and not exceeding 60 percent of factory test value.

D. Remove and replace non-compliant cables or terminations and retest as specified above.

1.09 TEST VALUES

A. Compare bolted connection resistances to values of similar connections.

B. Bolt-torque levels shall be in accordance with Table 100.12 of NETA ATS, unless otherwise specified by the manufacturer.

C. Microhm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If the manufacturer's data is not

available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.

D. Shielding shall exhibit continuity. Investigate resistance values in excess of ten (10) ohms per 1000 feet of cable.

E. If the test is performed by means of direct voltage, graphic plots shall be made of leakage current versus step voltage at each increment and leakage current versus time at final test voltages.

F. Residual voltage at the end of each interval shall be approximately the same for each phase and/or parallel conductor.

PART 2 – PRODUCTS

2.01 15KV CABLES:

A. Cables shall meet the latest requirements of UL 1072, AEIC CS8, NEMA WC74/ICEA S-93-639 for power cables with Ethylene Propylene Rubber (EPR) insulation.

B. Cables shall be single conductor rated 15kV ungrounded and UL listed as Type MV-105.

C. Cables shall be capable of operating continuously in both wet and dry locations at a conductor temperature of 105 degrees C for normal operations, 130 degrees C under emergency operating conditions, and 250 degrees C under short-circuit conditions. Cables shall be suitable for use in metallic and non-metallic conduits or ducts.

D. Conductors shall be Class B stranded, compact round, soft or annealed copper per ASTM B496.

E. The strand screen shall be extruded black, semi-conducting, thermosetting compound applied over the conductor. The material shall be compatible with the conductor metal, shall be uniformly and firmly bonded to the overlying insulation, and shall be free stripping from the conductor. The contact area between the insulation and strand screen shall not exhibit projections or irregularities which extend from the cylindrical surface of the strand screen by more than five (5) mils toward the insulation.

F. The insulation shall be high-quality, heat, moisture, ozone, and corona resistant ethylene propylene rubber compound contrasting in color from the strand screen and insulation shield. The insulation level shall be 133 percent with a minimum average thickness of 220 mils. The minimum thickness at any point shall not be less than 90 percent of the specified thickness.

G. The insulation shield shall consist of an extruded, semi-conducting, thermosetting compound applied directly over the insulation. The material shall be compatible with the insulation and overlying metallic shield. The insulation shield shall be free of stripping from the insulation.

H. The contact area between the insulation and insulation shield shall not exhibit

projections or irregularities which extend toward or away from the cylindrical insulation and insulation shield interface by more than 10 mils.

I. The metallic shield shall be 0.005-inch-thick copper tape, helically applied over the insulation shield material with a minimum of 25 percent overlap.

J. The jacket shall consist of tightly extruded polyvinyl chloride (PVC) material meeting the physical and dimensional requirements of NEMA WC-74/ICEA S-93-639.

K. The overall jacket shall be surface printed in a contrasting color at two (2) foot intervals with the following information:

1. Manufacturer's Name
2. Location Code of Plant
3. Conductor Size
4. Conductor Material
5. Insulation Type and Thickness
6. Voltage Rating
7. UL Designation

L. The cables furnished shall be in complete compliance with ICEA S-93-639.

M. The cable manufacturer shall supply evidence demonstrating production experience in triple tandem extrusion of EPR insulation in 15kV cable construction. The manufacturer shall in-house formulate and mix all insulation and semi-conducting compounds used in the cable construction. The insulation shall contain no polyethylene.

2.02 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers:

1. The Okonite Company
2. Kerite Company

2.03 SPLICES, TERMINATIONS, AND ARC PROOFING

A. Cable splice kits shall contain materials which are completely compatible with the conductors' insulation, shields, and jackets, and which are approved by the cable manufacturer. The splice kits shall be heat shrinkable. The heat shrinkable core splice shall utilize a semi-conducting layer bonded to the underlying insulating layer to ensure no air gaps exist between the layers. The splice shall be rejacketed with a heavy wall sleeve to provide a waterproof hot melt adhesive seal. Pre-molded and taped splices are not acceptable. Splice kits shall be permanent, fully shielded, fully submersible, straight splice with a current rating equal to that of the cable on which it is installed. High voltage cable splices shall be qualified to IEEE-404 standards and shall be capable of properly splicing cables described herein. Splices shall be qualified to the water submersion tests described in ANSI-C119.2. Splices shall be tested to meet the performance requirements of the MV-105 standards with 105 degree C continuous operating temperature / 140 degree C emergency operating temperature. Splice kits shall be Tyco-Raychem HVS Series or approved equal.

B. All 15kV cable terminations shall be heat shrinkable. The heat shrinkable kits shall be factory-engineered for the application and shall consist of a coextruded metal

oxide mastic coating bonded to outer non-tracking (per ASTM D2303) housing. Mastic sealant shall be utilized to prevent ingress of moisture and contaminants. Termination kits shall include a constant force spring and a factory solder blocked tinned copper grounding braid. High voltage cable terminations shall be qualified to Class 1 A, IEEE-48 standards and shall be capable of properly terminating cables described in this specification. Terminations shall be tested to meet the performance requirements of the MV-105 standards with 105 degree C continuous operating temperature / 140 degree C emergency operating temperature. Tyco-Raychem HVT-Z Series or approved equal.

C. 15kV Cable Wrapping in Manholes: Irvington Brand No. 7700, 3-inch-wide arc-proofing tape, or equal Bishop tape. 3M Scotch Brand No. 27 tape shall be applied for binding, or equal Permacel tape.

D. 15kV Termination to Insulated Bus Connections: All terminations to insulated bus connections shall be re-insulated over the bolted connections with either a heat shrinkable bus insulation tape or tubing to help prevent incidental contact flashover. Tyco-Raychem HVBT or BPTM Series products.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine surfaces, substrates, and conditions for compliance with requirements of other sections in which that related work is specified, and determine if surfaces, substrates, and conditions affection performance of the work of this Section are satisfactory. Do not proceed with the work of this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Contractor. Starting installation constitutes acceptance of surfaces, substrates, and conditions.

3.02 GENERAL

A. Handling of cables, installing, grounding, splicing, and testing shall be accomplished in full compliance with the instructions and recommendations of the cable manufacturer.

3.03 CABLE HANDLING AND INSTALLATION

A. On receipt, cable protective covering shall be inspected for evidence of damage during shipment.

B. Work and storage areas shall be kept clean and dry. Manholes shall be pumped dry and kept dry from the start of duct preparation until all cables are installed and tested. Cables shall be properly supported at all times, so they do not lay on the floor or reach within 12 inches of it.

C. Sealing:

1. Each length of cable shall be kept sealed at both ends at all times except when actual splicing or termination is in progress.
2. If cables must be cut, both ends shall immediately be resealed utilize a heat shrinkable adhesive coated end sealing cap. Tyco-Raychem ESC Series or approved equal. Seals shall be physically protected.

3.04 DUCT PREPARATION

A. Ducts shall be cleaned prior to pulling of any cables. Immediately before cables are to be pulled, a well fitted swab shall be pulled through the duct in one (1) direction to wipe all foreign matter and moisture from the duct.

B. A mandrel assembly shall be pulled through the duct without forcing. If the mandrel does not easily pass through the duct, the distance pulled to that point shall be noted and the duct work exposed. Corrections and repairs shall be made to the satisfaction of the Engineer.

C. Existing conduits, into which new cables are to be pulled, shall be cleaned of all debris, even to the extent of “rotary cleaning methods” if required, prior to the passing of a mandrel through the conduit as described hereinbefore.

D. Cable Pulling:

1. Use only lubricants recommended and approved by the cable manufacturer. Petroleum based products shall not be used as cable lubricants.
2. Cable reels shall be supported on substantial reel supports located near enough to the pullboxes and manholes to permit feeding-in the cable without back-tension or its rubbing on the sides of the openings. The reel shall be provided with an approved method for braking.
3. The cable shall be pulled with a power-driven winch, having sufficient power to start and pull the cable without jerking. Pulling speed and cable tension shall not exceed the manufacturer's recommended values.
4. Cable pulling crews shall consist of sufficient workforce to ensure the installation of the cable in a safe manner without damage to the cable.
5. Pulling shall be accomplished utilizing a dynamometer. Copies of signed dynamometer records shall be submitted to the Engineer, on a daily basis.
6. The pulling cable shall be attached to the conductor of the power cable with an approved swivel clevis to prevent twisting cables.
7. The cables shall enter into the duct in a manner that will prevent its dragging on the edge of the duct, mouth, or causing back pressure.
8. No pressure or sharp contact shall be applied to the cable jacket which may damage or cause voids to the cable components.
9. Cable sidewall pressures shall not exceed 500 pounds per foot of bend radius. Cable pulling tension shall not exceed 0.008 pounds per kcmil of the cable area.
10. Cables in vaults, settlement pits, and manholes shall be trained onto supporting racks and secured with guides.
11. Cable bending radius shall be in accordance with all applicable codes. Install feeder cables in one (1) continuous length unless splices are favorably reviewed. Minimum radii shall be 12 times the cable O.D.
12. The cable reel shall be set up so that reverse bending is not required. The cable shall be unreeled from the top of the reel. Cables cut in the field shall be immediately sealed with rubber tape and protected with PVC tape. Cables for splicing shall be overlapped by a minimum of two (2) feet. Cables shall be looped around the manhole circumference before exiting again.
13. Cable pulling by means of a vehicle is not allowed. The Contractor shall have all the necessary cable installation equipment.

E. Cable Splicing:

1. Splices shall be carefully made in strict conformance with the manufacturer's instructions.
2. Once splice or termination work has been started, work shall continue in one (1) continuous work period until completed.
3. Under no conditions shall termination or splice work be subjected to moisture. Tents shall be available at the work site to protect the area from rain. Pumps shall be available for keeping manholes dry. Blowers shall be provided to force fresh air into manholes where free air circulation is obstructed. Unused ducts shall be kept plugged.
4. Locate splices midway between the cable racks and support on cable arms at enclosing conduit heights.
5. After preparation of cable ends, the splice shall be assembled with the required basic components, in the desired configuration, using tools recommended by the manufacturer.
6. Splices shall be installed in such a manner which will allow removal without disturbing other splices and cables.

F. Cable Termination:

1. Clean mating surfaces by using stainless steel wire brush.
2. Use crimping tools, dies, and techniques as recommended by the manufacturer.
3. Protect insulation from heat when soldering, brazing, or welding. Make the insulation cutback longer and wrap insulation with tape. Use only rosin flux when soldering copper electrical connections.

G. Cable Grounding:

1. Shields at splices and terminations shall be solidly grounded.
2. Grounding systems shall be complete including all necessary cables and grounding copper to provide a permanent and effective ground.
3. Connections of grounding wires shall be made only to clean, scale, and corrosion free metal surfaces.
4. Grounding connections shall be made utilizing installation tools and recommendations of the grounding equipment material manufacturer.

H. Cable Arc Proofing:

1. All power cables in vaults, settlement pits, and manholes shall be wrapped with arc proofing tape.
2. Tape shall be wrapped in either two (2) layers butt-taped with second layer covering joints in the first layer or one (1) layer half taped.
3. Wrapping shall extend the full length of the cable from the duct entrance to the duct entrance, except where splices are installed. Splices shall be left uncovered and wrapping shall stop at grounding device.

END OF SECTION

SECTION 26 05 19
600V WIRE AND CABLE

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide 600V wires and cables, and all ancillary connectors and terminations, in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 STANDARDS

A. Rubber Insulated Wire and Cables: ICEA S-19-81, NEMA WC 3, and UL 44

B. Thermoplastic Insulated Wire and Cables: ICEA S-61-402, NEMA WC 3, and UL 83

C. Cross Linked Thermosetting Polyethylene Insulated Wire and Cables: ICEA S-66-524, NEMA WC 7, and UL 44

D. Service Entrance Cables: UL 854

E. Annealed Copper Wire for Conductors: ASTM B-3

F. Mineral Insulated (MI) Cables: UL 2196/ULC S139 for Fire Resistance

G. Connectors: UL 486A & 486B

H. Terminal Blocks: UL 1059

I. NFPA 70

1.04 QUALITY ASSURANCE

A. All conductors, connectors, and terminations shall be of the same manufacturer.

1.05 SUBMITTALS

A. Product data for each type of wires, cables, connectors, and terminations proposed for this project.

B. Mineral Insulated (MI) Cables:

1. Manufacturer’s product data sheets of all systems component, including

indication of 2-Hour rating and all associated fittings.

C. Field test results and reports.

1.06 FIELD TESTING

A. Engage the services of a qualified testing agency to perform all the necessary field inspections and testing.

B. Inspect all splices and terminations and make them mechanically and electrically tight during the two (2) week period prior to final acceptance of the work.

C. Feeder insulation shall be tested after the installation and before final connections in accordance with NETA or NRTL Acceptance Testing.

1. Tests shall be performed with a 500-volt megger, and conductors shall test free from all short circuits and grounds.
2. Conductors shall be tested phase-to-phase and phase-to-ground.
3. Furnish all necessary instruments, tools, materials, and labor for all testing.

D. Demonstrations: Subsequent to the conductor installations and connections, energize the circuits and demonstrate that the feeders are all functioning properly in accordance with the Contract Documents and Codes. Correct and repair all deficiencies and retest to demonstrate full compliance.

E. For Mineral Insulated (MI) cables provide certification from the manufacturer verifying that the entire installation and testing data meets their requirements and that all cable ratings are maintained.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Wires and Cables:

1. Southwire Co., Belden, AFC, Rome Cable, General Cable Corp, Alcan, and Priority Wire & Cable.

B. Mineral Insulated Cables:

1. Pyrotenax, a brand of nVent (System 1850) or approved equal.

C. Connectors:

1. Conductor AWG No. 14 through No. 6:
   a. Hand Applied: Piggy (Thomas & Betts), Scotch Lock (3M), or Wing Nut (Ideal).
   b. Tool Applied: Burndy HYDENT, Thomas & Betts, or Stakon.
2. Conductor AWG No. 4 through No. 1:
   a. Tool Applied: One (1) hole compression type, Burndy HYLUG, OZ/Gedney, or Thomas & Betts.
3. Conductor AWG No. 1/0 through 1000 MCM: Thomas & Betts, OZ/Gedney, or Burndy.

D. Electrical Insulating Tape:

1. Johns-Manville, 3M, or approved equal.

2.02 WIRES AND CABLES

A. General:

1. All cables shall have a 600V minimum insulating rating.
2. Provide all required tools, equipment, and materials to install and terminate all conductors.
3. All raceway systems shall be capped after installation to avoid debris entering. Prior to installing any cables, clean all raceways and remove any foreign matter.
4. Avoid damage to any conductor insulation or sheath during the installation process. Fully replace any damaged conductor.

B. Conductors:

1. Electrical grade, annealed copper conductors, and factory fabricated in accordance with ASTM and ICEA standards. Minimum size No. 12 AWG for branch circuits; No. 14 AWG for control wiring.
2. Aluminum conductors are not permitted.

C. Conductor Number and Stranding:

1. Conductors No. 12 and No. 10 AWG shall be solid.
2. Conductors larger than No. 10 AWG shall be stranded ASTM Class B stranding designations.
3. Control wires shall be stranded in accordance with ASTM Class B stranding designations.
4. Cables for low voltage systems shall be multi conductor type, unless otherwise noted.

D. Insulation:

1. Indoor Applications: 600 volts, 90-degree C. thermoplastic insulation, nylon jacket, surface printed identification, listed as type XHHW per UL 83.
2. Exterior and Underground Applications: 600 volts, XLPE insulation, surface printed identification, listed as XHHW-2 per UL.

E. Insulating Tape:

1. Vinyl plastic tape rated 600V suitable for indoor and outdoor applications, minimum of 8.5mm per UL 510 and ASTM D-3005.

F. Color Coding:

1. All conductors shall be color coded as follows:

Conductor	120/208V System

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

2. Conductors No. 8 AWG and smaller shall be factory color coded the entire length. Conductors No. 6 AWG and larger shall be color coded by color tape the entire length of the exposed conductors at all accessible locations.
3. Control wiring shall be color coded in accordance with the manufacturer's recommendations.

2.03 MINERAL INSULATED (MI) CABLE

A. Factory assembly of one (1) or more conductors insulated with highly compacted magnesium oxide insulation, enclosed in a seamless, liquid, and gas tight continuous copper sheath.

B. Conductors shall be solid, high electrical conductivity copper (suitable for equipment grounding purposes) rated 600V or less, with a cross-sectional area corresponding to the standard sizes indicated on the Contract Drawings.

C. Insulation shall allow for proper spacing of conductors. Thickness on insulation shall be at least 55 mils for cables rated from No.14 AWG through 250 MCM.

D. Mineral insulated cable shall be classified by Underwriters Laboratories (UL) as having a minimum 2-hour fire resistive rating.

E. All fittings shall be identified for such uses. Gland conduit fittings – three (3) or four (4) terminal kits, two (2) 3-hole brass plates, and all required termination tools.

F. Acceptable Manufacturer: nVent or approved equal. Conductor sizes on the Contract Documents are based on nVent.

2.04 CABLE LUBRICANTS

A. Provide cable pulling lubricants compatible with cable insulation to minimize friction and temperature gains.

B. Refer to the respective manufacturers' recommendations for each cable and in accordance with UL and IEEE.

PART 3 – EXECUTION

3.01 GENERAL

A. Maximum of three (3) current carrying conductors in one (1) conduit unless otherwise indicated. The Contractor shall derate conductors and size feeders and conduits in compliance with the National Electrical Code.

B. All branch circuits shall utilize, as a minimum, No. 12 AWG conductors, unless otherwise indicated in the Contract Drawings.

C. Provide minimum No. 10 AWG conductors for 120-volt branch circuits exceeding 100 feet in length from the panelboard source to the furthest outlet. Provide No. 8 AWG conductors for any branch circuit greater than 200 feet in total length.

D. All conductors shall be installed in a raceway system, regardless of operating voltage. Do not install any conductors until the raceway system installations are fully complete and free of all debris.

E. Utilize conductor type XHHW for lighting, receptacle, motor branch circuits; and panelboard and equipment feeders.

F. Utilize conductor type XHHW for branch circuits passing through the light fixture enclosures.

G. Provide accessible cable support boxes for all vertical copper conductor risers in accordance with the NEC.

1.	Up to No. 1/0 AWG	- Every 100 feet
2.	No. 2/0 AWG to No. 4/0 AWG	- Every 80 feet
3.	No. 250 MCM to No. 350 MCM	- Every 60 feet
4.	No. 400 MCM to No. 500 MCM	- Every 50 feet
5.	No. 600 MCM to No. 750 MCM	- Every 40 feet

H. Conductor ratings shall be uniform for the entire length of the circuit, unless noted otherwise.

I. Do not splice feeders or dedicated branch circuits, unless otherwise indicated.

J. Make connections, splices, taps, and joints with solderless devices, mechanically and electrically secure.

K. Lubricate cables to facilitate the necessary pulling. Lubrication material shall be inert to the cable insulation and raceways. Do not exceed maximum recommended pulling tension of all conductors.

L. Install compression connectors with hydraulic die, embossing the die code into the connector. Connect to the bus with Bellville type washers for positive pressure over complete contact area. Insulate with heat shrink tubing.

M. Provide a separate neutral conductor for each dimmer branch circuit and ground fault circuit interrupter branch circuit.

N. The Contractor shall fire seal all cable and conduit penetrations at all fire rated barriers.

O. Provide a shared neutral conductor sized one (1) AWG larger than the receptacle branch circuit phase conductors.

P. Steel plates shall be provided where any non-metallic sheathed cables are less than 1.25” from the stud edge in accordance with the NEC.

Q. Provide identification labels for all conductors in all enclosures. All conductor identification labels and non-metallic straps shall be flameproof.

3.02 MINERAL INSULATED (MI) CABLES

A. All MI cables and fittings shall be stored in dry locations.

B. Provide support identified for such use at all intervals not exceeding three (3) feet designed and installed so as not to damage the cables. Provide identification labels every six (6) feet.

C. Where single conductor cables enter ferrous metal boxes or cabinets, the installation shall be made to prevent inductive heating.

D. Provide seals immediately after stripping to prevent the entrance of moisture into the insulation. The conductors extending beyond the sheath shall be individually provided with an approved insulated material.

E. All cables and fittings shall be installed in accordance with the manufacturer's recommendations and shall maintain the 2-hour rating.

F. All penetrations shall be fire stopped.

G. Where required, provide steel sleeves for all floor and wall penetrations.

H. After installing the conductors and prior to energizing, perform visual and electrical tests of all conductors for compliance with the manufacturer’s requirements.

END OF SECTION

SECTION 26 05 26
GROUNDING SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide grounding systems in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Electrical components, devices, and accessories shall be UL listed and labeled as defined in NFPA 70 by a qualified testing agency and marked for the intended use.

B. Westchester County Airport standards and approvals of the service installation.

1.04 STANDARDS

A. UL 467 and 486A

B. ANSI C2

C. IEEE 142, 1100, 80, and 837

D. NFPA 70

E. National Electrical Safety Code

F. NETA

G. NRTL

H. Local Authority Having Jurisdiction

1.05 SUBMITTALS

A. Manufacturer’s product data sheets for all grounding equipment, devices, and connectors.

B. Prepare and submit shop drawings indicating floor plans and wiring diagrams of all grounding components and connections, including all applicable details.

C. Field testing procedures, results, and final reports.

1.06 FIELD TESTING

A. The Contractor shall retain an independent testing agency in accordance with a Nationally Recognized Testing Laboratory (NRTL).

B. After installing the grounding system; but before permanent electrical systems are energized, test for compliance with all requirements.

C. Resistance testing of the ground rod system indicating a maximum five (5) ohms resistance to ground shall be achieved. Install additional ground rods spaced ten (10) feet apart and retest until the desired results are achieved.

D. Upon completion of the project, the Contractor shall perform testing of the grounding system for any stray currents, grounds, shorts, etc. The Contractor shall rectify any unacceptable test results and perform additional testing until the systems are fully compliant.

E. Perform point-to-point field testing to confirm all resistance values for all derived neutrals and system neutrals.

F. Inspect all physical and mechanical conditions, including verification of tightness of all electrical connections.

G. Prepare and submit all field test reports.

1.07 IDENTIFICATION

A. Provide an identification nameplate for each ground bus bar.

B. Label each grounding electrode conductor exiting the main ground bus bar.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Erico Products, Inc.; Appleton Electric Co.; OZ/Gedney Electric Co.; and Raco, Inc.

2.02 GENERAL

A. All grounding system equipment shall be copper. Conductors shall be sized per the NEC Table 250-95.

B. Provide a continuous ground path for all electrical feeders and branch circuits.

C. Grounding connections shall be brazed molded exothermic welded, bolted clamp terminal, or heavy-duty pressure connector type.

D. Ground conductors shall be bare or insulated (with green color) annealed stranded copper conductors as indicated on the Contract Drawings and as required by Code.

E. All feeders and branch circuits shall be equipped with a dedicated equipment ground conductor. Use of the metal raceway as the ground path in lieu of the separate

equipment ground conductor is not acceptable.

2.03 GROUNDING ELECTRODE SYSTEM

A. Provide the following grounding electrodes, bonded together to form the grounding electrode system:

1. Metal underground water pipes in direct contact with the earth for ten (10) feet or more and electrically continuous to the point(s) of connection of the grounding electrode conductor and the bonding conductors.
2. The metal structural frame of the building, where effectively grounded.
3. Ground rods of copper clad steel, minimum 5/8-inch diameter and ten (10) feet long, driven full length into the earth. Rods shall be a minimum of ten (10) feet apart and driven until the tops are a minimum of 12 inches below grade. If a maximum resistance to ground of five (5) ohms cannot be obtained with a single ground rod, provide additional ground rods installed not closer than six (6) feet apart until a maximum resistance to ground of five (5) ohms is achieved.
4. Ground plates shall be 24" x 24" x ¼" thick of high conductivity copper. Plates shall be a minimum of six (6) feet apart and installed a minimum of 36" below grade.
5. A ground ring consisting of driven ground rods and direct buried bare copper cable, No. 4/0 AWG minimum encircling the building.
6. Do not penetrate the foundation or retaining wall waterproofing system. Underground conductors shall be buried a minimum of 24" below grade with markers above.
7. Grounding test wells shall be provided for testing and shall include:

    a. Precast concrete underground box with flush removable cover at grade.
    b. Cover shall be steel and labeled to indicate "GROUND WELL – GROUND ROD."
    c. Minimum dimensions shall be 18" deep x 12" square.

2.04 GROUND BUS BAR

A. Provide a main ground bus bar in the main switchboard room. Provide additional ground buses in other locations shown on the Contract Drawings.

B. The main electrical room ground bus bar shall be copper which is a minimum of 24" long x 4" high x ¼" thick. Utilize Type 304 stainless steel mounting connections and fasteners, mounted on standoff isolators. The exact length of the bus bar shall be field coordinated to allow connections to all grounding requirements plus 25% spare.

2.05 TELECOMMUNICATIONS GROUNDING SYSTEM

A. Provide a continuous green insulated No. 6 AWG (minimum) copper grounding conductor between each telecom terminal backboard and each telecom terminal cabinet. Bond the telecommunications grounding system to the grounding electrode system and to the nearest available structural steel on each floor.

B. Provide 20" long x 4" high x ¼" thick copper ground bus bar (TMGB) in the MDFs, server, and all demark rooms; and 12" long x 2" high x ¼" thick ground bus bars (TGBB) in all the IDFs (TRs).

C. All ladder racks and data racks shall be bonded and grounded with No. 6 AWG green insulated copper ground in conduit.

2.06 WIRING TROUGHS AND ALL ENCLOSURES

A. All wiring troughs and enclosures shall be bonded together utilizing a minimum of No. 4/0 AWG.

B. Provide a minimum of No. 2 AWG insulated copper conductors for bonding between any cable support system and service equipment.

C. All hinged connections shall be equipped with bonding jumpers.

D. Provide bonding jumpers between all troughs and enclosures, and all conduits entering the troughs and enclosures.

E. Install bonding jumpers within all metallic enclosures containing any feeders rated 150 amperes or greater. Where an enclosure contains feeders rated less than 150 amperes, utilize locknuts and bushings – inside and outside the enclosure.

F. Provide bonding jumpers within all panelboards and the feeder conduits entering the panelboard enclosure.

G. Generator and its enclosure, pad mounted transformer, respective foundations, surrounding bollards, and pad reinforcements shall be grounded.

PART 3 – EXECUTION

3.01 GENERAL

A. Metallic raceways, cable trays, cable armor, cable sheath, enclosures, equipment frames, fittings, and other metallic noncurrent carrying equipment parts and surfaces shall be effectively bonded to the grounding system. Nonconductive paint, enamel, or similar coating shall be removed at threads and contact surfaces to preserve grounding continuity or fittings shall be provided to make such removal unnecessary.

B. The grounded service conductor (neutral) of each service shall be connected to the grounding electrode system with an appropriately sized grounding electrode conductor.

C. The grounded conductor (neutral) of each separately derived system shall be connected to the nearest effectively grounded building structural steel and nearest interior cold-water pipe with an appropriately sized grounding electrode conductor. Separately derived systems include each of the following:

1. Transformer
2. Engine generator
3. UPS system
4. Photovoltaic system

D. Where cold water pipe grounding is installed, utilize a minimum of No. 4/0 AWG bonding jumpers with ground clamps on both sides of the utility domestic water

meter.

E. Neutral wiring shall be grounded at the system point of origin only and shall be isolated from downstream grounding systems.

F. Provide a complete grounding system to include all metallic equipment such as metal antennas; elevator; building steel structure; flag poles; fences; chimneys; etc.

G. Provide an insulated grounding conductor, within the flexible metal conduit, for all segments of branch circuits serving motors and motor controllers.

H. Bond interior metal piping systems to the grounding electrode system. Where metallic piping and duct systems are rendered metallically noncontinuous by nonconductive couplings, bonding copper jumpers to provide grounding continuity. All mechanical equipment shall be bonded to the building's electrical grounding system. Utilize flexible bonding jumpers, connections, and couplings for all rotating and vibrating equipment.

I. Receptacles and light fixtures shall be grounded to the outlet box by means of a bonding jumper between the outlet box and the receptacle or light fixture grounding terminal.

J. Feeders and branch circuits shall be provided with an insulated equipment grounding conductor run with the circuit conductors. This grounding conductor shall be in addition to the ground path provided by the continuously grounded metallic raceway system that encloses the phase and neutral conductors. All equipment grounds shall be installed within the same raceway as the phase conductors.

K. Provide bolted clamp terminal connectors connected to removable equipment.

L. Provide brazed molded exothermic welded connections to the ground rods and connections to building structural steel.

END OF SECTION

SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide raceways, boxes, and ancillary enclosures in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 STANDARDS

A. Rigid Galvanized Steel (RGS): UL 6, ANSI C80.1 & C80.6, Federal Specification WWC-581E, and NEMA RN-1.

B. Electrical Metallic Tubing (EMT): UL 797, Federal Specification WWC-563, and ANSI C80.3.

C. Metal Clad (MC) Cables: UL 83, 1479, 1569, 1581, 2556; and Federal Specification AA-59544.

D. Liquid Tight Flexible Metal Conduit (LFMC): UL 360, 1660, and 514B.

E. Flexible Metal Conduit (FMC): UL 1 and Federal Specification WWC-566.

F. Rigid Non-Metallic Conduit: UL 651, Federal Specification WC-1094-A, ANSI F512, and NEMA TC-2.

G. Auxiliary Wireway Gutters: UL 870.

H. NFPA.

I. NEMA.

1.04 QUALITY ASSURANCE

A. All raceways, boxes, and ancillary enclosures shall be of the same manufacturer.

1.05 SUBMITTALS

A. Provide manufacturer’s data sheets for all raceways, fittings, cabinets, enclosures, and all accessories.

B. Provide detailed scaled drawings indicating the dimensional data and access requirements of all enclosures, including any cable support boxes. Indicate where all expansion joints will be utilized.

1.06 IDENTIFICATION

A. Mark junction and pull box covers with permanent stencil identification of the panelboard, voltage, source (normal, emergency, etc.), and circuit numbers of the wiring contained within. Apply identification after any painting of the boxes or respective conduits. Emergency raceways shall be labeled every 10 feet with a yellow nameplate and black lettering.

B. Provide conductor labels for all cables which are routed within any junction or pull box, including all switchboards, panelboards, etc. Labels shall provide all conductor data including source, load, feeder ratings, overcurrent protection rating, etc.

C. All fire alarm and fire pump systems pull boxes and junction boxes shall be painted red.

D. All rooftop conduits shall be painted durable, weatherproof, and reflective red paint.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Conduits and Boxes:

1. UL listed and labeled products, which comply with NEMA and ANSI Standards, of any manufacturer meeting the specified performance requirements are acceptable.

B. Metal Clad (MC) Cables:

1. AFC, Southwire, or approved equal.

C. Wireways and Auxiliary Gutters:

1. Square D - Schneider, Hubbell, or approved equal.
2. Wireways and auxiliary gutters shall be UL listed and labeled.

2.02 CONDUITS AND FITTINGS

A. Rigid Galvanized Steel (RGS) Conduits:

1. Rigid conduit, heavy wall, hot dipped galvanized steel inside and out, with threaded ends.
2. Threaded type fittings.

B. Rigid Aluminum Conduits:

1. Rigid conduit, heavy wall, with threaded ends.
2. Threaded type fittings.

C. Electrical Metallic Tubing (EMT) Conduits:

1. Continuous, seamless steel tubing galvanized or sherardized on the exterior, coated on the interior with smooth hard finish of lacquer, varnish, or enamel.
2. Steel, compression type fittings for all raceways. Set screw type fittings are unacceptable for use on this project.
3. Provide concrete type fittings where required.

D. Metal Clad (MC) Cables:

1. Galvanized steel armor, copper conductors, insulated internal copper equipment grounding conductor, and internal marker tape.
2. Screw in grounding type insulated throat type fitting with die cast steel locknut.
3. Steel insulating bushings.

E. Flexible Metal Conduits (FMC):

1. Single strip, continuous, flexible interlocked double-wrapped steel, hot dip galvanized inside and out forming smooth internal wiring channel.
2. Steel, compression type fittings.

F. Liquid Tight Flexible Metallic Conduits (LFMC):

1. Same as flexible metal conduit except with tough, inert, watertight plastic outer jacket.
2. Fittings shall be cast malleable iron body and gland nut, cadmium plated with one-piece brass grounding bushings threaded to the interior of the conduit. Spiral molded vinyl sealing ring between gland nut and bushing and the nylon insulated throat. Fittings shall be rated for outdoor applications.

G. Rigid Non-Metallic Conduits:

1. Schedule 80 polyvinyl chloride suitable for 90°C.
2. Solvent cement type fittings.

H. Electrical Non-Metallic Tubing (ENT) Conduits:

1. High impact resistant PVC.
2. Concrete tight fittings.
3. Color coded by cable system type.
4. Threaded hub for connection to rigid galvanized metallic raceways when exiting out of slab or through foundation walls.

2.03 AUXILIARY WIREWAY GUTTERS

A. All auxiliary wireway gutters shall be field coordinated as required to suit field conditions.

B. Provide necessary elbows, tees, connectors, adapters, etc.

C. NEMA 250 Type 1 (indoors) or Type 4X (outdoors) sheet metal, with enamel finish shall be utilized.

D. Continuous removable front cover secured with screws and keyhole slots. Hinged covers where installed above the suspended ceiling. NEMA 4X shall be flanged and gasketed type.

E. Provide wire retainers at not greater than 12 inches on center.

2.04 OUTLET, JUNCTION, AND PULL BOXES

A. Cast Type Boxes:

1. Ferrous alloy box with the inside threaded hubs for rigid galvanized steel conduit.
2. Aluminum box with threaded hubs for rigid aluminum conduit.
3. Ferrous alloy box with compression or inside threaded hubs with adapter for electrical metallic tubing.
4. Cast raised cover; size matched to the contour of box.
5. Tapered threads for hubs.

B. Galvanized Pressed Steel Type Boxes:

1. General:

a. Pressed steel galvanized or cadmium-plated, four (4) inches minimum octagonal or square with galvanized cover or extension ring as required.

2. Concrete Boxes:

a. Four (4) inches minimum octagonal with removable backplate. Depth of the box shall allow for a minimum of one (1) inch of concrete to be poured around the backplate.

3. Light Fixture Junction Boxes:

a. Four (4) inches minimum octagon.
b. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box, and extend flexible metal conduit to each fixture.
c. Provide 2" x 4" junction boxes in conditions where a 4” octagonal box exceeds smallest dimension of the fixture being attached to the junction box. Coordinate the outlet box dimensions and fixture dimensions with the light fixture product data sheet such that the outlet box is not visible under the fixture.

4. Provide 3/8 inch no bolt fixture studs where required.

C. Sheet Steel Boxes:

1. Provide No. 12 gauge sheet steel for boxes with maximum sides less than 40 inches, and maximum area not exceeding 1,000 square inches; riveted or welded ¾ inch flanges at exterior corners.

2. Provide No. 10 gauge sheet steel for boxes with maximum sides 40 to 60 inches, and a maximum area of 1,000 to 1,500 square inches; riveted or welded ¾ inch flanges at exterior corners.
3. Provide No. 10 gauge sheet steel riveted or welded to 1½ inch by 1½ inch by ¼ inch welded angle iron framework for boxes with maximum sides exceeding 60 inches and more than 1,500 square inches in area.
4. Outdoor type boxes shall be the same as above, except aluminum reinforced with stainless steel screws, and completely gasketed.
5. Provide ground lugs in all boxes.
6. Covers shall be:

    a. Same gauge steel as the box.
    b. Subdivided single covers so no section of the cover exceeds 50 pounds.
    c. Machine bolts or machine screws threaded into tapped holes.
    d. Covers shall be labeled.

7. Paint:

    a. Rust inhibiting primer, ANSI 61 grey enamel finish coat.

2.05 ELECTRICAL BOX PADS

A. Provide fire rated electrical box pads where enclosure boxes are installed in fire rated walls.

B. Fire Rated: Pads shall be manufactured by Specified Technologies, Inc. (STI) or approved equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide independent raceways for each voltage and system type. Emergency system wiring shall be kept independent of other wiring systems. Provide insulated equipment grounding conductor in all raceways. The minimum conduit size utilized on this project shall be 3/4 inch; minimum of 1-inch for underground conduits.

B. All conductors (power, controls, and fire alarm) shall be installed in separate raceways.

C. Protect metallic raceways in earth or fill from corrosion with two (2) coats of corrosion resistant paint or tape wrap.

D. Protect all conduits from moisture and construction debris entry with appropriate coverings.

E. Elbows for conduits installed below grade, embedded within the floor slabs, and stub-ups through the concrete slabs shall be rigid galvanized steel conduit with two (2) coats of corrosion resistant paint, tape wrap, or plastic-coated rigid galvanized steel conduit.

F. Empty conduits stubbed into the ceilings of the Tenant shell spaces for the Tenant's

future use shall be installed 6-inches below the bottom of the ceiling slab to the top of the conduit, unless otherwise shown on the Contract Drawings.

G. Tie embedded raceways securely in place prior to the concrete placement. Raceways installed below or within floor slabs shall extend a minimum of four (4) inches above the finished slab or housekeeping pad to the first connector. Install capped bushings on conduit stub ups.

H. Branch circuit conduits or wiring device conduits for miscellaneous systems shall not be installed below slab on grade or embedded within the floor slabs.

I. Locate raceways so that the integrity of the structural members is not affected, and they do not conflict with the services of other trades. Draw up couplings and fittings full and tight. Protect threads from corrosion after installation with zinc chromate or equivalent protection.

J. All conduits embedded in the concrete fill or structure shall be pre-approved by the Structural Engineer, prior to any work. Do not install any raceways in any concrete slabs prior to approval by the Owner. The contract bid is based on no conduits installed in the slab.

K. Conceal raceways except at surface mounted cabinets and freestanding equipment. Install a minimum of six (6) inches from any flues, steam pipes, or other heated lines. Provide flashing and counterflashing for waterproofing of raceways which penetrate the roof. Install power raceways a minimum of 24 inches from data (and any low voltage cabling system) raceways, cross at 90-degree angle. Route exposed raceways and raceways above suspended ceilings parallel or perpendicular to the building lines with right angle turns and symmetrical bends. Provide steel sleeves for concrete walls, floor slabs, and partitions. Waterproof-sleeved raceways where required.

L. The Contractor shall install junction boxes in accessible ceiling locations. Where junction boxes must be installed above hard sealed ceilings, the Contractor shall identify these locations to the Architect and Engineer prior to installation, and coordinate access panel locations and types with the Architect. Should the Architect require the junction box to be relocated to avoid an access panel, this Contractor shall relocate as part of the base bid.

M. Provide expansion joints in the exposed and concealed raceways at all expansion joints and between structures to compensate for differential movement and at every 200-foot interval. Provide bonding jumping conductors.

N. Provide one (1) empty ¾ inch raceway, with labelled pull line, for each three (3) spare unused poles or spaces for each flush-mounted panelboard. Terminate conduit stubs in an accessible ceiling location for future extension.

O. Provide raceways with appropriate seal-offs, fittings, etc. in special occupancy areas as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceilings, or floors which separate adjacent rooms having substantially different maintained temperatures, refrigeration, or environmental rooms.

P. Provide labeled pull cords in all empty (power & low voltage) raceways. Tag both ends noting destination and provide slack at each end.

Q. Coordinate with the mechanical, plumbing, and fire protection trade Contractors when installing conduits near their equipment. Install conduits away from equipment control panels and outside of the equipment clearance zones. Do not block any access points required by other trades.

R. Clear raceways of all obstructions and dirt prior to pulling of any conductors. Use ball mandrel (diameter approximately 85% of the conduit insider diameter) followed by a close-fitting wire brush and felt or similar material. This assembly may be pulled with, but ahead of the cable being installed. Clean all empty raceways similarly. Clear or replace any raceway which rejects the ball mandrel.

S. Install exterior underground conduits 36 inches (top of conduit bank) minimum below finished grade. Do not penetrate waterproof membranes unless proper seals are provided. For incoming utilities, coordinate installation depth with the respective utility company prior to any work. All penetrations shall be coordinated with the Structural Engineer prior to any work.

T. Secure raceway clamps or supports to the masonry materials with toggle bolts, expansion bolts, or steel inserts. Install raceways on steel construction with approved clamps which do not depend on friction or set-screw pressure alone.

U. Provide independent support for raceways larger than 3/4 inch. Provide Unistrut support and threaded rod to the structure above for multiple suspended raceways when installed together. Use of lathe channels or other miscellaneous steel to support raceways is not permitted. Use listed supports such as Unistrut or similar systems for support.

V. Raceways Embedded in Floor Slabs:

1. Raceways shall not be installed in any slab without the prior written approval of the Structural Engineer.
2. Raceways shall not interfere with the placement of the floor slab reinforcement components.
3. Install raceways between the upper and the lower layers of the reinforcing steel.
4. Space raceways not less than eight (8) inches on centers except where they converge at panels or junction boxes.
5. Raceways running parallel to slabs supports, such as beams, columns, and structural walls shall be installed not less than 12 inches from such supporting elements.

W. Non-Metallic Raceway Installations:

1. Joints shall be made using the material recommended by the raceway manufacturer. Components shall be cleaned prior to assembly.
2. Raceway cutoffs shall be square and shall not deform the conduit. Ream rough surfaces.
3. Provide male box adapters to terminate raceways.
4. Where separable terminations are required, provide PVC threaded adapters with locknuts or bushings. Provide “O” rings for watertight installations.
5. Bends shall be made by methods that do not deform or damage the raceway.
6. Provide expansion fittings where required.
7. Raceway supports shall be installed to allow the non-metallic conduit to

slide through the supports.

8. Non-metallic raceways are not permitted within or on the building.

X. Raceways Installed Above Suspended Ceilings:

1. Single runs of ¾ inch raceways shall be supported from the ceiling support wires where permitted by the rating of the ceiling system.
2. Provide independent supports of raceways larger than ¾ inch. Provide independent support at multiple raceways (more than one) locations. Provide Unistrut support and threaded rod to the structure above. Attachment to the ceiling support wires is not permitted.
3. Provide independent support for raceways installed above fire rated ceilings. Attachment to the ceiling support wires is not permitted.
4. Install conduits at 1 foot-0-inch minimum above the top of the ceiling. This shall be coordinated with all trades prior to any work.

Y. Underground Duct Banks:

1. A utility survey shall be performed to identify locations of all existing site utilities prior to any work. This survey shall be included as part of this Contractor's scope of work. Contact DIG SAFE prior to any trenching work performed on site.
2. Provide underground duct banks as indicated on the Contract Drawings. Provide concrete encasement of power systems duct banks except where duct banks run beneath the building slab on grade. Provide concrete encasement of the duct bank elbows for all systems. Provide steel reinforcing bars for concrete encased duct banks. Provide spacers to permit concrete to completely surround and encase each conduit. Concrete strength shall be 3,000 pounds per square inch minimum. Provide red dye inhibiting agent in the concrete mix.
3. Pitch conduit down and away where duct banks enter the building, utility access holes, or equipment.
4. Duct banks shall be installed at not less than 36" below grade to the top of the encased duct bank.
5. Support raceways installed in duct banks every five (5) feet, minimum, to ensure correct alignment prior to placing concrete.
6. Terminate raceways with flared end bells. Mandrel and clear raceway terminations of burrs and rough edges prior to any cable installation.
7. All duct banks routed below parking areas and roads shall be reinforced by steel rebars.

Z. Conductors serving the electric automatic fire pump shall be either in conduit encased in a minimum of three (3) inches of concrete, in conduit installed beneath the slab on grade, or 2-hour rated Mineral Insulated (MI) cable. Within the electrical room where the fire pump service originates, any conductors from the main service switchboard serving the fire pump service switch located within the same room shall be in conduit encased in minimum 3" of concrete or utilizing rigid galvanized steel conduit. Utilize a red dye in the concrete pours.

AA. Feeder conductors serving emergency life safety system panels shall utilize 2-hour rated cable assemblies or shall be installed within a 2-hour rated enclosure.

BB. Conduits connected to rotating or vibrating equipment shall be flexible metal conduit or liquid tight flexible metal conduit.

CC. Conduits directly connected to the UPS enclosure (primary and secondary feeders and ground) shall be flexible metal conduit a minimum of 36" from the UPS enclosure.

3.02 WIREWAYS AND AUXILIARY GUTTERS

A. Install auxiliary wireway gutters above suspended ceilings such that the cover will hinge upward from the side.

B. Provide a minimum of 12 inches clear from the wireway cover when in the open position.

3.03 OUTLET, JUNCTION, AND PULL BOXES

A. Provide outlet, junction, and pull boxes as indicated and as required for a complete installation and to facilitate the proper pulling, racking, and installation of all conductors. Boxes shall be sized per the Electrical Code as a minimum. Plug all open enclosure knock outs. Complete raceway installation before starting the conductor's installation.

B. The exact location of outlets and equipment is governed by field conditions. Where necessary, relocate outlets so that fixtures and equipment are symmetrically located in accordance with the room layout and will not interfere with other work or equipment. Verify final location of outlets, fixtures, and equipment with the Architect prior to installation.

C. Back-to-back outlets in the same wall, or "through-wall" type boxes are not permitted. In an effort to minimize acoustic transmission, provide 12-inch minimum spacing for outlets shown on opposite sides of a common wall. Provide acoustic potting compound (Electrical Box Pads) on outlet boxes installed in private offices, conference rooms, and in all sound insulated drywall partitions. Install box pads on the outside of the box and fill all holes.

D. Fit outlet boxes in all finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one (1) switch or device is located at a single location, use multiple gang boxes, and covers. Provide a tile box or a 4-inch square box with a tile ring within masonry walls not plastered or furred. Where drywall material is utilized, provide plaster rings. Provide outlet boxes of types and sizes suitable for the specific field application. Provide steel barriers where required and where different voltages are applied; systems (normal, UPS, and emergency power) separation; or where dimmers are installed.

E. Provide accessible pull boxes so that an individual run of conduit does not contain more than the equivalent of four (4) ninety-degree bends (360 degrees total).

F. Boxes recessed in walls or ceilings with a surface of concrete, tile, gypsum, plaster, or other noncombustible material shall be installed so that the front edge of the box shall not be set back from the finished surfaces more than ¼ inch. Boxes recessed in walls and ceilings constructed of wood or other combustible surface material shall be flush with the finished surface.

G. Where boxes are installed in plaster, drywall, or plasterboard surfaces with cut openings for box installation, the cut openings shall be repaired so there shall be no gaps or open spaces greater than 1/8 inch at the edge of the box or fitting.

H. Pull boxes containing conductors rated over 600 volts shall be equipped with insulated cable supports and steel barriers to isolate each feeder, where multiple feeders are provided.

I. For exterior roof applications utilize B-line C-port series (or approved equal) supporting devices so as to not damage the roof system.

J. All rooftop conduits shall be located to not interfere with any access or egress paths. Where conduits are located on the roof, the height shall not exceed 1'-0" and the width shall not exceed 24". Where dimensions are greater, provide steel steps and/or ramps (with platforms) to easily traverse.

K. All conduit wall penetrations shall be framed around with a minimum of ½," but not greater than 2" clearance at full perimeter. The gap between the conduit and the wall shall be acoustically sealed as follows:

1. Less than 2" gap shall be filled tightly with batt insulation and/or firesafe materials and sealed with caulking or sealant similar to USG "Acoustical Sealant".
2. Equal to or greater than 2" gap shall be filled with heavy density putty such as Nelson FSP or CLK sealant, JM Clipper DuxSeal, or 3M Moldable Putty.
3. Fire ratings shall match the wall rating.

L. Apply firestopping to all electrical penetrations of fire rated floor and wall assemblies to restore original fire resistance rating of assembly.

M. After completing the installation of exposed raceways and boxes, inspect the entire installation and clean all finishes.

3.04 APPLICATION OF RACEWAYS

A. Below are raceway applications as a minimum, unless otherwise indicated on the Contract Drawings.

B. Rigid Galvanized Steel (RGS) Conduits:

1. Where exposed to physical damage.
2. Indoors where exposed to moisture.
3. Where required by Code.
4. Service Entry Feeders.
5. Foundation wall penetrations and any elbows and penetrations from concrete floors.
6. Fire pump feeders (concrete encased) when MI cable is not utilized.
7. Exposed indoor installations within 10 feet above finished floor.
8. Exposed outdoor installations, including PV system.
9. Systems voltage higher than 600 volts.
10. Feeders and circuits in the elevator pit, sump pump pit, and ejector pump pit.
11. For all sleeve applications. All sleeves shall extend a minimum of 2" (4" in mechanical rooms or roof) above the finished floor or beyond the walls.

C. Rigid Aluminum Conduits:

1. Exposed outdoor locations where RGS is not installed.

D. Electrical Metallic Tubing (EMT) Conduits:

1. General purpose feeders and branch circuits, except where another conduit type is specifically required.

E. Metal Clad (MC) Cables:

1. Use in dry locations only concealed above suspended ceilings or within hollow partitions for lighting and receptacle branch circuits (not permitted for branch circuit home runs).
2. Not to be used within electrical rooms, mechanical rooms, elevator room, telecom rooms, other similar MEP rooms, exposed ceiling spaces, and where not permitted by Code.

F. Flexible Metal Conduits (FMC):

1. Dry locations only.
2. Connections to light fixtures in suspended ceilings.
3. Connections to equipment install in suspended ceilings.
4. Connections to equipment where vibration isolation is needed.
5. Maximum length shall be 6 feet.

G. Liquid Tight Flexible Metal Conduits (LFMC):

1. Same as flexible metal conduit, except in damp or wet locations.
2. Motor connections.

H. Rigid Non-Metallic Conduits – Schedule 80:

1. Underground duct banks outside of the building not concrete encased.
2. Incoming electrical service from the pad mounted transformer, portable generator connection, and the emergency generator.

I. Electrical Non-Metallic Tubing (ENT) Conduits:

1. Embedded in concrete floor slabs.
2. Transition to rigid galvanized steel raceway when exiting out of slab or penetrations in foundation walls.

J. Mineral Insulated (MI) Cables:

1. Fire pump feeders – 2 Hour Rated. Refer to specification section 26 05 19 for additional information.

K. Auxiliary Wireway Gutters:

1. Where required to suit field conditions and as indicated on the Contract Drawings.
2. Above and below panelboards and terminal cabinets to accommodate large concentrations of conductors.

3.05 APPLICATION OF BOXES OUTLET, JUNCTION, AND PULL BOXES

A. Below are box applications as a minimum, unless otherwise indicated on the Contract Drawings.

B. Cast Type Boxes:

1. Where connected to rigid galvanized steel, rigid aluminum conduit, and liquid tight flexible metal conduit, 1¼ inches and smaller.
2. Exposed conduit installations within 10 feet above the finished floor.
3. Where exposed to moisture and outdoors.

C. Galvanized Pressed Steel Type Boxes:

1. Where connected to electrical metallic tubing and flexible metal conduit, 1¼ inches and smaller.
2. Dry indoor locations.
3. Where concealed in walls and above suspended ceilings.

D. Sheet Steel Boxes:

1. Where connected to conduits larger than 1¼ inches.

E. Cable Support Boxes:

1. Provide cable support boxes where required by the Code and as indicated in the Contract Drawings.
2. The cable supports shall be manufactured by OZ/Gedney Type S or approved equals.

END OF SECTION

SECTION 26 05 48
VIBRATION ISOLATION AND SEISMIC RESTRAINTS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide vibration isolation devices and seismic restraints in accordance with the Contract Documents for all electrical equipment, including engine generator, and for all electrical equipment connections to vibrating or rotating equipment.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Vibration isolation devices and seismic restraints shall be products of a single manufacturer. Products of other manufacturers are acceptable provided that their systems comply with the system performance design including static deflection.

B. Vibration isolation equipment manufacturers shall determine the exact locations and sizes of all equipment.

C. Vibration isolation firms shall have a minimum of ten (10) years' experience designing and installing vibration isolation systems.

D. The installation of all vibration isolation units, hangers, and bases shall be under the direct supervision of the vibration isolation manufacturer's representative.

1.04 STANDARDS

A. IBC Seismic Design Category for NYS – Westchester County

B. NFPA 101

C. SMACNA Guidelines for Restraint of Mechanical Equipment.

D. ASHRAE Chapter 48 – Noise and Vibration Control

1.05 SUBMITTALS

A. Manufacturer's catalog cuts, product data sheets, and installation instructions for each vibration isolation device and seismic restraint, including their respective ratings. All data sheets shall indicate compliance with these specifications.

B. An itemized list showing the equipment or conduits to be isolated, the isolator type, model number selected, isolator loading, and deflection value.

C. Dimensioned plans and elevation diagrams depicting all required equipment, points of attachment, vibration isolation devices, seismic restraining devices, installation details, and all ancillary hardware types and sizes. Include an itemized list of equipment.

D. The manufacturer shall be responsible for:

1. Determination of vibration isolation sizes and locations.
2. Provide conduit and equipment isolation systems as specified.
3. Isolation system deflection.
4. All respective installation drawings and field supervision to assure proper installation and performance.

E. Seismic restraint calculations shall be provided, signed, and sealed by a Professional Structural Engineer registered in the State of New York.

1.06 MANUFACTURER RESPONSIBILITIES

A. The manufacturer of vibration isolation equipment shall have the following responsibilities:

1. Determine vibration isolation sizes and locations.
2. Provide conduit and equipment isolation systems as specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings, and field supervision to assure proper installation and performance.

1.07 FIELD INSPECTIONS

A. Upon completion of the installation, the manufacturer's local representative shall field inspect the installation and submit a report verifying the completeness and performance of the installation.

B. A certified report shall be prepared and submitted based on the field inspection findings.

C. Any work or equipment found to be unacceptable shall be replaced with new equipment without any additional compensation.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following are acceptable manufacturers:

1. Mason Industries, Inc., Vibration Mounting & Controls (VMC) Inc., and Kinetics Noise Control Inc.

2.02 DESCRIPTION

A. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.

B. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of not less than 50% above the design deflection.

C. Where spring isolation systems are described herein, the mounting assemblies shall utilize bare springs with a spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the springs remain parallel. The minimum deflection from loaded operating height to spring solid height shall be 50% of the rated static deflection of the spring.

D. Where neoprene-in-shear isolation systems are described in the following specifications, the mounting assemblies shall utilize bare neoprene elements with unit type design molded in oil resistant neoprene. The neoprene shall be compounded to meet the following:

1. Shore hardness of 35 to 65 ± 5, after minimum aging of 20 days or corresponding oven-aging.
2. Minimum tensile strength of 2000 PSI.
3. Minimum elongation of 300%.
4. Maximum compression at 25% of original deflection.

E. The isolator ratio of lateral to vertical stiffness shall not be less than 0.9 nor more than 1.5.

F. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than 10%.

G. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

2.03 VIBRATION ISOLATION AND SEISMIC RESTRAINT DEVICES

A. Provide the following mounting methods to suit field conditions.

1. Mounting Method A:
   a. Floor mounted spring isolators.
   b. Built in resilient limit stops shall limit upward, downward, and horizontal travel to a maximum of ¼ inch.
   c. Trapped holes in top plate for bolting to equipment.
   d. Mounting holes in bottom plate for bolting to concrete housekeeping pad.
   e. Neoprene pad, minimum ¾” thick, between bottom plate of isolator housing and bottom of spring isolator.

f. Mason Industries Type SLR; VMC Type B/C/D; Kinetics Type FLS-1 or -2; or approved equal.

2. Mounting Method B:
   a. Elastomer hanger rod neoprene isolators.
   b. 45º slack seismic restraint cables.
   c. Neoprene element with a projecting bushing to prevent steel to steel contact.
   d. Clearance between the mounting hanger rod and the neoprene bushing shall be a minimum of 1/8".
   e. Steel retainer box encasing the neoprene element.
   f. Rod shall be able to swing 15º before contacting resilient bushing.
   g. Mason Industries Type HD; VMC Type RHD; Kinetics Type FH; and Mason Industries Type SCB seismic cable brace, or approved equals.

3. Mounting Method C:
   a. Floor mounted bridge bearing neoprene mounts with all directional seismic capability.
   b. Two (2) separated and opposing molded bridges bearing neoprene elements contained in a ductile iron casting.
   c. Mounting holes in the bottom plate for bolting to the concrete housekeeping pad.
   d. Mason Industries Type BR or approved equal.

PART 3 – EXECUTION

3.01 GENERAL

A. Installations shall be in accordance with the seismic restraint calculations and the manufacturer's installation instructions. Vibration isolators must not cause any change of position, equipment, or connections resulting in any stresses or misalignments.

B. Verify that mounting methods provide the required vibration isolation and seismic restraint and that there are no vibration short circuits.

C. Conduits connected to rotating or vibrating equipment shall be flexible metal conduit or liquid tight flexible metal conduit, minimum of 18" in length.

D. No rigid connections between the equipment and the building structure shall be made that degrades the noise and vibration isolation systems specified herein. Electrical feeder connections to isolated equipment shall be looped to allow free motion of isolated equipment.

E. Conduits supported by the building structure shall be equipped with resilient hangers or supported by vibration isolators. No rigid connections between any equipment and building structure (slabs, beams, columns, studs, and walls) shall be made that degrade the noise and vibration isolation systems herein specified.

F. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

3.02 INSPECTIONS

A. Upon completion of the installation of all vibration isolation devices herein specified, the local representative of the isolation materials manufacturers shall inspect the completed system and report in writing any installation errors, improperly selected isolation devices, or other faults that could affect the performance of the system. The Contractor shall submit a report to the Architect, including the manufacturer's representative's final report, indicating all isolation reported are installed properly or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

3.03 MOUNTING SCHEDULE

A. Utilize the following mounting schedule for the specific equipment listed below.

Equipment	Mounting Method	Static Deflection
Engine Generator	A	3 inches
UPS Cabinets, Battery Cabinets, Dimming Racks - Floor Mounted	C	1.5 inches

END OF SECTION

SECTION 26 05 73
ELECTRICAL POWER SYSTEM STUDY

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide a complete Electrical Power System Study for the electrical distribution system as detailed in the Contract Documents. The scope shall include a software-based fault current and overcurrent protective device study and an arc flash study.

B. Prepare a delegated design overcurrent protective device coordination study which commences at the incoming point of electrical service (pad mounted transformer) for the building and includes all downstream distribution and branch panelboards, and all significant motor loads (25HP and larger). In addition, all equipment that is required to be rated for the available fault current shall be evaluated in the study including but not limited to all transformers, switchboard, panelboards, enclosed switches/breakers, individual motor controllers / variable speed drives, and contactors. The study shall include the standby generator and any associated emergency power distribution equipment, including all automatic transfer switches, UPS, and downstream distribution.

C. Prepare a delegated design software-based arc flash study which determines the arc flash hazard distances and incident energy to enhance personnel safety who can be exposed to such when near the respective electrical equipment.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Prepare short circuit protective device coordination and arc flash hazard analysis studies in accordance with the latest standards of ANSI C37.010 and C37.13; and IEEE 141, 241, 242, and 399; NFPA 70E; and the NEC.

B. All electrical systems analysis shall be performed by a qualified Professional Engineer trained and employed by the equipment manufacturer.

1. All of the analysis shall be performed, stamped, and signed by a registered Professional Engineer in the State of New York.
2. The Firm shall have a minimum of ten (10) years' experience in the analysis, evaluation, and coordination of electrical distribution systems.
3. All studies shall be prepared by the same firm and submitted as a single submission.

1.04 STANDARDS

A. ANSI: American National Standards Institute.

1. ANSI C37.010: Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
2. ANSI C37.13: Low-Voltage AC Power Circuit Breakers Used in Enclosures

B. IEEE: Institute of Electrical and Electronics Engineers.

1. IEEE 141: Recommended Practice for Electric Power Distribution for Industrial Plants
2. IEEE 241: Recommended Practice for Electrical Power Systems in Commercial Buildings
3. IEEE 242: Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
4. IEEE 399: Recommended Practice for Industrial and Commercial Power Systems Analysis
5. IEEE 1015: Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
6. IEEE 1584: Guide for Performing Arc-Flash Hazard Calculations

C. NFPA: National Fire Protection Association.

1. NFPA 70E: Standard for Electrical Safety in the Workplace
2. NEC: National Electrical Code

D. Authority Having Jurisdiction.

1.05 SUBMITTALS

A. The following information shall be submitted. All shall be signed, dated, and sealed by the Professional Engineer as indicated above:

1. A final report containing individual sections. The sections shall include the following:

a. Firm Name, Address, Phone Number, and Professional Engineer's signature and seal of the NY State registered Professional Engineer that performed the study.
b. Executive summary.
c. Method used to perform the studies and respective analysis.
d. Short-circuit analysis with device evaluations.
e. Protective device coordination and protection study.
f. Each study shall include recommendations for overcoming non-compliant devices/settings.
g. Arc Flash Analysis.
h. A listing of all PPE (Personal Protective Equipment) shall be included.
i. Input Data.
j. One-line diagram.
k. Electronic file used in creating the study including all non-standard curves created to produce the study. The software version including revision number shall be clearly indicated.
l. Sample warning labels.

2. Submit Relay Settings as follows:

   a. Submit one (1) electronic “relay settings file” for each programmable solid state protective relay after final relay settings have been determined. These files shall be compatible with the relay setting software provided with each relay.
   b. Submit one (1) hard copy printout of the relay settings for each programmable solid-state relay from the programming software used to program each relay.

3. Provide maintenance procedures for use by the Owner’s engineering staff in accordance with NFPA 70E.

4. These studies shall be submitted at the same time as the electrical equipment submittals. Electrical equipment submittals provided without these studies will be rejected and returned to the vendors.

5. Upon receipt of the Engineer’s review comments, correct all noted deficiencies, and resubmit for review.

PART 2 – PRODUCTS

2.01 COMPUTER SOFTWARE APPLICATIONS

A. Acceptable Providers

1. SKM Systems Analysis, Inc.
2. Easy Power, LLC
3. Power Analytics Corporations

B. Software Requirements:

1. The software program shall be fully capable of providing plotted time current characteristic curves, along with the respective output data.
2. The output shall include all device settings and ratings required for a fully compliant and coordinated system.

C. Prepare the analysis with the latest version of the power system modeling software.

2.02 SHORT CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATIONS

A. Systematically calculate fault currents based on the available incoming utility fault current at the building’s point of entry. The vendor’s Professional Engineer shall obtain the maximum available fault current and power factor or X/R ratio of the fault current at the service entrance from the local utility.

B. The study shall be based on a fully rated system.

C. All motor contributions for motors rated 25HP and larger shall be incorporated in determining fault levels.

D. Evaluate the distribution device and equipment ratings compared to the calculated fault current and make recommendations where equipment is non-compliant.

Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings.

E. When the power factor or X/R ratio of the maximum symmetrical fault calculated at the device location is determined to be more inductive than that used to establish the device interrupting rating, adjust the available short circuit current in accordance with IEEE 242.

F. At a minimum, all calculations shall include:

1. Location identification.
2. Voltage.
3. Manufacturer and type of each equipment.
4. Each equipment's short-circuit current rating.
5. Calculated short-circuit current and recommended adjustments, if needed.
6. Calculated X/R ratio of the fault.
7. Recommendations where equipment is calculated to be non-compliant.

2.03 PROTECTIVE DEVICE COORDINATION AND PROTECTION STUDY

A. Prepare coordination time-current characteristic curves to determine the required settings of the protective devices to achieve coordination between specified devices and also provides equipment and personnel protection. The utility / campus upstream protective device feeding the building shall be maintained as the upper limit for coordination. These settings shall be obtained by the vendor's Professional Engineer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and shall illustrate adequate clearing times between devices. The curves provided shall reflect actual protective devices being provided by this vendor. Adequate time-current curves shall be generated to depict coordination and protection between all system protective devices.

B. Curves shall also include motor starting profiles, transformer inrush, transformer and cable damage curves, generator characteristics, reactor and capacitor characteristics, and all other information used to reflect equipment and conductor properties used to determine protective device settings to protect equipment from damage, limit nuisance tripping, and enhance coordination while reducing arc flash incident energy.

C. The coordination study shall include ground fault protection coordination and recommended device settings for the devices provided with ground fault protection.

D. Protective device characteristics shall extend to the maximum symmetrical or asymmetrical fault current to which the device is exposed.

E. Curves shall reflect the maximum arcing fault current at the power distribution device that the plotted protective device is protecting. Arcing fault current shall be depicted by a vertical line indicated on the curve and labeled by each location.

F. The study shall recommend protective device settings that will minimize arc flash incident energy while maintaining coordination selectivity and protection at the distribution equipment being protected. Reduce arc energy to 12 calories per square centimeter or less where possible while maintaining device coordination and protection as defined herein.

G. In addition to overcurrent protection settings, all other specified protection and relay settings shall be studied and setting recommendations shall be reflected in the Protective Device Coordination Study. Examples of protective functions include over and under voltage, phase failure, phase reversal, frequency protection, differential protection, directional relaying, etc.

H. A narrative analysis shall accompany each coordination curve sheet and describe the coordination, protection, and arc flash incident energy limiting. All curve sheets shall be multi-colored or use hatching for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide recommendations to improve coordination.

I. Arc Energy Reduction Settings: Where manual energy reducing maintenance switches are specified for circuit breakers, the coordination and protection settings for “Standard Mode” and “Reduced Setting Mode” shall be recommended. “Standard Mode” shall be set to minimize arc flash incident energy while maintaining coordination selectivity and protection. The “Reduced Setting Mode” shall prioritize reducing incident energy over coordination while also considering limiting nuisance tripping from inrush and from starting large motors such as large pumps, elevators, etc. Both recommended settings shall be shown in the coordination curves and the device settings table and the Arc Flash Risk Assessment shall indicate the incident energy available from each of the two (2) settings.

J. The following information shall be provided on all curve sheets.

1. Device identification and associated settings/size.
2. Voltage at which curves are plotted.
3. Current multiplier.
4. ANSI frequent fault damage curve.
5. Cable insulation damage curves.
6. Transformer inrush point.
7. Single line diagram for the associated portion of the system.
8. Motor starting profiles.
9. Maximum Arcing Fault Current at each distribution equipment being protected.

K. The recommended device settings shall be provided in tabular form and shall include:

1. Location identification.
2. Voltage.
3. Device manufacturer.
4. Device catalog number/series.
5. Adjustable long-time pickup and delay.
6. Adjustable short time pickup and delay.
7. Adjustable ground fault pickup and delay.
8. Adjustable instantaneous pickup.
9. All relay protective function and device settings associated with specified protective relays (voltage, frequency, differential, phase reversal, etc.).

2.04 ARC FLASH RISK ASSESSMENT

A. An arc flash risk assessment shall be performed based on the short circuit values and device settings in conjunction with a short circuit, coordination, and protection

study. The results from the short circuit, coordination, and protection study shall be used to determine incident energy levels at each power distribution location in the building where work could be performed on energized parts.

B. Where any part of the electrical system is served by multiple power sources the system configuration that delivers the highest level of incident energy shall be used for the evaluation. Include significant (25HP and larger) motor contribution in the calculations.

C. For each location with a main device, the line and load side fault contributions shall be included in the calculations.

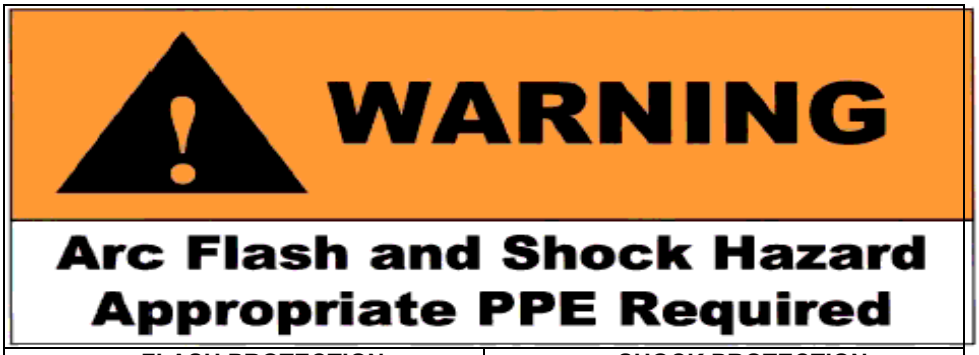
D. Incident Energy Analysis results shall be presented in tabular form and shall include:

1. Location identification.
2. Voltage.
3. Arcing fault magnitude.
4. Protective device clearing time.
5. Duration of arc.
6. Arc flash boundary.
7. Shock protection boundaries.
8. Incident energy.
9. Minimum arc rating of clothing and other PPE.

E. Equipment labeling shall be provided in accordance with NFPA 70E. The actual Arc Flash Warning Labels shall be provided as part of the report. Labels shall be provided in accordance with ANSI Z535.4. The labels shall be 3.5-inch x 5-inch thermal transfer type labels of high adhesion polyester for each work location analyzed. Labels shall be machine printed with no field markings. The labels shall include the following information:

1. Device name.
2. Available incident energy.
3. Arc flash protection boundary.
4. Minimum arc rating of clothing (Note: shall be no less than 12 cal./cm^2).
5. Nominal system voltage.
6. Shock protection boundaries.
7. Date of arc flash risk assessment.
8. Indicate system configuration on the label “Valid for Emergency System Configuration Only” or “Valid for Normal System Configuration Only” for ATS’s and distribution equipment downstream of ATS’s.

F. Sample Arc Flash Warning Label:



1. Coordinate the installation of each label with the Owner prior to any work, specifically all panelboards located in public areas. Install all labels once locations are approved.

2.05 INPUT DATA

A. The study shall be conducted based on the actual equipment and conductors being installed. Input data for the report shall be compiled from the Electrical Contractor, manufacturers, and codes and standards as required to conduct a proper evaluation.

B. Conductor lengths, sizes, materials, and raceway information shall be provided by the Electrical Contractor to the vendor's Professional Engineer performing the study so that the study is performed based on the final installation.

C. Input data used for the studies shall be provided in the final report. The input data for the report shall include supporting data from the manufacturer used for the evaluation, lengths of all feeders provided by the Electrical Contractor, transformer data, motor data, utility company data, generator data, and any other supporting data to the report.

2.06 SINGLE-LINE DIAGRAM

A. The final report shall include a single-line diagram of the electrical distribution system within the scope of the project. The single line shall include:

1. Transformer ratings, voltage ratios, impedances, and winding connections.
2. Feeder cable per phase, neutral and ground size, length of cable, conductor material, and conduit size and type.
3. Switchboards, panelboards, individual motor controllers, variable speed drives, fuses, circuit breakers, ATS's, and enclosed switches.

4. Protective relays with appropriate device numbers and CT's and PTs with associated ratios.
5. Motor identification and horsepower used in the evaluation.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall thoroughly review the studies and provide overcurrent protective devices and equipment meeting the respective results as part of the base contract.

B. All equipment shall be installed after confirmation of meeting all study findings.

C. The Contractor and vendor who performed all the study calculations shall provide a 4-hour course which is NFPA 70E and OSHA certified. The training shall include the selection of personal protective equipment (PPE) and a review of all the actual equipment ratings and safety features. Distribute copies of all training materials.

3.02 FIELD ADJUSTMENTS

A. All adjustments shall be made to the protective devices as required for placing the equipment into final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.

B. The Electrical Contractor shall coordinate and provide all adjustments with the equipment vendor prior to any equipment being energized.

C. Arc Flash Labels shall be attached to the equipment after the study is reviewed by the Engineer.

1. One (1) label shall be affixed at a height and location that is clearly visible on the front of the panelboards, switchboards, and other electrical equipment that is less than 6 feet in length unless otherwise noted.
2. Switchboards that are longer than 6 feet shall have labels affixed at a height and location that is clearly visible on the front of the equipment at each end of the equipment.
3. Transformer labels shall be based on the primary side of the transformer.
4. Labels shall be affixed at similar locations on each type of equipment.
5. Where multiple labels are affixed to equipment, the labels shall be identical and identify the worst-case information for that equipment.
6. Where equipment is rear connected, affix labels on both the front and rear of the equipment. Locate the labels on the rear at a similar height and location as on the front.

D. Device settings and adjustments and affixing of Arc Flash Hazard Labels shall be performed by the equipment manufacturer's authorized service and testing organization.

E. Submit final electronic relay setting files compatible with relay setting software for all specified programmable solid-state relays.

END OF SECTION

SECTION 26 12 19
MEDIUM VOLTAGE LIQUID FILLED PAD MOUNTED TRANSFORMER

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide liquid filled medium voltage pad mounted transformer in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Firm engaged in the manufacture of the specified products of types and sizes required, and whose products have been satisfactorily in use in similar service for a minimum of ten (10) years.
2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by a third-party registrar. Develop and control manufacturing, inspection, and testing procedures are under the guidelines of a quality assurance system.
3. Service, repair, and technical support services are available 24 hours per day, 7 days per week from the manufacturer or their representatives.
4. Certified in accordance with ISO 14001.
5. The equipment shall be assembled as an integral unit by a single manufacturer.

B. Installer Qualifications: Firm with a minimum of ten (10) years' experience with equipment of similar type and scope.

C. Prior to delivery to the project site, verify suitable storage space is available to store all materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

D. Protect all materials during delivery and storage and maintain within the manufacturer's written storage requirements. At a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

E. An independent testing agency, with the experience and capability to conduct the testing indicated that is a member company of the International Electrical Testing Association or is a Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA and is acceptable to the AHJ.

1.04 STANDARDS

A. 10 CFR 429 and 10 CFR 431 (Subpart K)

B. ANSI Z535.4

C. ANSI/IEEE C57.12.00, C57.12.28, C57.29, C57.12.34, and C57.12.90

D. UL

E. OSHA

F. Factory Mutual (FM) Approved

G. NFPA 70 and 70E

H. NY State Building Codes and Local Laws

1.05 SUBMITTALS

A. Provide sufficient information to determine compliance with the Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Clearly identify specific model numbers, options, and features of the equipment proposed.

B. Indicate deviations from the Contract Documents with reference to corresponding drawings or specification numbers and written justification for the deviation.

C. Product Data: Provide the manufacturer's standard catalog pages and data sheets for transformers, switches and fuses, enclosures, components, and all accessories.

D. Shop Drawings: Indicate the transformer enclosure dimensions, kVA, primary and secondary nominal voltages, voltage taps, BIL, impedance levels, insulation class, sound levels, core and winding losses, required clearances, and unit weight. Include a nameplate diagram.

E. Wiring diagrams indicating all taps and all required field connections, including grounding.

F. Seismic Qualification Certification:

1. Certificate of compliance.
2. Dimensioned equipment drawings identifying the center of gravity and mounting/anchoring provisions.
3. Details and installation requirements of equipment anchorage devices on which certification is based.

G. Operational Readiness Report:

1. Document test results, including assumptions, conditions, allowances, and any corrections made.

2. Provide a listing of field modifications and adjustments made including settings/parameters not identified as factory defaults within the equipment's operations and maintenance manual documentation.
3. Include certification, signed by the Contractor and the manufacturer's representative, that the equipment and associated system have been installed, configured, and tested in accordance with the manufacturer's recommendations; conforms to the requirements of the Contract Documents; and is ready for operation.

H. Functional Demonstration Testing Report: Document test results, including any assumptions, conditions, allowances, and corrections made.

I. Manufacturer's qualification statement, including all factory testing reports.

J. Installer's qualification statement.

K. Operation and Maintenance Data:

1. Provide detailed information on the system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
2. Include the manufacturer, supplier, support, and repair center contact information.
3. Include the manufacturer's standard operation and maintenance data assembled for each size and type of equipment being provided.
4. Include contact information for parts stocking location closest to the Owner.
5. Identify critical spare parts associated with long lead times and/or those critical to the unit operation.
6. Identify maintenance spare parts required to regularly perform scheduled equipment maintenance including, but not limited to, consumable parts required to be exchanged during scheduled maintenance periods.

L. Executed warranty: Provide a copy to the Owner.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Eaton, ABB, Siemens, or Square D Schneider Electric.

2.02 RATINGS

A. The pad mounted transformer shall be designed for continuous operation at the rated kVA, indicated on the Contract Drawings, 24 hours a day, 365 days a year.

B. Voltage Ratings:

1. Primary: 13.2kV, 3 phase, 3 wire, delta connected.
2. Secondary: 208Y/120V, 3 phase, 4 wire, wye connected.

C. Efficiency: Comply with 10 CFR 431, Subpart K; registered on the Department of Energy's Compliance Certification Database in accordance with 10 CFR 429.

D. Seismic Qualification:

a. Provide an independent third-party testing for compliance with ICC/ASCE 7, certifying that the equipment will remain operable following design level earthquake.
b. Perform shake table testing in accordance with ICC-ES AC156, using importance factor (Ip) of 1.5.

E. Cooling Type: Envirotemp™ FR3™, less flammable liquid (biodegradable and nontoxic). UL listed as complying with NFPA 70 requirements for a fire point of not less than 300 deg. F. in accordance with ASTM D92.

F. Primary Taps: Two (2) 2.5 percent full capacity above normal, two (2) 2.5 percent full capacity below normal.

G. Impedance: 5.75 percent.

H. Temperature Rise: Average 65 degrees C above maximum 40-degree C, average 30-degree C ambient at rated kVA output, without loss of service life expectancy. Transformers shall be designed to carry short-time emergency overloads in accordance with ANSI C57.12.92 as applicable.

I. Basic Impulse Levels (BIL):

1. 95 kV for 15 kV class.

J. Sound Level: As defined in NEMA TR 1 and ANSI standards for the kVA rating.

K. High-Voltage Terminations and Equipment: Dead-front.

L. Bushings:

a. Live-Front Bushings: Porcelain with clamp-type connector incorporating 2-hole drilling pattern; externally clamped and front-removable.

b. High-Voltage Dead-Front Bushings:

(1) 600 A Bushings: One-piece integrated, with removable stud, for use with separable connectors; externally clamped and front removable.
(2) The primary terminations shall be suitable for accepting terminations of shielded copper up to No. 500MCM AWG cables from the underground distribution system. The number of conductor sets shall be per the Contract Drawings.
(3) Primary feeder cables which are exposed shall be wrapped with fire and ARC proofing, similar to 3M Scoth #77 or approved equal.

c. Low-Voltage Bushings:

(1) Molded polymer, provided with blade-type spade terminals with NEMA standard hole spacing arranged for vertical take-off.

(2) Provide low-voltage neutral insulated bushing, grounded to the tank by removable ground strap.
(3) The secondary terminations shall be suitable for accepting terminations of copper No. 600MCM AWG cables from the underground distribution system. The number of conductor sets shall be per the Contract Drawings.

M. Where the low-voltage compartment contains exposed live parts over 600 V, require removal or opening of non-hygroscopic barrier for access.

N. Switches:

1. Provide load-break, gang-operated, liquid-immersed switch, externally operable from the high-voltage compartment with distribution hot-stick.
2. Switch Type: 2-position, OFF-ON for radial-feed system.
3. Switch Rating: 600 A.

O. Fusible Protection:

1. Provide internal liquid immersed cartridge fuses.
2. Provide Bay-O-Net liquid-immersed fuses, externally replaceable with a hot-stick without opening the transformer tank.
3. Provide Bay-O-Net liquid-immersed fuses in series with the oil-immersed, current-limiting fuses; Bay-O-Net fuses shall be externally replaceable with a hot-stick without opening the transformer tank.
4. Provide dry-well-canister-mounted, current-limiting fuses, externally replaceable with a distribution hot-stick without opening a transformer tank.

P. Surge Protection:

1. Provide three (3) 15kV distribution class lightning arresters mounted in the high-voltage compartment complying with IEEE C62.11.
2. Live-Front Units: Provide lightning arrester mounting provisions.

Q. Transformer Cores:

1. Construct of high-grade, grain-oriented, nonaging silicon steel with high magnetic permeability and low hysteresis and eddy current losses.
2. Magnetic Flux Densities: Maintain well below saturation point.

R. Transformer Coils Winding Material: Copper.

S. Enclosures:

1. Construction: Sealed tank of sufficient strength to withstand pressure of 7 psi without permanent distortion; provide welded cover and tamper-resistant handhole coverings.
2. Tank and Compartment: Comply with IEEE C57.12.28 or IEEE C57.12.29; limit disassembly, breakage, and prying open of doors, panels, and sills with doors in the closed and locked positions.
3. Maintain tank seal for top oil temperature range of 23 degrees F (minus 5 degrees C) to 221 degrees F (105 degrees C).
4. When required, provide cooling panels on the back and front of the tank.
5. Provide lifting eyes and jacking pads.

6. Transformer unit shall include suitable outdoor paint finish per the manufacturer's standard painting process. The color shall be light gray.
7. All bolts, nuts, and washers shall be zinc-plated steel.

T. Markings and Labeling:

1. Provide identification and warning labels/nameplates exterior to the equipment resistant to weather, UV, and intended installation environment.
2. Provide engraved nameplates identifying project-specific equipment tag and service description.
3. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.
4. All terminations shall be labeled and marked in a permanent manner. Phase designators are A-B-C when facing the front of the transformer and reading from left to right.

U. Provide the following accessories:

a. Tap changer with silver-plated stationary and movable contacts, for de-energized operation only, externally operable and pad lockable.
b. Nameplate in the low voltage compartment.
c. Penta Head bolts for compartment doors.
d. Key interlocks to the primary or secondary compartment doors.
e. Mounting provisions for low-voltage current transformers and potential transformers.
f. KWH meter socket with hinge cover externally mounted on side of low-voltage compartment.
g. 1-inch upper filter press and filling plug.
h. 1-inch drain valve with sampling device.
i. Dial-type thermometer.
j. Magnetic liquid-level gauge.
k. Pressure vacuum gauge.
l. Grounding pads.
m. Pressure relief valve.
n. Automatic pressure relief device, self-resealing with indicator.
o. Sudden pressure relay, with seal-in relay.
p. Bushing well inserts.
q. Feed-thru inserts.
r. MOVE elbow arresters.
s. Hot stick.

2.03 CABLE FAULT INDICATORS

A. Provide each incoming and outgoing cable within the medium voltage compartment with a single-phase cable fault indicator with in-rush restraint. Mount the indicator on the cable support member.

1. The sensor assembly shall have a split-core for easy installation over the incoming and outgoing cables. The core shall be laminated, grain-oriented silicon steel, and encapsulated. Provide a clamp to secure the two (2) coil halves around the cable.

2.04 FIELD TESTING

A. Perform the manufacturer’s required field tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with the specifications and approved shop drawings.
b. Inspect physical and mechanical conditions, including any damaged or cracked bushings and liquid leaks.
c. Verify that all control and alarm settings on temperature indicators are provided.
d. Inspect all field installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections, and perform thermographic survey after energization under load.
e. Vacuum clean all interior compartments. Clean the exterior enclosure.
f. Verify all liquid levels are correct.
g. Verify correct equipment grounding.
h. Verify the proper connection of the surge arresters.
i. Verify the tap changer is properly set.

B. Field Testing:

1. Perform testing accordance with IEEE C57.12.90 including:
a. Ratio.
b. Polarity.
c. Phase rotation.
d. No load loss.
e. Excitation current.
f. Impedance voltage.
g. Load loss.
h. Applied potential.
i. Induced potential.
j. QC impulse test.
k. Leak test.
l. Temperature test.
m. Sound test.

PART 3 – EXECUTION

3.01 GENERAL

A. Examine the equipment exterior and interior for damage, including but limited to, structure, moisture, and mildew.

B. Install all equipment in accordance with the manufacturer’s written instructions.

C. Provide a raised concrete housekeeping pad that is a minimum of 8” high and reinforced with a 6” x 6” No. 6 mesh placed uniformly 4” from the top of the pad, sized per the final approved transformer submittal. The pad shall be placed on a 6”

thick, well compacted gravel base. The top of the pad shall be a minimum of 4" above the finished grade with chamfer edges. Pad details to be coordinated and approved by the Structural Engineer prior to any work. Provide primary and secondary pad window openings for the conduits entering the pad. All conduits shall be rigid galvanized steel serving both the primary and secondary conductors. Seal all voids around conduit openings with water- and oil-resistant caulking/sealant.

D. Install and anchor the transformer on this pad with rustproof bolts, nuts, and washers not less than ½" diameter in accordance with the manufacturer's instructions.

E. Provide a grounding electrode conductor from the transformer secondary neutral to the grounding grid and rods per the NEC.

F. Engage a factory authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including all conductor connections. Submit test reports.

1. Include all required materials, equipment, labor, and technical supervision.
2. Replace damaged or malfunctioning equipment and report any discrepancies or installation issues to the manufacturer and Engineer.

G. Perform and submit all field tests in accordance with NETA or NRTL Acceptance Testing guidelines and the equipment manufacturer's recommendations. The Contractor shall correct any deficiencies and perform additional testing until successful results are obtained.

1. Measure and record all primary and secondary voltages and currents.
2. Inspect all feeder and grounding connections and torque values.
3. Inspect all required access conditions.
4. Confirm primary and secondary overcurrent protective devices are installed and are appropriately rated.
5. Confirm all internal components have been cleaned and are free of any dust and debris.
6. Infrared scan of all connections.
7. Remove and replace units that do not pass tests or inspections and retest as specified above.

3.02 GROUNDING

A. Provide grounding conductor from the transformer secondary to a ground rod grounding grid around the equipment pad for each separately derived system. Grounding electrode conductor shall be sized in accordance with NEC Section 250 for the derived phase conductors. Ground rods shall be copper and shall be 10' long x ¾" diameter.

B. Provide all required ground rods to maintain a maximum resistance of 5 ohms to ground.

C. Connect the ground rod to the ground pads in the primary and secondary voltage compartments.

D. Install and connect the cable shield grounding adapter per the manufacturer's instructions.

3.03 SPARE PARTS

A. Provide three (3) spare primary overcurrent protection bayonet, liquid immerse, expulsion fuses to match those on the Contract Drawings.

B. Six (6) insulated protective caps.

C. Touch-up paint.

3.04 WARRANTY

A. At a minimum, provide a five (5) year warranty starting from the installation acceptance date. The warranty shall include all manufactured equipment and devices, as well as all installation work.

3.05 CLOSEOUT ACTIVITIES

A. Functional Demonstration Testing: Demonstrate proper operation of the transformer and associated systems to the Owner's designated representative and Engineer, observing, and documenting compliance with Contract Documents.

B. Training:

1. Train the Owner's personnel in the operation and maintenance of the equipment and system.

    a. Accommodate a minimum of four (4) attendees.
    b. Provide not less than two (2) repeated sessions with the required hours of classroom and hands-on training needed for the equipment and system provided.
    c. Training Reference: Provide operations and maintenance manuals and documentation for each participant.
    d. Instructor: Factory-trained manufacturer's representatives.
    e. Location: Project site.

2. Provide sufficient time and detail in each session to cover the following at a minimum:

    a. Operation theory.
    b. Major equipment components.
    c. Equipment operation.
    d. Equipment configurations.
    e. Maintenance, troubleshooting, and repair.
    f. Component level parts replacement.

3.06 FINAL CLEANING

A. The entire enclosure shall be clean, dry, and free of all construction debris. Vacuum the enclosure of debris after the installation and prior to energizing.

B. Repair and touch up any scratched and damaged surfaces with new touch up paint.

END OF SECTION

SECTION 26 24 13
SWITCHBOARDS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide switchboards in accordance with the Contract Documents.

B. Switchboards include both main switchboards and distribution type switchboards.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. All switchboards shall be labeled as a single integrated piece of equipment by the manufacturer and certified to be fully capable of performing to the ratings listed per the Contract Documents and per the vendor's final approved short circuit coordination study.

B. Switchboards shall be the same manufacturer as the panelboards.

C. All applicable County standards and approvals of service end boxes, service terminations, busways, incoming sections, and metering provisions shall be enforced.

D. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

E. Testing Agency Qualifications: Member company of NETA or NRTL.

1.04 STANDARDS

A. Switchboards:

1. NEMA PB-2, PB-2.1, and PB-2.2
2. UL 891
3. UL Service Entrance Label
4. NRTL - Labeled for Service Equipment
5. Metering – ANSI C39.1
6. NFPA 70E
7. National Electrical Code
8. NY State Building Code

B. Overcurrent Protection Devices:

1. Circuit Breakers: NEMA AB-1, Federal Specification W-C-375 B/GEN, UL 489, and QMQB Operators: UL E1818, ANSI C37.51
2. Switch and Fuse Assembly: UL 977
3. Ground Fault Circuit Protection: UL 1053

C. Acceptance Testing:

1. NETA
2. NRTL
3. ANSI C37.13
4. NEMA

1.05 SUBMITTALS

A. Manufacturer's product data sheets for all overcurrent protection devices.

B. Dimensioned layouts, sections, and elevation drawings showing all switchboards, housekeeping pads and support locations and types. The detailed drawings shall be prepared at a minimum of ¼" scale and shall indicate all code and maintenance clearances, incoming/outgoing conduit locations, shipping splits, and weights.

C. Single line diagrams showing all electrical ratings, bus arrangements, overcurrent protection device ratings, surge protection, ground fault protection, cable lugs, barriers, metering and CT configuration, metering displays, mimic bus, identification nameplate, any auxiliary components, and fuse clip sizes.

D. The submittal shall include integrated electronic submetering equipment such as CTs, transponders, and meters which will be utilized at the switchboard level.

E. Indicate service entrance label where required.

F. Schematic wiring diagrams – power, controls, and metering.

G. Installation instructions.

H. Arc Flash Hazard Study and Electrical Power Systems Study (short circuit, arc flash, and coordination study) per specification section 26 05 73. This must be submitted at the time of the switchboard equipment submittal. The submittal equipment ratings must be coordinated with the study results. The submittal will be returned unreviewed if the study is not included and coordinated.

I. Certified test reports and field-testing procedures.

J. Seismic restraint calculations and certifications.

1.06 FIELD TESTING

A. Field inspection and testing shall occur after the installation is complete, feeders are terminated, and the electrical room is secure and cleaned of all debris and dust. Testing shall be conducted not more than four (4) weeks before the equipment is scheduled to be energized. Submit all certified testing results and reports. Do not energize until mimic board is installed and verified correct.

B. Testing Scope shall include, but is not limited to:

1. Visual and physical inspection of the entire equipment.
2. Inspect all equipment to be free of any debris.
3. Verify equipment is properly secured and all connections are compliant.
4. Resistance testing.
5. Verify all overcurrent protective devices are secured in place and are appropriately sized.
6. Check control wiring and metering.
7. Check and adjust bolt torque levels.
8. Meter calibration.
9. Full Operation of the following:

    a. All metering components.
    b. All disconnecting means under load (provide load banks, temporary cabling, and terminations for such testing).
    c. All cable bracing and connections.
    d. All alarm devices and components.
    e. All surge protection devices and components.

10. Ground Fault Protection settings.
11. Adjust protective device settings based on recommendations in the final short circuit and coordination study.
12. Primary current injection testing of circuit breakers.
13. System grounding.
14. Infrared scan tests.

C. Certified Test Reports:

1. Field testing shall be performed by a NETA or NRTL certified, independent third-party testing agency.
2. Verify that the installation is in accordance with the manufacturer's instructions.
3. Verify that the equipment has been fully tested, successfully passes all inspections, and is operational.
4. Perform testing and compile detailed test reports for each switchboard and all overcurrent protection devices. Report shall include all test results, identify any deficiencies found, and any remediation work.
5. Should any remediation work be required, such work shall be completed and all testing shall be performed until all results are found acceptable.

D. Perform the following infrared scan tests and inspections and prepare the following reports:

1. Initial Infrared Scanning

    a. After substantial completion, but not more than 60 days after final acceptance, perform an infrared scan of the switchboards. Remove all panels so joints and connections are accessible to portable scanning equipment.

2. Additional Infrared Scanning

    a. Perform an additional follow up infrared scan of the switchboards prior to one (1) year after date of substantial completion.

1.07 IDENTIFICATION

A. Provide engraved nameplates secured with rivets or screws for all switchboards. Nameplates shall be black bakelite plates with white lettering. Utilize red plates for emergency systems. Lettering shall be a minimum of 2" high. Labels shall be provided for all distribution overcurrent protection device.

B. Provide an identification nameplate for each switchboard and service switch; and each main and each feeder overcurrent protection device.

C. Include on the nameplate the outgoing feeder conductor and raceway ratings and the load.

1.08 SHORT CIRCUIT AND COORDINATION STUDY

A. Refer to specification section 26 05 73 Electrical Power System Study for additional information.

B. Prepare a short circuit and coordination study based on the actual overcurrent protection devices proposed for use and the actual conductor sizes and lengths. The study shall be prepared by the vendor's Electrical Engineer licensed in the State of New York and shall be submitted as a supplemental permit and shop drawing submission.

C. The study shall be submitted with the distribution equipment submittals and shall indicate where device substitutions are being made in order to achieve adequate interrupting capacity ratings (to meet the study requirements) for each piece of equipment.

D. The study shall include recommended settings of adjustable overcurrent and ground fault settings. These final settings shall be set for each piece of equipment by the Electrical Contractor.

E. Provide overcurrent protective devices of suitable type and rating to meet or exceed the available short circuit currents indicated in the short circuit study. Circuit breakers and fuses serving the emergency power system as well as devices protecting elevators, including all upstream feeder devices, shall be of the appropriate rating to ensure 100% selectivity in the instantaneous region of the trip curves at the calculated fault current. Coordination study shall demonstrate selective coordination is achieved and shall include the effects of ground fault protection devices where indicated on the Contract Drawings and per the NEC.

F. Interrupting capacities shall be based on a fully rated protection system where all overcurrent protection devices are rated for the full prospective short circuit current (as indicated in the Contractor's final short circuit submittal). Series rated panelboards and equipment are not permitted.

G. Obtain from the County and confirm in writing the short circuit current available at the utility company's transformer secondary and incoming service.

1.09 ARC FLASH HAZARD STUDY

A. Refer to specification section 26 05 73 Electrical Power System Study for additional information.

B. Prepare an arc flash hazard study for electrical service and distribution equipment. The study shall be prepared by the vendor's Electrical Engineer licensed in the State of New York and shall be submitted as a supplemental permit and shop drawing submission.

C. The study shall be submitted with the electrical service and distribution equipment submittal and shall indicate the required level of protective wear for each piece of electrical equipment.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Switchboards and Service Switches: Eaton, General Electric/ABB, Siemens, or Square D Scheider Electric.

B. High Pressure Contact Switches and Bolted Pressure Switches: Eaton (Pringle Switch Co.), Siemens, and General Electric/ABB.

2.02 RATINGS

A. Switchboards shall be of the ratings and configurations indicated on the Contract Documents.

B. Switchboards and overcurrent protection devices shall have a minimum short circuit rating as specified herein or greater where indicated on the Contract Drawings and per the final vendor prepared short circuit study.

2.03 CONSTRUCTION

A. Switchboards shall be free standing, front accessible, with individually mounted, compartmentalized, front connected main and feeder overcurrent protection devices of the number, rating, and arrangement as shown on the Contract Drawings. Vertical sections shall be aligned at the front and rear.

B. Each service switch shall have a separate enclosure as required per NEC 230.71.

C. Switchboards shall be completely self-supporting structures of the required number of vertical sections bolted together to form a single metal enclosed switchboard. Sides, top, and rear covers shall be code gauge steel, bolted to the switchboard structure. The frame structure members shall be die-formed, 12-gauge steel bolted together and reinforced at corners with rugged gussets internal and external to the switchboard members. All cubicle sections shall be equipped with a steel barrier between each other.

D. Overcurrent protective devices rated 1600 amperes or more shall be individually mounted in the switchboard cubicle. Devices rated below 1600 amperes can be group mounted.

E. Switchboards shall be provided with adequate lifting means and be capable of being rolled or moved into position and bolted directly to the floor without the use of floor sills.

F. Steel surfaces shall be chemically cleaned and treated, providing a bond between paint and metal surfaces to prevent the entrance of moisture and formation of rust under the paint finish. The finish shall be ANSI-61 grey enamel paint.

G. Space for future devices shall include all necessary fully rated buses, overcurrent protection device supports and mounting brackets, and connections.

H. Switchboard enclosures shall be NEMA Type 1 where installed indoors. Switchboard sections shall be aligned on top, 90 inches high, unless lower height is required due to space limitations.

I. Crown Box

1. Provide crown boxes above the switchboard to allow required terminations at the overcurrent protective devices in the switchboard.
2. Crown boxes shall match the switchboard construction and allow for adequate ventilation within the boxes. The box faces which connect to the switchboard shall be insulated and maintain fire rating at all cable penetrations.
3. Crown boxes shall be equipped with multiple removable covers to allow full access.
4. All cables within the boxes shall be supported.
5. Cable support shall be arranged to facilitate cabling and adequate to support all cables indicated, including those for future installations.

J. Arc Flash Protection

1. Electrical Contractor shall provide all arc flash warning labels and shall install such directly on the equipment.
2. Based on the results from the vendor's arc flash study, the required level of protective gear shall be clearly displayed on the warning labels.

2.04 BUS SYSTEM

A. Bus bars shall be arranged throughout the enclosure with phases A-B-C left to right, top to bottom, and front to rear. Bus bars shall be permanently labeled by phase. Bus joints shall be bolted with high tensile zinc plated steel bolts with spring loaded Bellville type washers.

B. Bus bars shall be copper of 98% conductivity silver plated and sized at 1,000 amperes per square inch, but in no case, less than to limit the temperature rise to 55 degrees C above ambient temperature of 40 degrees C. based on ANSI standard temperature rise criteria.

C. Bus bars shall be of the ampere rating (continuous) as shown on the Contract Drawings. Neutral bus shall be full size. Provide a 33% minimum copper ground bus, extending along the full length of the switchboard. All bus bars shall be rigidly braced to comply with the integrated switchboard rating.

D. The horizontal bus shall be full size, tapered bus is not permitted. Provide bolt holes drilled and tapped for future extension at the end of the bus bars including neutral and ground buses so that the addition of a future section would require only the installation of standard bolted splice plates. Vertical bus bars shall be fully extended to allow for the installation of future overcurrent protective devices within the cubicle

where spaces are provided.

E. Busway terminating at the switchboard shall be bus connected, including neutral and ground. Cable connections are unacceptable.

F. All incoming and outgoing feeders shall be fully accessible from the front, requiring no rear access.

2.05 OVERCURRENT PROTECTION DEVICES

A. General:

1. Feeder overcurrent protection devices shall be bus connected on the line side.
2. Overcurrent protection devices shall have an external operating handle located on the front door.
3. All unused spaces shall be fully capable of accepting future devices without the addition of bus work or rails. These sections shall be fully equipped with appropriate bus, connectors, and mounting hardware.

B. Overcurrent Protection Device Types:

1. Main Switchboards:

a. Main Overcurrent Protection Device

(1) High Pressure Contact (HPC) Switch
(2) Insulated Case Power Circuit Breaker

b. Distribution Overcurrent Protection Devices

(1) Fusible switch units or molded case circuit breakers as shown on the Contract Drawings.

2. Distribution Switchboards: Fusible switch units or molded case circuit breakers as shown on the Contract Drawings.
3. All Fused Disconnect Switches and Circuit breakers rated 1200A and above shall be equipped with Arc Fault Energy Reduction per NEC 240.67 and 240.87, respectively.
4. Provide dedicated free-standing switchboard cubicles for overcurrent protective devices serving the fire pump. These devices shall be tapped ahead of the main service switch. All fire pump device enclosures shall be painted red and clearly labeled.

C. High Pressure Contact (HPC) Switches:

1. Stored energy, quick make/quick break operation. Extra heavy duty, low torque, rotary operated handle closing mechanism. The fingertip OPEN button shall instantly open the main contacts.
2. High interrupting capacity disconnect with electric trip for remote tripping or ground fault protection.
3. The fuse compartment interlocked to prevent access when the switch is closed.
4. Handle shall be capable of being padlocked in the OFF position.

5. Positive ON/OFF indicators; Green for OFF and Red for ON.
6. UL Class L fuses.
7. UL listed for continuous operation at 100% rated load.
8. Blown fuse protection shall trip switch when switch is closed with a blown fuse, or no fuse is installed.
9. Auxiliary switch for remote indication of the switch ON/OFF position.
10. HPC type switches shall be provided when on the primary side of any step-up or step-down transformers. Such switches shall have a closing rating of twelve (12) times the continuous current rating compared to the standard bolted pressure switch which is rated six (6) times the closing rating.

D. Bolted Pressure Switches

1. Switches rated 1600 amperes or more, all main switches, and all services switches shall be bolted pressure type. Switches shall be of charge before closing type.
2. The fuse compartment shall be interlocked to prevent any opening or access when the switch is in the closed position. The switch handle shall be capable of being padlocked in the off position.
3. The switch shall be manually operated and electrically tripped where required.
4. Switches shall be rated 200k AIC, UL listed for continuous operation, and capable of being opened when carrying 750% of its rated load.
5. Switch cubicles shall be equipped with arc barriers and replaceable arcing contacts.
6. Provide Ground Fault relays as indicated on the Contract Drawings, required by Code, and in accordance with UL 1053. Include test switch and functions, indicator lights, and metering.

E. Ground Fault Protection (GFP):

1. Provide Ground Fault Protection for main and feeder devices per the NEC and as follows:

    a. Current Monitor: The current monitor shall consist of a zero-sequence current transformer which shall enclose all current carrying conductors, including the neutral conductor if used, of the circuit being protected.
    b. Ground Fault Sensor: The ground fault sensor shall continuously sense the output of the current monitor. Should the sensor detect a ground current in excess of the pick-up setting for a duration exceeding the time delay, the sensor shall shunt-trip the appropriate device.
    c. Test Panels: Each ground fault sensor shall be provided with a test panel which shall completely test the ground fault system. The test panel shall indicate that a ground fault was sensed; or test the system with or without tripping the switch. The test panel shall be installed in the front of the switchboard adjacent to each device being protected.
    d. Shunt-Trip: Automatically opens the device when signaled by the sensor.
    e. Provide fuse protected control power transformer from the switchboard line side for the ground fault system. Ground fault and shunt-trip device shall be capable of operation at 55% of rated

voltage.

f. Set each ground fault sensor pick up setting at 25 percent of the rating of the respective overcurrent protection device with a 6-cycle time delay or as specifically indicated in the vendor's final short circuit and coordination study submittal.

F. Fusible Switch Units:

1. Quick-make, quick-break, dead-front type. Each switch shall be a self-contained unit, externally operated from the front, with a maximum of 1200 amperes. Above 1200 amperes shall be bolted pressure type switch.
2. Fuse and switch compartment with defeatable interlock to prevent access with switch in the 'ON' position.
3. Switches shall be equipped with rejection type clips suitable for UL Class R fuses up to 600A, suitable for UL Class L fuses above 600A.
4. Handle shall be capable of being padlocked in the OFF position.

G. Molded Case Circuit Breakers:

1. Bolt on type capable of being group mounted within a common rail assembly.
2. Completely sealed enclosure. Toggle type operating handle. Trip ampere rating and ON/OFF indications clearly visible.
3. Thermal-magnetic trip-free, trip-indicating, quick-make, quick-break, with inverse time characteristics, and electronic solid state trip settings (LSIG). Single-handle and common tripping on multipole breakers. External handle shall be suitable for locking in the OFF position.
4. Silver alloy contacts with auxiliary arc-quenching devices.
5. Shunt trip breakers shall be supplied with 120V AC coils.

2.06 GROUND FAULT PROTECTION (GFP)

A. Ground fault protection shall be provided where specified and on all overcurrent protection devices rated 1000 amperes or more as required by the NEC.

B. The ground fault protection shall as a minimum include ground fault relays; current sensors; monitor panel; and shunt trip mechanisms.

C. Settings: Set each ground fault sensor pick up setting at 25 percent of the rating of overcurrent device with a 6-cycle time delay unless specifically indicated otherwise in the final short circuit and coordination study submittal.

2.07 SURGE PROTECTIVE DEVICES (SPD)

A. Provide SPD at all service entrance switchboards as indicated on the Contract Drawings. Refer to specification section 26 43 13.

2.08 MIMIC BUS

A. Provide a mimic display bus on all normal and emergency switchboards which accurately represents the internal bus work and connections to the as-built conditions.

B. The Contractor and manufacturer shall verify that the mimic bus is accurate and

installed properly prior to the equipment being energized.

C. Firmly secure the mimic bus to the equipment enclosure and avoid disruptions or blockage of any overcurrent protective devices and displays. At a minimum, the mimic bus shall be a ¼" thick and ½" wide with directional flow of the distribution.

2.09 METERING DIGITAL DISPLAYS

A. Provide an electronic digital true RMS sensing metering display for each main switchboard main and each feeder as indicated on the Contract Drawings. The display shall indicate true RMS three (3) phase and single-phase voltages, current, watts, vars, power factor, frequency, watt demand, and watt hours. Displays shall be positioned not lower than 48 inches or higher than 72 inches above the finished floor.

B. The integral meter module shall house the meter terminal board and the meter protective device. All metering components shall be integral to the switchboard enclosure. Refer to specification section 26 27 14. The meter housing shall be integral to the switchboard interior with isolation from the main bus.

C. A circuit breaker or fused disconnect switch shall be provided at the metering location to allow safe access to metering components without powering down the entire panel.

PART 3 – EXECUTION

3.01 GENERAL

A. Only install switchboards when the electrical rooms are watertight and cleared of all construction debris. The rooms shall be considered architecturally complete prior to any electrical equipment being installed. Protect the switchboards from dust and moisture throughout the construction phase. The new switchboards shall not be utilized for temporary lighting and power services.

B. Install all switchboards on 4-inch-high concrete housekeeping pads which shall follow the contour of the switchboards with 1 inch of overlap on all sides. Utilize the final equipment submittal to dimension the required pad.

C. Where front accessible switchboards are installed 12" or more from a wall, provide sealed ends to restrict personnel access behind the switchboards.

D. Provide 1" empty conduit with a labelled pull line from the meter section of each switchboard to the nearest telecom closet.

E. Provide channel iron sills below each switchboard where the switchboard frame is not suitable for use as a floor sill.

F. All overcurrent protective device enclosures serving the fire pump system shall be painted red and labeled accordingly.

G. Provide engraved nameplates secured with rivets or screws. Nameplates shall be black bakelite plates with white lettering. Utilize red plates for emergency systems. Lettering shall be a minimum of 2" high. Labels shall be provided for each

switchboard and all overcurrent protective devices on the switchboard.

H. Provide an insulated mat, with a dielectric test voltage of 30,000V, at the front of all switchboards. The mat shall be a minimum of 3' wide x ½" thick x the entire length of the switchboard.

I. This Contractor shall prepare an as-built riser diagram of the entire electrical distribution system and mount it in a frame to be hung in the main and emergency electrical rooms. Submit digital copies of the same riser diagram to the Owner and Engineer.

J. Feeder cable revolutions shall be as tight as possible to prevent magnetic stress during any fault occurrence. Feeder revolutions shall be in accordance with the NEC.

K. All cable feeders entering the switchboards from below shall be properly sealed per the NEC.

3.02 SPARE PARTS

A. Provide all spare parts listed below and deliver to the Owner.

1. Fused Devices & Switches: 10% of all types and ratings provided. A minimum of three (3) shall be provided when 10% equates to less.
2. Control Fuses: 10% of all types and ratings provided. A minimum of three (3) shall be provided when 10% equates to less.
3. A quart of touch up paint for the enclosure.

3.03 OWNER TRAINING

A. Provide a factory authorized technician to train the Owner's Building Engineers and staff to operate, maintain, and adjust all equipment components. Training shall be videotaped.

B. Review all O+M procedures included in the O+M manuals.

C. Turn over all training materials and videos to the Owner upon completion.

3.04 WARRANTY

A. At a minimum, provide a five (5) year warranty starting from the installation acceptance date. The warranty shall include all manufactured equipment and devices, as well as all installation work.

3.05 FINAL CLEANING

A. The entire enclosure shall be clean, dry, and free of all construction debris and fireproofing overspray. Vacuum enclosure of debris after the installation and prior to energizing.

B. Repair and touch up and scratched and damaged surfaces with new touch up paint.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide panelboards in accordance with the Contract Documents.

B. Panelboards include both branch panelboards and distribution style panels.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Panelboards shall be the same manufacturer as the switchboards.

B. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

C. Testing Agency Qualifications: Member company of NETA or NRTL.

1.04 STANDARDS

A. Panelboards:

1. NEMA PB-1 and PB-1.1
2. NFPA 70
3. Federal Specification W-P-115A Type II, Class 1
4. UL 50 and 67

B. Circuit Breakers:

1. NEMA AB-1
2. Federal Specification W-C-375a and W-C-375b
3. UL 489
4. UL 943 – Ground Fault Circuit Interrupter (GFCI)

C. Fusible Switches:

1. Federal Specifications W-S-865c
2. NEMA KS-1
3. UL 98

D. Acceptance Testing:

1. NETA
2. NRTL
3. NEMA

1.05 SUBMITTALS

A. General:

1. Manufacturer's product data sheets, electrical ratings (voltage, bus and device ratings, lugs, AIC, etc.) and installation instructions for the panelboards and all overcurrent protective devices.
2. Enclosure types.
3. Support locations and types.
4. All drawings shall be prepared at a ¼" scale minimum.
5. Wiring diagrams indicate all connection points and metering devices.

B. Branch Panelboards:

1. Detailed description, elevation drawing, and layout of each panelboard, showing physical dimensions, circuit breaker ratings and layout, identification nameplates, Surge Protective Devices (SPD) (where indicated on the Contract Drawings), and cable lugs.

C. Distribution Panels:

1. Dimensioned layout and elevation drawings showing physical dimensions and housekeeping pads.
2. Detailed description and layout of each distribution panel, showing overcurrent protection device ratings and layout, identification nameplates, Surge Protective Devices (SPD), cable lugs, and fuse clip sizes.

D. Seismic restraint calculations.

E. Certified test reports and field-testing procedures.

F. Installation instructions.

G. Electrical Power Systems Study (short circuit, arc flash, and coordination study) per specification section 26 05 73. This must be submitted at the time of the panelboard equipment submittal. The submittal equipment ratings must be coordinated with the study results. The submittal will be returned unreviewed if the study is not included and coordinated.

H. Provide a five (5) year warranty from the installation acceptance date. The warranty shall include all manufactured equipment and devices, as well as all installation work.

1.06 IDENTIFICATION

A. Provide engraved nameplates secured with rivets or screws for all panelboards. Nameplates shall be black bakelite plates with white lettering. Utilize red plates for emergency systems. Lettering shall be a minimum of 1" high. Labels shall be provided for all overcurrent protective devices on the panelboards.

B. Provide as-built typewritten directory card indicating load served by type and location for each branch circuit in all panelboards. Mount directory in a frame on the inside of the branch panelboard door. Provide additional copies to the Building Engineer.

C. Include on the panel directory the incoming feeder conductor and raceway ratings and the source.

D. Current ratings of the overcurrent protection devices shall be displayed on the device.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Eaton, General Electric/ABB, Siemens, or Square D Scheider Electric

2.02 RATINGS

A. Panelboards shall be of the ratings and configurations shown on the Contract Drawings.

B. All panelboards shall be fully rated. Series rated is unacceptable.

C. Panelboards and overcurrent protection devices shall have a minimum short circuit rating as specified herein or greater where indicated on the Contract Drawings. Final ratings shall be per the vendor's final short circuit study.

2.03 CONSTRUCTION

A. Enclosures shall be corrosion resistant galvanized (zinc finished) sheet steel. Fronts shall be cold rolled steel, finish coated with ANSI 61 grey enamel over a rust inhibitor. Panel locks shall be keyed alike. Recessed flush mounted panels shall have overlapping fronts.

B. Doors for branch panelboards shall be one (1) piece bolt on front with a lockable hinged door over the overcurrent protection devices. Door-in-door construction shall be used for all panelboards.

C. All panelboards shall be lockable-type and keyed alike. Provide six (6) spare keys to the Owner.

D. Space for future devices shall include all necessary bus supports and connections.

E. Provide oversized gutters to accommodate all the branch circuits and incoming feeder to suit field conditions.

2.04 BUS SYSTEM

A. Bus bars shall be sequence phased, rigidly supported by high impact resistant, insulated supporting bus assemblies to prevent vibration and resulting damage when subjected to stress, vibration, or short circuits. Solderless terminations shall be

suitable for copper conductors.

B. Bus bars shall be of the ampere rating shown on the Contract Drawings. Bus bars shall be plated copper (98% conductivity) sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

C. Copper bus bars shall have a current density of 1000A per square inch in cross sectional area.

D. The neutral bus bar shall be full size. The neutral bus bar shall be 200% rated when supplied from an oversized neutral conductor. The neutral bus bar shall be capable of terminating one (1) neutral conductor per pole position minimum.

E. Provide copper equipment ground bus bar in each panelboard. Each ground bus bar shall be capable of terminating one (1) conductor per pole position minimum.

F. Where multi-section panelboards are indicated on the Contract Drawings, provide each section to contain the same number of pole positions and all ratings.

G. Lugs shall be bolted-on type suitable for copper conductors and 75 deg. C. terminations.

H. Provide SPD as indicated on the Contract Drawings.

2.05 OVERCURRENT PROTECTION DEVICES

A. Overcurrent Protection Device Types:

1. Branch Panelboards: Molded case bolt-on circuit breakers.
2. Distribution Panels: Molded case bolt-on circuit breakers or fusible switch units as indicated on the Contract Drawings.

B. Molded Case Bolt-On Circuit Breakers:

1. Completely sealed enclosure. Toggle type operating handle. Trip ampere rating and ON/OFF indication clearly visible.
2. Bolt-on type. Plug-in type breakers are not permitted.
3. Vertical main breakers on all panelboards.
4. Thermal-magnetic trip-free, trip-indicating, quick-make, quick-break, with inverse time characteristic. Single-handle and common tripping on multi-pole breakers. External handle shall be suitable for locking in the OFF position.
5. Silver alloy contacts with auxiliary arc-quenching devices.
6. Breakers utilized for switching lighting circuits shall be SWD rated.
7. Breakers for mechanical equipment shall be HACR rated.
8. Shunt trip breakers shall be equipped with 120V AC coils.
9. Bolted type terminals suitable for copper 75 deg. C. conductors.
10. Provide UL listed tie-bars on all single pole circuit breakers feeding multi-conductor branch circuits in accordance with NEC Article 210.4(B) to allow simultaneous disconnection of all ungrounded conductors.

C. Ground Fault Circuit Interrupter (GFCI)

1. Provide GFCI circuit breakers as indicated on the Contract Documents and as required by Code. Circuit breakers shall operate manually for normal switching activity and automatically under short circuit, overload, and when 0.005-amp line to ground fault conditions occur.

D. Fusible Switch Units:

1. Quick-make, quick-break, dead-front type. Each switch shall be a self-contained unit, externally operated from the front.
2. Defeatable interlock to prevent opening of the door when the switch is in the ON position.
3. Switches shall be equipped with rejection type clips suitable for UL Class R fuses up to 600A, suitable for UL Class L fuses above 600A.
4. Handle shall be capable of being padlocked in the OFF position.

E. Provide additional devices and equipment as indicated on the Contract Documents as follows:

1. Vertical Type Main circuit breakers
2. Shunt trip circuit breakers
3. SPD breakers
4. 200% neutral bus
5. Feed through construction or lugs
6. Oversized lugs and quantities, including double lugs
7. Increased gutter sizes to suit field conditions
8. CT, metering, and wiring for electronic monitoring

2.06 MAIN METERING AND SUBMETERING PANELS

A. The integral meter module shall house the meter terminal board and the meter protective device. All metering components shall be integral to the panelboard enclosure. Refer to specification section 26 27 14.

B. A circuit breaker or fused disconnect switch shall be provided at the metering location to allow safe access to metering components without powering down the entire panel.

C. The meter housing shall be integral to the panel interior with isolation from the main bus.

D. The meter shall be accessible through the same door as the branch devices.

E. Current transformers shall be solid core type and individually mounted in the wire gutter space on insulated factory assembled mounting brackets. Hanging current transformers from the load cables is not acceptable.

F. Ample wire bending space meeting NEC requirement shall be provided in the gutter for load cables.

G. Secondary CT wiring shall be bundled and out of the wire way for the load cables.

H. Current transformers shall be individually replaceable.

I. All circuits shall be labeled by the manufacturer.

J. All current transformers shall be UL Listed or Recognized and installed by the panel manufacturer.

K. The integrated panel shall be UL Listed by the panel manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Mount panelboards six (6) feet above the finished floor to the top overcurrent protective device, unless otherwise noted.

B. Connect feed-through panels to the main feeder by insulated parallel gutter taps (O.Z. Electrical Manufacturing Company Type PMX or PMX-C). All taps shall be full size.

C. Where panelboards are mounted recessed flush in the wall, maintain the fire integrity of the wall. Where panelboards are surface mounted, provide steel channels mounted 1" from the wall. Provide one (1) empty ¾" EMT conduit stubbed up into nearest accessible ceiling location for every three (3) spare or space breaker positions in the panel.

D. Neatly arrange wiring and tie together in each gutter with Thomas & Betts nylon Ty-Raps or equal at minimum 4-inch intervals.

E. Install all floor mounted distribution panels on 4-inch-high concrete housekeeping pads which shall follow the contour of the panel with 1-inch of overlap on all sides. Utilized the final submittal to dimension the required pad.

F. Provide plugs on all open knockouts.

G. Arc Flash Protection

1. Electrical Contractor shall provide all arc flash warning labels and shall install such directly on the equipment.
2. Based on the results from the vendor's arc flash study, the required level of protective gear shall be clearly displayed on the warning labels.

3.02 SYSTEM TESTING

A. The Contractor shall provide third party testing of the power metering system and multi-utility metering wiring. The Owner's Submetering Service Company or manufacturer's qualified service organization can provide third party testing.

B. Third party testing shall include testing of Power Line Communications between power meters and Transponders.

1. Testing shall confirm that all power meters included in cross reference are effectively communicating with the Transponders.
2. Testing shall confirm that remote connection system via phone line is complete.
3. Testing shall confirm that all Transponders on the RS-485 network are communicating properly.

3.03 FIELD TESTING

A. The Contractor and a certified 3rd party testing agency (retained by this Contractor) shall perform all required field testing in accordance with NETA or NRTL Acceptance Testing guidelines. At a minimum, the following visual inspections and testing shall be performed:

1. Confirm all mounting connections are secured.
2. All equipment is clean – internally and externally.
3. All overcurrent protective devices are properly mounted and installed.
4. Any GFCI devices are tested and working properly.
5. All feeders and branch circuits are labeled.
6. All feeders and branch circuits are properly terminated.
7. All code and maintenance clearances have been achieved.
8. All loads are balanced.
9. Equipment is properly grounded.
10. All panelboard directories are provided and are accurate.

B. Perform testing until all items are successfully completed.

C. Submit all testing data and results in a final report.

D. Perform infrared scans and testing of all equipment and prepare a report for submission to the Engineer and Owner.

3.04 WARRANTY

A. At a minimum, provide a five (5) year warranty starting from the installation acceptance date. The warranty shall include all manufactured equipment and devices, as well as all installation work.

3.05 SURGE PROTECTIVE DEVICES (SPD)

A. Provide Surge Protective Devices (SPD) at all distribution panels and branch circuit panelboards as indicated on the Contract Drawings. Refer to specification section 26 43 13 for additional information.

3.06 FINAL CLEANING

A. All panelboard backboxes shall be clean, dry, and free of all construction debris and fireproofing overspray prior to installation of the panelboard interior.

B. Vacuum backboxes clean of debris after the installation and prior to energizing.

C. Repair and touch up any scratched and damaged surfaces with new touch up paint.

END OF SECTION

SECTION 26 27 14
ELECTRICAL SUBMETERING SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide a complete Electronic Submetering System in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 STANDARDS

A. ANSI C12.1 and ANSI C12.20 compliant. Class .5S precision in revenue metering.
B. NY Public Service Commission Approved per requirements of 16 NYCRR 93.
C. The metering equipment shall be UL listed.
D. NFPA 70.
E. NY State Building Code and all applicable County and Local Laws.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer of this equipment shall have a minimum of 10 years' experience producing similar electrical equipment.
B. Comply with requirements of the latest revisions of applicable industry standards.
C. All metering shall be of the same manufacturer.
D. Engage a factory authorized service technician to start up, install, certify, test, and adjust all the system components.

1.05 SUBMITTALS

A. The following information shall be submitted:

1. System description including an overview of the system provided with a detailed description of suggested communications architecture.
2. Bill of material including a complete listing of all hardware, software, configuration, training, and start-up services being supplied under this contract.
3. Detailed wiring diagrams indicating all equipment connections and conductor sizes.
4. Hardware and software description shall be provided in detail.
5. Provide the manufacturer's data sheets for all equipment, cabinets, enclosures, and all accessories.
6. Approved submittal shall be stamped and signed by the Contractor prior to start-up.

7. Detailed power and control wiring diagrams indicating all equipment connections and conductor and raceway sizes.
8. Drawings indicating integration into the panels, distribution panels and switchboards, including elevations, dimensions, and wiring diagrams. These shall be coordinated with the respective electrical equipment submittals.

B. A final close-out submittal shall be provided and shall include a system operational manual that will include the following information:

1. A system description and as-built layouts / riser diagrams.
2. System field verification and commissioning report.
3. Descriptive bulletins and/or sales aids covering each component.
4. Manuals for all the products.
5. Software data files.
6. A complete list of device addresses and ID numbers.
7. All testing reports.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver all material in the manufacturer's original unopened protective packaging unless it is built into the new electrical distribution equipment.

B. Securely store materials in the original packaging in a manner to prevent soiling, physical damage, incursion of moisture, or corrosion prior to installation.

C. Handle in a manner to prevent damage to all finished surfaces.

D. Maintain protective coverings until the installation is complete and remove such covers as part of the final clean-up.

1.07 IDENTIFICATION

A. Provide engraved nameplates secured with rivets or screws for all meter enclosures. Nameplates shall be black bakelite plates with white lettering. Utilize red plates for emergency systems. Lettering shall be a minimum of 1" high.

B. Provide as-built typewritten directory cards indicating loads metered for each meter. Mount directory in a frame on the inside of the enclosure door. Provide additional copies to the Building Engineer.

C. Include in the directory the incoming feeder conductor and raceway ratings and the source.

PART 2 – PRODUCTS

2.01 ELECTRONIC SUBMETERS

A. Acceptable Manufacturers

1. The built-in or wall mounted electrical measurement system shall be supplied by SATEC Branch Feeder Monitor: Model BFM136. Contact Shaun Olson – 908-209-9987; or approved equal.

B. Components:

1. The Branch-Feeder-Monitor, SATEC Model SP1710 metering units, shall be incorporated into the electrical manufacturer's switchboards, distribution panelboards, and branch circuit panelboards as a single integrated unit. This shall include the metering unit, data logger, digital display, and a fused disconnect/breaker with respective circuit feeder.
2. This system shall monitor all the specified locations with time-of-use metering units that will provide kWh readings for potential monthly tenant billing.
3. The metering operating system shall be eXpertPower billing service or a Third-Party Metering Company, as selected by the Owner.
4. The metering operating system shall have a User-friendly interface for managing accounts and metering information for each load.
5. The metering operating software shall be capable of providing metering information for electricity, water, and air usage.
6. The metering operating software shall allow selection of monitoring periods (start date/time and end date/time).
7. The metering operating software database shall support reading "interval data" directly from a PAS operating database to execute the database queries and to minimize the query times.
8. The metering operating software shall have a minimum of four (4) virtual channel totalization sub-meters, allowing automatic totalization of multiple sub-meters.
9. The SATEC Inc. Branch-Feeder-Monitoring system is defined to include, but not limited to, remote metering devices embedded in the electrical manufacturer's panelboards, pre-wired current transformers in the manufacturer's panelboards, central display for monitoring the system, web-based software, software configuration, ancillary equipment, start-up, and training services.
10. A kWh total display shall be available as an option at the branch-feeder-monitor unit for energy consumption and in a mechanical numeric digit format.
11. A central display shall be available that will display all individual meters' consumption readings.
12. The branch-feeder-monitor shall be configured in the following: 12 three-phase circuits, 18 split-phase circuits, 36 single-phase circuits, or any combination.
13. The units shall be mounted in single NEMA 1, 3, 3R, 4, 4X, or 12 enclosures depending on its application and environmental conditions, when not installed integrated into the electrical distribution equipment. Provide all mounting brackets and rails.
14. The metering units shall provide daily load profile data for up to 120 days.
15. A minimum of 8MB of non-volatile memory shall be provided.
16. A local LCD display shall view all basic measurement requirements.
17. The metering units shall use metering grade current transformers.
18. Up to 6kV impulse, isolated for 2.5kV. Voltage output shall not exceed 8 Volts max.
19. The current transformers shall be installed at the electrical manufacturer's plant or can be field mounted at the job site. Electrical Contractor shall coordinate this prior to purchase and installation.
20. Front-end equipment such as a modem, network controller, or computer is not required as part of the metering system.
21. Local interface for property management to access current and historic

meter data shall be available within the metering system. Pass code protected and shall provide current reading, graphing, and profiling features.

22. Tenant bill preparation shall be available based on NY State Code regulations & PSC approved bulk rate, if applicable.
23. Software for reading, logging, and printing tenant bills at the remote site (self-administered) shall be available by the metering unit hardware manufacturer. Software shall Windows based.
24. Remote Web Based software shall be available for monitoring the property load via the internet via a web browser.

C. Communication Overview

1. The Electronic Branch-Feeder Monitoring system shall be able to utilize the following standard communications configuration, as a minimum:

    a. Optically isolated RS485 port standard: Modbus RTU/ASCII.
    b. Direct hard-wire Ethernet Category 5e (CAT5e) or CAT6. Transformer-isolated 10/100BaseT, Connector RJ45, Modbus TCP. The CAT5e communications cable's maximum length shall be 330'.
    c. Remote monitoring over an Ethernet LAN network connection.
    d. Direct Application Voltages (For higher voltages, potential transformers are used.): 120 / 240 / 480 – Max 544 L-L.
    e. Operating Frequency: 60 Hz.
    f. Voltage Rating: 120/208V (+/- 15%).
    g. Power Factor Range: 0.5 to 1.0 lead/lag.
    h. Power Supply Requirements: Powered from three (3) sensing inputs.
    i. Current Ratings: 100 – 4000 amps.
    j. Accuracy: +/- 0.5% of 100% registration at 1.0 pf, 1% to 100% load to meet: ANSI C12.2.
    k. Operating Temperature Range: -20 degrees to +60 degrees C.

D. Current Transformers

1. Provide revenue class solid core current transformers associated within the metering system.
2. Range of 100-amp to 4000-amp CT shall be milliamp driven. Each CT shall include blocking diodes to prevent harmful operation when not connected to the meter base. Milli-voltage driven CT shall not be acceptable.
3. Current transformers shall be driven 600' without loss of phase accuracy and milli current driven. The open CT shall not exceed 8 volts max.
4. Each current transformer input channel shall have the ability to adjust the individual transformer correction with phase angle adjustment within minutes to provide precise measurement.

E. Potential Transformers

1. The potential transformers, if required, shall be mounted in a separate enclosure rated for the size and capacity necessary to feed the number of meters shown on the Contract Drawings and rated by the manufacturer. Potential transformers shall be approved for revenue metering.

2.02 UTILITY CHECK ELECTRONIC SUBMETERS

A. Acceptable Manufacturers

1. The embedded electrical measurement system for power quality, single-circuit shall be supplied by SATEC Model PM 174: Contact Shaun Olson – 908-686-9510 or approved equal.

B. Components

1. The Power Meter 174 shall be mounted in its own NEMA 1 enclosure, Model SP1740. The enclosure shall be mounted externally from the desired panelboards or switchboards. Alternately, the metering units shall be incorporated into the electrical manufacturer's panelboards as one (1) contained unit and include the metering unit, data logger, digital display, and a fused disconnect or breaker with respective circuit feeder.
2. This system shall monitor all the specified locations with time-of-use metering units that will provide kWh readings for monthly tenant billing.
3. The metering operating system shall be PAS, eXpertPower, or other Modbus System.
4. The metering operating system shall have a User-friendly interface for managing the account and meter information.
5. The metering operating software shall be capable of providing metering information for electricity, water, and air usage.
6. The metering operating software shall allow selection of monitoring period (start date/time and end date/time).
7. The metering operating software database shall support reading "interval data" directly from a PAS operating database to execute the database queries and to minimize the query times.
8. The SATEC Inc. Power Meter 174 system shall include, but is not limited to, remote metering devices embedded in the electrical manufacturer's panelboards (or switchboards), pre-wired current transformers in the manufacturer's equipment, central display for monitoring the system, web-based software, software configuration, ancillary equipment, start-up, and training services.
9. A kWh total display shall be available as an option at the power meter unit for energy consumption and in a mechanical numeric digit format.
10. A central display shall be available that will display the consumption readings.
11. The units shall be mounted in single NEMA 1, 3, 3R, 4, 4X, or 12 enclosures depending on its application and environmental conditions, when not installed integrated into the electrical distribution equipment. Provide all mounting brackets and rails.
12. The embedded metering units shall provide daily load profile data for up to 120 days.
13. A minimum of 1MB of non-volatile memory shall be included within the Power Meter 174.
14. A local LCD display shall view all basic measurement requirements.
15. The metering units shall use metering grade current transformers.
16. Up to 6kV impulse, isolated for 2.5kV. Voltage output shall not exceed 8 Volts max.
17. The current transformers shall be installed at the electrical manufacturer's plant or can be field mounted at the job site.

18. Front end equipment such as a modem, network controller, or computer is not included as part of the metering system.
19. Local interface for tenant and property management access to current and historic meter data shall be available within the metering system. The system shall be passcode protected and shall provide current reading, graphing, and profiling features.
20. The system shall have the ability to incorporate other utilities such as water measurements into the system.
21. Software for reading, logging, and monitoring at the remote site (self-administered) shall be available by the metering unit hardware manufacturer. Software shall be Windows based.
22. Remote Web Based software shall be available for monitoring the property's load via the internet over a computer's web browser.

C. Communication Overview

1. The Electronic Power Meter 174 system shall be able to utilize the following standard communications configuration, as a minimum:

    a. Optically isolated RS485 port standard: Modbus RTU/ASCII.
    b. Direct hard-wire Ethernet category 5e (CAT5e) optional. Transformer-isolated 10/100BaseT, Connector RJ45, Modbus TCP. The CAT5e communications cable's maximum length shall be 330'.
    c. Optional RS232 port, baud rate to max 115,200. Modbus RTU/ASCII.
    d. Dial-Up Modem or 56K Modem available, Connector: RJ11, Modbus RTU/ASCII.
    e. Remote monitoring over an Ethernet LAN network connection.
    f. Direct Application Voltages (For higher voltages, potential transformers are used.): 120 / 480 – Max 690 L-L.
    g. Operating Frequency: 60 Hz.
    h. Voltage Rating: 120/208V (+/- 15%).
    i. Power Factor Range: 0.5 to 1.0 lead/lag.
    j. Power Supply Requirements: Powered from L/+ and N/-.
    k. Current Rating: 100 – 4000 amps.
    l. Accuracy: +/- 0.2% of 100% registration a 1.0 pf, 1% to 100% load to meet: ANSI C12.2.
    m. Operating Temperature Range: -20 degrees to +60 degrees C.

D. Current Transformers

1. Provide revenue class current transformers associated with the metering system.
2. Range of 100-amp to 4000-amp CT shall be milliamp driven. Each CT shall include blocking diodes to prevent harmful operation when not connected to the meter base. Milli-voltage driven CT shall not be acceptable. The PM174 has the option of 40mA, 1A, or 5A configuration available.
3. Current transformers shall be driven 600' without loss of phase accuracy and milli current driven. The open CT shall not exceed 8 volts max.
4. Each current transformer input channel shall have the ability to adjust the individual transformer correction with phase angle adjustment within minutes to provide precise measurement.

E. Potential Transformers

1. The potential transformers shall be mounted in a separate enclosure rated for the size and capacity necessary to feed the number of meters shown as per the Contract Drawings and rated by the manufacturer.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The Contractor shall furnish and install the equipment specified herein. The equipment shall be as indicated in the Contract Documents and outlined herein.

B. All conductors shall be installed in metallic conduits and be properly supported in all enclosures.

C. All equipment shall be grounded per the manufacturer's recommendations and Code.

D. Meters shall not be mounted higher than 6' – 6" from the finished floor. Maintain all access and Code clearances.

E. A circuit breaker or fused disconnect switch shall be provided at the voltage connection for each meter to allow safe access to the devices for service without powering down the entire panel.

F. All meters shall be installed in accordance with the manufacturer's installation instructions.

3.02 ADJUSTING AND CLEANING

A. The meters shall be adjusted so that accurate readings appear and that the readings are within the meters' accuracy range.

B. Clean exposed surfaces using the manufacturer's recommended materials and methods prior to energizing any equipment.

3.03 WARRANTY

A. All equipment shall be free from defects in materials and workmanship under normal use and service for the period of thirty-six (36) months from the date of shipment from the factory.

3.04 TESTING

A. Perform factory and installation tests in accordance with applicable NEC, NEMA, and UL requirements.

B. Correct any found deficiencies and retest until all requirements are met.

C. Assure all connections are properly torqued to the acceptable recommendations. Verify all grounding connections.

D. Perform all metering functionalities and operations to ensure all equipment meets the manufacturer's capabilities.

E. Submit all field-testing reports.

3.05 STARTUP SERVICES

A. The Contractor and equipment supplier shall provide supervision and project management for the entire project.

1. On-Site start-up and training of the Owner's personnel is required on the system and shall be included in the project bid.
2. Startup shall consist of complete meter configuration and on-site service testing of the meters & communication to the web-based system.
3. Training shall include any documentation and hands-on exercises needed by the Owner's personnel at the site during the last day of the startup.
4. Provide additional Owner training for troubleshooting, servicing, adjustments, and maintenance of the equipment.
5. Supplier shall have a remote fully functional support facility for support related questions.

B. Calibration and Maintenance Service

1. All meters shall be factory calibrated with precision test equipment and shall remain accurate for the life of the product, eliminating the need for in-service calibration or adjustments.

C. Time Of Use (TOU)

1. All meters are factory configured for "Time of Use" application if or when required.

3.06 ONSITE ADJUSTMENTS

A. Provide supplemental Owner requested site visits (up to three (3) in one (1) year) to perform adjustments and calibrations of any equipment installed by this Contractor.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide wiring devices in accordance with the Contract Documents. Lighting controls refer to specification section 265000 – Luminaires and Accessories.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firms regularly engaged in manufacture of devices and wall plates of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide fire classified electrical floor boxes and fittings produced by a manufacturer listed in this section.

B. Source Limitations: Obtain each type of device and wall plate through one (1) source from a single manufacturer.

C. Equipment shall be certified for use in the State of New York and shall meet the NY State Energy Code and local energy ordinances.

D. Coordinate service fittings with the electrified furniture system supplier.

E. Floor boxes shall comply with UL scrub water tests for carpet, wood, and tile floors.

1.04 STANDARDS

A. Receptacles: Federal Specification WC-596D, NEMA WD1, NEMA WD6, and UL 498

B. Ground Fault Circuit Interrupter (GFCI) Receptacles: UL 943 Class A

C. Floor Boxes: UL 514B

D. NFPA 70

1.05 SUBMITTALS

A. Submit the manufacturer's standard catalog pages and data sheets, including termination method and available ratings, configurations, instruction sheets, certificates, qualification statements, and colors.

B. Submit samples as requested by the Architect of any cover plates and devices for color selection.

1.06 FIELD TESTING

A. The rotometer tests all three phase receptacles and verifies correct phase orientation.

B. Test GFCI operation of all receptacles.

C. Verify proper polarity and ground continuity for all wiring devices.

D. Submit all field test results and reports.

1.07 COLORS

A. Device and cover plate colors shall be as selected by the Architect. Catalog numbers, where included in this specification, are not to be used to determine the colors of devices or cover plates.

B. Receptacles and cover plates connected to the emergency power system shall be red, unless otherwise directed.

1.08 IDENTIFICATION

A. Provide engraved cover plates for all wiring devices.

B. All cover plates shall indicate the controlling loads which are not local to the controller. All receptacles controlled by sensors shall be clearly labeled and permanently marked by the manufacturer to visually differentiate them from uncontrolled receptacles.

C. Provide cover plate labels for all receptacles and metal surface raceways indicating the panel source and circuit number.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Catalog numbers shall not be used to determine colors of devices and cover plates. Catalog numbers are used to establish a minimum acceptable standard.

B. Receptacles: Leviton, Hubbell, Cooper, Legrand, or Pass & Seymour.

C. Floor Boxes and Fittings:

1. Poke through type: Walker/Wiremold or Hubbell
2. Recessed flush floor box type: Hubbell, Steel City, or Walker/Wiremold

D. Plug strips and Metal Surface Raceways: Wiremold, Hubbell, or approved equal.

2.02 STRAIGHT BLADE RECEPTACLES

A. General:

1. Receptacles shall be of the type indicated on the Contract Drawings.
2. Receptacles shall be commercial specification grade, two-pole, 125V, grounding type, and side wired up to No. 10 AWG conductors.
3. Receptacles shall have a single piece, heavy duty brass ground contact, and mounting strap.
4. All Receptacles shall have a nylon face and heat-resistant base.
5. GFCI receptacles shall interrupt ground leakage currents between 4-6mA (trip time .025 seconds nominally) and shall be equipped with indicator LED lights.
6. Rectangular decora series.
7. Controlled receptacles shall be permanently marked to visually differentiate the controlled receptacles from the uncontrolled receptacles.

B. Receptacles:

1. Duplex, 20A: Leviton 5362, Hubbell 5362, or Cooper 5362.
2. Designer style duplex, 20A: Leviton Decora 16352, Hubbell DR20, or Cooper 6362.

C. USB Charger Type Receptacles:

1. Dual USB charging ports 6.0A (minimum) – Type A & Type C.
2. Comply with USB battery charging spec USB BC1.2.
3. Commercial / specification grade
4. Tamper resistant outlet.
5. Duplex, Decora style 20A: Leviton T5832 or Hubbell USB20PD.

D. Ground Fault Circuit Interrupter (GFCI) Receptacles (Safelock ™ Protection Type):

1. Duplex, 20A: Leviton 8898-HG, Hubbell LED GFRST20, or Cooper VGF20.

E. Special Purpose Receptacles: Rating as indicated on the Contract Drawings.

F. Clock Receptacles:

1. Simplex, 20A: Leviton 5261-CH, Hubbell RR151TRCHW, or Cooper 775.

G. Weatherproof Receptacles:

1. Duplex, weatherproof while “In-Use” rated cover plate with a hinged door.
2. All 20- ampere, 125- and 250-volt nonlocking receptacles located in damp or wet locations shall be a listed weather-resistant type. Listed devices shall bear a “WR” marking on the face that is visible when installed.

2.03 FLOOR BOXES AND FITTINGS

A. General:

1. Provide floor boxes and fittings of the types, ratings, and configurations as shown on the Contract Drawings.
2. Floor boxes and fittings shall match the fire rating and thickness of the floor slab.

3. Combination type power/telecom/low voltage boxes shall have steel barriers to separate power, telecom, and any low voltage wiring.

B. Poke Through Pedestal Type Floor Box:

1. Fire rated insert, junction box, and service fitting. Service fittings shall be diecast aluminum, satin finish or as selected by the Architect.
2. Duplex receptacle outlet, 125V, 20A: Legrand/Walker, Hubbell, or Cooper.
3. Special purpose receptacle outlet (NEMA outlet type as indicated on the Contract Drawings): Legrand/Walker, Hubbell, or Cooper.
4. Combination duplex receptacle/telecom outlet, 125V, 20A: Legrand/Walker, Hubbell, or Cooper equipped with grommeted hole and modular jacks (coordinate modular jack types with IT Contract Documents).
5. Combination double duplex receptacle/telecom outlet, 125V, 20A: Legrand/Walker, Hubbell, or Cooper equipped with grommeted hole and modular jacks (coordinate modular jack types with IT Contract Documents).
6. Telecom outlet: Legrand/Walker, Hubbell, or Cooper equipped grommeted holes and two (2) factory installed telecom modular jacks (coordinate modular jack types with IT Contract Documents).

C. Poke Through Flush Type Floor Box:

1. Fire rated (2HR) insert, junction box, and service fitting. Combination power/telecom outlets shall have integral steel barrier to separate power and telecom wiring. The carpet flange shall be diecast aluminum with finish as selected by the Architect.
2. Units shall be field configurable and modifiable to accommodate the power, and/or low voltage requirements as noted on the Contract Drawings.
3. All components of the poke through shall be from the same manufacturer.
4. Combination duplex receptacle with four (4) telecom outlets, 125V, 20A: Legrand/Walker, Hubbell, or Cooper.
5. Combination double duplex receptacle with four (4) telecom outlets, 125V, 20A: Legrand/Walker, Hubbell, or Cooper
6. All finishes shall be as selected by the Architect.

D. Recessed Flush Floor Box:

1. Cast iron box, multiple gangs, 2-inch shallow depth, brass carpet flange, and cover plates.
2. Duplex receptacle outlet, 125V, 20A: Legrand/Walker, Hubbell, or Cooper.
3. Combination duplex receptacle/telecom outlet, 125V, 20A: Legrand/Walker, Hubbell, or Cooper.
4. Combination double duplex receptacle/telecom outlet, 125V, 20A: Legrand/Walker, Hubbell, or Cooper.
5. Telecom outlet: Legrand/Walker, Hubbell, or Cooper.
6. All finishes shall be as selected by the Architect.
7. Coordinate the floor finish with the Architect prior to any work.

2.04 PLUG STRIPS AND METAL SURFACE RACEWAYS

A. Provide plug strips and metal surface mounted raceway systems in lengths shown and suitable for the branch circuiting and telecom cabling indicated on the Contract Drawings.

B. Plug strips and raceways shall be grounding type, painted color as selected by the Architect. Provide all required fittings and mounting brackets for complete installation.

C. All surface telecom raceways shall have full capacity corner elbows to accept fiber cable installations.

D. Provide number and NEMA configurations of receptacles as indicated on the Contract Drawings.

E. Power Type:

1. Single compartment surface metal raceway with removable cover.
2. Single receptacle outlet mounted on 12-inch centers, UON.
3. Wiremold 2000 Series or Hubbell 2000 Series.

F. Power/Telecom Type:

1. Two (2) compartment surface metal raceway with internal divider and removable covers.
2. Duplex receptacle outlets and telecom fittings mounted on 24-inch centers, UON.
3. Wiremold V-4000 Series or Hubbell 4750 IV Series with combination type covers.

G. Power/Telecom Type:

1. Three (3) compartment surface metal raceway with internal dividers and removable covers.
2. Duplex receptacle outlets or telecom fittings mounted on 24-inch centers, UON.
3. Wiremold N1-834-134-3-2-XX or Hubbell 6750 IV Series with 67473 series face plates.
4. Each channel shall be capable of housing a standard device.

2.05 COVER PLATES

A. Provide cover plates for all wiring devices. Provide multiple gang cover plates where multiple devices are installed in a common location.

B. Provide screw-less type cover plates for all wiring devices located in all areas except back of house spaces.

C. Provide stainless steel Type 430, smooth face cover plates in equipment rooms. Provide nylon thermoplastic, smooth face cover plates in other areas. Thermoset cover plates are not acceptable.

D. Wet-Locations: Provide weatherproof “In-Use” cover plates complying NEMA 3R, weather resistant, die cast aluminum with lockable covers.

PART 3 – EXECUTION

3.01 GENERAL

A. General:

1. Verify the exact location and mounting height of all wiring devices with the Architect prior to any work.
2. Devices mounted above the counters shall be 2-inches above the top of the backsplash to the bottom of the cover plate.
3. Provide a No. 12 AWG grounding conductor from the device grounding terminal to the panelboard ground bus. Bond the wiring device to the outlet box.
4. Receptacles mounted in boxes shall be installed so that the mounting yoke or strap of the receptacle is held rigidly against the surface of the wall. Drywall or plaster surfaces shall be repaired so there are no gaps greater than 1/8 inch from the edge of the box or fitting.
5. Receptacle faces shall project a minimum of 0.015 inches from the faceplate. Faceplates shall be installed so as to completely cover the opening and seat against the mounting surface.

B. Receptacles:

1. Receptacles shall be mounted vertically with the grounding pin on bottom.
2. Provide conventional style duplex receptacles in the equipment rooms. Provide designer style type duplex receptacles to match rocker handle type lighting switches in other areas.
3. Receptacles which are switched shall be circuited to allow only the top receptacle to be controlled.
4. Receptacles within six (6) feet from a sink shall be GFCI type receptacles, including receptacles installed under a sink.
5. Provide duplex 20A weatherproof GFCI receptacle at each elevator shaft pit, outdoor locations, and loading docks. Provide weatherproof “in-use” covers with locking capabilities.
6. Additionally, provide GFCI receptacles in all kitchens and within elevator machine rooms.
7. For elevators where there is serviceable equipment at the top of the elevator shaft (such as an elevator motor installed on top of cab), provide a weatherproof GFCI 20A receptacle at the top of the shaft. Coordinate exact location with elevator vendor.
8. Provide dedicated 20A (NEMA 5-20R) or 30A (NEMA 6-30R) receptacles within the technology rooms. Refer to the T series drawings for exact quantities and mounting locations – wall, ceiling, on cable tray side, etc., prior to any work.

C. Plug Strips:

1. Provide a 1.25-inch empty conduit home run to the nearest telecommunications terminal board for each 12 linear feet of telecommunications plug strip.
2. All empty conduits shall be equipped with a labeled pull line.

D. Cover Plates:

1. Install device cover plates in full contact with wall surface. Plates shall not project out from the wall.
2. Clean all cover plates and wiring devices.

3.02 FIELD TESTING

A. Perform all field testing to verify proper equipment operation.

B. Submit all test results and reports.

END OF SECTION

SECTION 26 28 13
600V FUSES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide 600V fuses in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. All fuses shall be of the same manufacturer.

B. All fuses shall be the same type within a piece of equipment.

1.04 STANDARDS

A. UL 198 and 977

B. IEEE 242

C. NFPA 70

1.05 SUBMITTALS

A. Manufacturer’s product data sheets for all overcurrent protection devices proposed to be used on the project, including a listing of let-through curves for all fuses.

B. Spare fuse cabinet project data sheet, including dimensional and mounting data.

C. Include a list of all spare fuses being provided.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Bussmann, Mersen, or Littlefuse.

2.02 FUSES

A. Rated 601 amperes through 6000 amperes:

1. UL Class L.
2. 200,000 RMS symmetrical amperes interrupting rating.
3. Bussmann KRP-C or Littlefuse KLP-C.

B. Rated 600 amperes and below:

1. UL Class RK1 - Dual Element.
2. 200,000 RMS symmetrical amperes interrupting rating.
3. Open fuse indictors.
4. Bussmann LPN-RK (250V) or LPS-RK (600V); or Littlefuse LLN-RK (250V) or LLS-RK (600V).

2.03 MOTOR OVERCURRENT PROTECTION FUSES

A. Utilize UL Class RK1, Class J, or Class L time delay fuses for individual motor feeder circuits.

B. Utilize Class CC fuses with open fuse indicators for motors rated under 10 horsepower.

C. Coordinate all motor overcurrent protection requirements with the specific equipment manufacturer prior to installing any fuses.

2.04 SPARE FUSES

A. Provide a minimum of ten (10) percent (minimum quantity of 3) spare power and control fuses of each type and rating utilized on the project.

B. Provide wall mounted fuse cabinet in the main normal electrical room. Locate all spare fuses in the respective cabinets.

PART 3 – EXECUTION

3.01 GENERAL

A. Fuses shall not be installed until equipment is ready to be energized and has successfully completed all testing.

B. Replace and properly discard any failed fuses.

C. Provide as-built drawings indicating the exact type and rating of all fuses.

END OF SECTION

SECTION 26 28 16
DISCONNECT SWITCHES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide disconnect switches in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Disconnect switches shall be the same manufacturer as the switchboards and panelboards.

B. Installer Qualifications: An employer of workers qualified and trained in electrical safety as required by NFPA 70E.

C. Testing Agency Qualifications: Member company of NETA or NRTL.

1.04 STANDARDS

A. Disconnect Switches:

1. Federal Specification W-S-865C
2. NEMA KS1
3. UL 20, 98, and 508

1.05 SUBMITTALS

A. Manufacturer’s product data sheets, electrical ratings (voltages, amperes, poles, lugs, etc.), physical dimensions, access requirements, and weights.

B. Enclosure types, including support locations and types.

C. Listing of disconnect switches which will be equipped with overcurrent protective devices.

1.06 FIELD TESTING

A. Submit certified testing reports performed for each piece of equipment.

1.07 IDENTIFICATION

A. Provide engraved nameplates secured with rivets or screws for all disconnect switches. Nameplates shall be black bakelite plates with white lettering. Utilize red plates for emergency systems. Lettering shall be a minimum of 1" high. Labels shall indicate conductor and raceway sizes; and power source.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Eaton, General Electric/ABB, Siemens, or Square D Schneider Electric.

2.02 DISCONNECT SWITCHES

A. All disconnect switches shall be heavy duty, horsepower rated, quick-make, quick-break, dead-front type. Self-contained unit in a NEMA 1 gasketed enclosure when installed indoors; and NEMA 4X Stainless Steel where installed outdoors or in wet conditions; all switches shall be externally operable from the front.

B. Defeatable interlock to prevent opening of the switch cover when the switch is in the ON position. All disconnect switch handles shall be capable of being padlocked in the OFF position.

C. Fusible switches shall be equipped with rejecting type clips suitable for UL Class R fuses up to 600A, suitable for UL Class L fuses above 600A. Interrupting rating shall be 200,000 RMS symmetrical amperes.

D. Switches shall be equipped with contact arc-quenching devices. Switch blades shall be self-aligned with silver alloy contact.

E. Voltage, ampacity, horsepower rating, and number of poles shall be appropriate for the system and load served. Provide neutral terminal for feeders with neutral conductors. Provide equipment ground lugs. Provide spare auxiliary contacts.

F. Provide six (6) pole switches for connection to motors requiring six (6) motor leads.

G. Provide lugs which have been coordinated with the feeder conductor type, quantity, and AWG ratings.

H. All disconnect switches shall be equipped with viewing windows as part of the switch door.

2.03 THERMAL OVERLOAD DISCONNECT SWITCHES

A. Single phase manual motor starter with quick-make, quick-break toggle mechanism and field adjustable overload heater element.

B. Self-contained unit in a NEMA 1 gasketed enclosure when installed indoors; and NEMA 4X Stainless Steel where installed outdoors or in wet conditions; all switches shall be externally operable from the front.

C. Provide thermal overload disconnect switches for all motor and damper connections.

PART 3 – EXECUTION

3.01 GENERAL

A. Disconnect switches shall be installed within ten (10) feet of load served and installed within sight of the motor. Provide additional disconnect switches if not within line of sight of the motor/equipment being controlled.

B. Provide independent steel support (Unistrut or Kindorf) for the disconnect switches and motor starters, do not mount on the housing of the equipment served.

C. Conduit connected between the disconnect switch or individual motor controller and the load served shall be liquid-tight flexible metal conduit, 24 inches minimum length, 36 inches maximum length.

D. Calibrate and adjust all motor controller components as required by the respective manufacturer's requirements and to suit field conditions.

E. Disconnect switch serving the fire pump shall be painted red, lockable type, and labelled accordingly.

F. Upon completion of the equipment installation, all switch enclosures shall be thoroughly cleaned of all debris.

END OF SECTION

SECTION 26 31 00
SOLAR PHOTOVOLTAIC SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide a complete and functional Solar Photovoltaic (PV) System as specified and in accordance with the Contract Documents. The system shall include all required photovoltaic panels, panel module framing, inverters, rapid shutdown switches and controls, disconnect switches, overcurrent protection, combiner boxes, grid ties, metering, conductors, and raceways.

B. The system shall consist of an array of photovoltaic panel modules with aluminum frames designed for grouping on steel racks, terminals, and combiner boxes, quick-connect electrical connectors, DC wiring, DC disconnect switches, grid-connected inverters, AC disconnect switches, data acquisition and monitoring system (DAS), and isolation transformers. The inverters shall be wired to the building's electrical system.

C. The actual orientation and tilt of the photovoltaic panel arrays shall be optimized based upon computer studies for the specific project location and its associated weather data and sun patterns. This Vendor and Electrical Contractor shall provide design analysis and installation recommendations for optimum output and energy savings.

D. This Vendor and Electrical Contractor shall provide design engineering, labor, materials, and all accessories required to furnish, install, start up, and commission a complete and operating solar photovoltaic system. Labor, materials, or accessories not specifically called for in the Contract Documents but required to provide a complete operating system shall be provided without additional cost to the Owner.

E. This Vendor and Electrical Contractor shall determine, coordinate, and incorporate the design and construction requirements of the Architect, Structural Engineer, Electrical Engineer, General Contractor, other Subcontractors, and the electrical power service provider.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Comply with the current applicable codes, ordinances, and regulations of the Authority or Authorities Having Jurisdiction, the rules, regulations, and

requirements of Con Edison and the County, and the Owner's insurance underwriter.

B. Equipment supplier shall have local representation and shall have been actively engaged in installation and service of solar photovoltaic systems and inverters for a period of not less than 10 years.

C. All equipment and installations shall meet or exceed minimum requirements of ANSI, ASTM, IEEE, IEC, NEC, NEMA, NETA, NRTL, NFPA, OSHA, UL, and the Fire Inspector.

D. Equipment shall be certified for use in the NY State and shall meet or exceed the requirements of the NY State Energy Code.

Maintain manufacturer uniformity for all equipment used in similar applications and sizes.

E. Testing Agency Qualifications: Member company of NETA or NRTL.

1.04 STANDARDS

A. The photovoltaic solar installation shall be designed and manufactured in compliance with the following latest standards and codes:

1. NEC Article 690
2. UL 1741
3. IEEE 929 and 1547
4. NY State Building and Fire Codes
5. Fire Inspector

1.05 SUBMITTALS

A. Proposal Submittal:

1. Written technical description of the proposed system broken down into the following categories:

a. PV panels
b. DC combiner boxes
c. DC/AC inverters
d. Isolation transformers
e. Distribution boards
f. Electrical connections
g. Grounding system

2. Voluntary alternatives to the base proposal may be presented at the Subcontractor's option. All such alternates shall include a description of the item; benefits obtained by the Owner and associated add or deduct cost. Creativity and ingenuity are encouraged in this regard; however, the impact imposed on the building's architecture and structure systems must be considered. All alternatives must be approved by the Owner and Architect. Any alternatives must be accompanied by the base bid system proposal.

B. Design Studies: Submit a study, which evaluates and determines the best orientation and slope of the solar panel arrays. The study shall examine and evaluate the associated energy production (kWh) for various orientations and slope. The study shall include average bi-annual (summer and winter) energy production and energy cost savings for panels set at the optimum orientation and for 5 degrees above and 5 degrees below the optimum angle and orientation to illustrate that the best orientation has been found. The study shall make final recommendations for the best orientation that will net the highest utility cost savings while meeting the overall design intent. The study shall take into consideration the adjacent obstructions and typical local weather conditions such as typical occurrences of fog or high clouds. In the condition that all panel arrays are not all in the same orientation, the study shall address any impacts this may have on the overall system performance.

C. Contract Documents:

1. Prepare and submit complete design engineering plans, specifications, and calculations for the solar photovoltaic system and the entire mounting and support system. Engineering designs shall be in accordance with all applicable codes, laws, and regulations applying thereto.
2. Respond in writing to reviews of the engineering documents made by the Architect and Engineer.
3. Contract Drawings:
    a. Provide detailed design drawings of the solar photovoltaic system, structural support systems, and accessories with dimensioned locations of all components and external connections and attachments. This shall include plans, elevations, sections, and mounting details.
    b. Detailed point-to-point wiring diagrams (power, signal, rapid shutdowns, and controls) showing each device and interconnections.
    c. Floor plans and elevations showing equipment layouts, supports, mounting details, dimensions, and interconnecting conduit and wiring.
    d. Include details of equipment assemblies. Indicate all dimensions, weights, loads, required clearances, method of field assembly, components, and locations of each field connection.
    e. Indicate mounting methods and grounding of solar panels and accessories.
    f. Indicate all utility company metering and protective relay equipment required for the proposed system.
    g. Indicate compliance with all codes and local regulations.
    h. Indicate clear access and working paths on all roof levels.
    i. Submit final construction documents set.
4. Construction Specifications:
    a. CSI format.
    b. General Electrical Provisions
    c. Electrical Materials and Methods
5. Design Calculations:
    a. Electrical sizing calculations

b. Energy calculations
c. Seismic restraint calculations

D. Prepare and submit all utility company applications as it relates to obtaining approvals of the system to be installed.

E. Submit manufacturer's product data sheets for all equipment.

F. Submit all field quality control reports.

G. Operating and maintenance manuals.

H. Prepare and submit all utility company rebate calculations and application forms for eligible items on behalf of the Owner's application for rebate.

1.06 IDENTIFICATION

A. Provide an identification engraved nameplate for each photovoltaic inverter, module, string, disconnect switch, rapid shutdown controls, transformer, panel, conductors, and each feeder overcurrent protection device. Provide engraved nameplates secured with rivets or screws for all equipment.

B. Provide additional markings and identification of the equipment as required by NEC Article 690.

C. Include on all panel directories the incoming feeder conductor and raceway ratings and the source.

D. Current ratings of the overcurrent protection devices shall be displayed on the devices.

1.07 COORDINATION

A. Coordinate the layouts and installation of the PV system, supports, and all accessories with all other roof-mounted equipment prior to any work.

B. Coordinate and communicate the final approved PV panel mounting conditions, structural framing and supports, penetrations, orientation, and tilt angle with the Structural Engineer. Coordinate final support detailing with the Structural Engineer and Architect.

1.08 WARRANTY

A. The system shall be warranted as specified in the purchase agreement but shall be no less than five (5) years from the time of acceptance. The Solar Photovoltaic system manufacturer shall replace or repair any defective parts within the warranty period at no extra cost (labor and materials) to the Owner.

B. The photovoltaic panels and modules shall be covered by the photovoltaic manufacturer's warrantee for a minimum of 20 years and shall be passed through the supplier to the Owner.

C. The inverters shall be covered by the manufacturer's warrantee for a period of not less than five (5) years and shall be passed through the supplier to the Owner.

D. Manufacturer's Special Minimum Power Output Warranty: The manufacturer shall repair or replace any or all PV systems components that fail to exhibit the minimum power output (indicated in the vendor's study) within the five (5) year warranty period.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with all specification requirements: Solar Edge, BP Solar USA, Schott Solar, Sayno North America Corporation, Sharp Electronics Corp., SunPower Corporation, SMA America, or approved equal.

2.02 RATINGS

A. System AC output voltage shall be 208Y/120V, 3-Phase, 4-Wire, 60 Hz.

B. Continuous power at 45 degrees C: 20kW (estimated)

C. Total harmonic distortion shall be less than 5 percent at rated power.

D. Inverter peak energy efficiency > 94 percent.

E. Power Factor > 0.99 percent.

2.03 PHOTOVOLTAIC SYSTEM DESCRIPTION

A. Interactive PV System: Provide collectors connected in parallel to the electrical utility; and capable of providing power for the building and supplying power to the distribution network to produce the maximum output per the layout on the Contract Drawing.

2.04 CONSTRUCTION

A. All equipment shall be NEMA 4X rated when located outdoors. Indoor equipment shall be NEMA 1 rated.

B. All conduits and boxes shall be rigid galvanized steel type.

C. Inverter enclosures shall be wall-mounted construction type.

D. The inverters shall be complete with the following features:

1. Convection forced air cooling.
2. Communications Interfaces.
3. Utility interactive interface.

4. Islanding protection to meet IEEE 929 and UL 1741.
5. Protective functions and annunciation:

    a. AC over/under voltage
    b. AC over/under frequency
    c. Ground over current
    d. Over temperature
    e. AC and DC over current
    f. DC over voltage

6. User display – LCD type.
7. AC and DC disconnects rated for system voltages
8. Remote display monitor
9. PV ground fault protection system
10. PV combiner board.
11. Lightning arrester AC/DC protection
12. Surge Protection
13. Rapid Shutdown controls
14. Communications software.

E. Photovoltaic modules shall be equipped with corrosion resistant heavy-duty anodized extruded aluminum frames with tempered low iron anti-reflective coated glass and clear encapsulated insulation.

F. Array framing construction shall include galvanized steel framing.

G. Roof mounting structures shall include extruded aluminum construction with four (4) rails and all required tilt legs, and roof standoffs.

2.05 SAFETY FEATURES

A. The system shall incorporate a maintained position ON/OFF switch located on each inverter enclosure. Under normal conditions, the ON/OFF switch is in the ON position. Turning the switch to the OFF position will initiate a controlled shutdown and open the A/C contactor within the unit. The A/C contactor shall not close unless the switch is in the ON position. The inverter shall be prevented from being restarted until the ON/OFF switch is turned back to the ON position.

B. The entire installation shall comply with all rapid shutdowns per the NEC and NY State Fire Code. Separate arrays shall have separate rapid shutdown controls.

C. The system shall be equipped with ground fault detection circuitry. Upon detecting 10 amps of ground fault current, the system shall execute an orderly shutdown and annunciate a ground fault at the operator interface. The system shall remain in the faulted position until the ground fault is remedied and cleared at the operator interface. There shall be only a single point of PV conductor ground.

D. Anti-Island Protection: A digital phase-shift-loop (PSL) circuit shall be implemented in the inverter controller to prevent “Islanding” of the system. In the event of a utility outage, these adjustments destabilize the feedback between the inverter and the remaining load, resulting in an over/under frequency or voltage condition. The system shall perform an orderly shutdown. The fault condition will

remain until the utility voltage and frequency have returned to normal for 5 minutes.

E. System overcurrent protection shall utilize fuses.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Connect and mount the complete photovoltaic installation per manufacturer's instructions.

B. Coordinate with the point of connection to the distribution system.

C. Ship, store, and install products and materials in a manner that will protect them from physical damage, water damage, weather, and entry of debris. If items are damaged, take immediate steps to obtain replacement or repair.

D. Provide and install all required permanent labeling and safety decal stickers to meet the NY State Fire Code, including appropriate formatting and colors.

3.02 SYSTEM TESTING

A. Photovoltaic modules shall be tested in the factory for design performance.

B. Inverters shall be factory tested for performance and results shall be included in the O & M manual.

C. System field testing of installed photovoltaic arrays shall be performed on all system strings and recorded in the O & M manual.

D. System start-up procedure will be as outlined by the manufacturer's installation manual and the inverter manual. Perform testing until all items are successfully completed.

3.03 FIELD TESTING

A. The Contractor and a certified 3rd party testing agency (retained by this Contractor) shall perform all required field testing in accordance with NETA or NRTL Acceptance Testing guidelines. At a minimum, the following visual inspections and testing shall be performed:

1. Confirm all mounting connections are secured.
2. All equipment is clean – internally and externally.
3. All overcurrent protective devices are properly mounted and installed.
4. Any GFCI devices are tested and working properly.
5. All feeders and branch circuits are labeled.
6. All feeders and branch circuits are properly terminated.
7. All code and maintenance clearances have been achieved.
8. All loads are balanced.

9. Equipment is properly grounded.
10. All panelboard directories are provided and are accurate.

B. Perform testing until all items are successfully completed.

C. Submit all testing data and results in a final report.

D. Perform infrared scans and testing of all equipment and prepare a report for submission to the Engineer and Owner.

3.04 FINAL CLEANING

A. All panelboard backboxes shall be clean, dry, and free of all construction debris and fireproofing overspray prior to installation of the panelboard interior.

B. Vacuum backboxes clean of debris after the installation and prior to energizing.

C. Repair and touch up any scratched and damaged surfaces with new touch up paint.

END OF SECTION

SECTION 26 32 13
ENGINE GENERATOR SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide an engine generator system, in an acoustically treated outdoor enclosure, and all accessories in accordance with the Contract Documents.

B. It shall be the responsibility of the Contractor to prepare and submit all of the Local Air Quality Management District permits. The Genset supplier shall provide the required engine manufacturer's data sheet and assist with other technical data requirements required to complete the permit submission application until approved.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. The engine shall be diesel fueled, four (4) cycle, water-cooled, while operating with nominal speed not exceeding 1800 RPM. The engine will utilize in-cylinder combustion technology, as required, to meet applicable EPA non-road mobile regulations and/or the EPA NSPS rule for stationary reciprocating compression ignition engines. The in-cylinder engine technology must not permit unfiltered exhaust gas to be introduced into the combustion cylinder. Emissions requirements / certifications of this package: EPA TIER 2.

B. The equipment supplier shall have local representation and shall have been actively engaged in the installation and service of generator sets for a period of not less than 10 years and have service facilities within a 50-mile radius of the project site.

C. Equipment supplier shall have full parts backup and 24-hour-per-day service availability for this equipment.

D. Equipment supplier shall be a manufacturer's local authorized dealer. Generator provided by a 3rd party dealer will not be acceptable.

E. The generator set supplier shall review the fuel system design and certify that the installation meets the engine manufacturer's requirements and will allow for proper operation of the generator set at full rated load.

F. The generator set supplier shall review the cooling system design and certify that the installation meets the engine manufacturer's requirements and will allow for proper operation of the generator set at full rated load.

1.04 STANDARDS

A. Comply with all of the latest applicable Code provisions, including to, but not limited to the following:

1. Alternator:

a. ASTM D396
b. NEMA MG-1-198, Part 32

2. Battery Charger:

a. UL 1236

3. Engine Generator:

a. Local Air Quality Management District
b. UL 2200

4. General System Design, Installation, and Testing:

a. NFPA 70, 99, 101, and 110 Level 1
b. NFPA 37
c. CSA C22.2, No. 14; CSA 282 ; and CSA 100
d. EN 61000-6 and EN 55011
e. FCC Part 15 Subpart B
f. ISO 8528
g. IEC 61000
h. UL 508, UL 2200, and UL 142

5. Acceptance Testing:

a. NETA
b. NRTL
c. Generator Manufacturer Requirements

1.05 LOCATION CRITERIA

1. Altitude: 1000 feet above sea level.
2. Wind Loading: IBC Force: 150 MPH
3. Maximum ambient temperature: 110 deg. F.
4. Minimum ambient temperature: -30 deg. F.
5. Seismic: IBC Ss (Short Period Special Response Acceleration)

1.06 SUBMITTALS

A. Detailed drawings of the engine generator set and the acoustically treated enclosure with dimensioned locations of components and external connections and attachments. Indicate the position of the radiator and direction of air movement. Drawings shall include any shipping splits and respective weights.

B. Detailed drawings of the generator enclosure indicating the dimensioned layout of the generator and all other components within the enclosure such as sound attenuation, load bank, jacket heaters, main fuel base tank, pull boxes, panelboard,

accessories, etc. The drawings shall indicate all required Code and access clearances. Drawings shall be at ½" = 1'-0" scale minimum.

C. Concrete housekeeping pads shall be sized (per the actual equipment in the submittal) and shown on the submittal. This submittal shall be signed and sealed by the vendor's Structural Professional Engineer in the State of New York.

D. Engine manufacturer's specifications and cut sheets, performance data, certified power outlet curves, wiring diagrams, weights, and certified fuel consumption curves.

E. Provide a statement or show calculations that confirms that the brake horsepower of the engine with all attached accessories as described within is not less than that which is required by the full load rating of the generator, taking into consideration efficiency losses, plus a reserve factor of at least five percent (5%) under environmental conditions as set herein.

F. Exhaust system back pressure calculations certifying that the engine exhaust system with proposed silencer and piping as indicated on the electrical and mechanical Contract Drawings for this installation is within the manufacturer's criteria. Include all heat rejection, exhaust gas flows, combustion air, ventilation air, acoustic data, fuel consumption, etc. Provide all emissions data indicating compliance with all applicable regulations.

G. Starting battery sizing calculations showing compliance with the specifications at ambient conditions.

H. Certified vibration isolation details and product data showing the number and location of each support and the exact number, size, and type of each anchor. Submit for the engine generator set, exhaust silencer, main fuel base tank, and battery rack. This shall include fabrication details and structural attachment details which shall be signed and sealed by a Professional Engineer in the State of New York.

I. Manufacturer's product data sheets, specifications, and wiring diagrams for each engine generator system component.

J. Detailed point-to-point power and control wiring diagrams indicating all internal and field required connections/terminations.

K. The manufacturer's statement that the overall system design and specification has been reviewed and is satisfactory for the entire system performance or a list of exceptions.

L. After the engine generator system is accepted, this Contractor and Vendor shall prepare and submit a completed permit application for the Westchester County Air Quality Management District and the Fuel Storage Commission, ready for submission by the Owner. Continue with these applications until approvals are received.

1. Prepare and provide all necessary drawings and documents required to obtain all approvals for the County and State to install a fuel oil storage tank. Provide as-built drawings signed and sealed by the vendor's Professional Engineer in the State of New York, as well as tightness testing

results.

2. Prepare a site plan indicating the building, property and lot lines, locations of storm drainage system, fuel oil tanks, and any other tanks on the site. The site plan must be signed and sealed by the vendor's Professional Engineer in the State of New York.

M. Provide all sound data for mechanical and engine exhaust, along with silencer data to comply with all applicable codes and regulations.

N. The name and location of the vendor's factory authorized service agency to approve and perform the startup installation.

O. The name and location of the vendor's factory authorized service agency to perform all warranty and service work.

P. The name and location of the vendor's certified testing agency to perform all field testing.

Q. Certified prototype, factory, and field test reports. Additional field reports shall consist of acoustic performance, exhaust emissions, etc.

R. For the outdoor enclosure, submit plans and details showing the exterior stairs and catwalk platforms, plus the enclosure color samples for Architectural approval. Indicate all required access clearances for the generator and the stairs/platforms.

S. Warranty data.

T. Prepare and file all required documents to obtain all permits necessary for the generator installation.

1.07 SYSTEM AND EQUIPMENT TESTING

A. Factory Tests:

1. Factory tests shall be conducted by the manufacturer in accordance with all applicable standards.
2. Factory testing shall be performed at the generator manufacturer's facility with the generator installed in the actual custom enclosure being provided. The custom enclosure, described herein and on the Contract Drawings, shall be shipped to the generator manufacturer's facility in advance of all testing and assembled with the generator for all required testing.
3. At a minimum, perform four (4) hours of both 100% resistive and reactive load tests at full rated load and power factor. The testing shall demonstrate compliance with the design criteria indicated on the Contract Documents.
4. The following operations and functions shall be tested.

    a. Monitor voltage stability.
    b. Monitor frequency stability.
    c. Load shedding and adding.
    d. All alarm and shutdown circuits.

5. Oscillograph chart recordings of voltage and frequency of generator set transient performance for 100% step load addition and subtraction indicating compliance with specifications.

6. Equipment shall be Prototype Test Supported certified.
7. Include all expenses and costs for up to three (3) Owner/Engineer representatives to witness all factory testing.
8. Submit all test results.

B. Field Tests:

1. Field tests shall be conducted by factory certified technicians.
2. Field inspection and testing shall occur after the generator and distribution installation is complete and the emergency electrical rooms are secure.
3. Test all automatic transfer switches, engine start circuits, time delay circuits, status points, and system control points.
4. Perform four (4) hours of 100% full resistive load test using temporary load banks. Unsuccessful tests shall be fully documented, submitted, and re-tested until successful.
5. The generator shall demonstrate it can start and accept all life safety loads within ten (10) seconds.
6. Conduct field tests in accordance with NFPA 110 and per the manufacturer's requirements.
7. Additionally, perform a pull-the-plug test to demonstrate proper operation of the entire emergency power system. Tests shall be performed until all systems function properly.
8. This Contractor shall obtain, rig, install, and disassemble all temporary load banks, temporary cables, etc. until all tests are successfully completed.
9. This Contractor shall provide a full tank of diesel fuel upon completion of all testing.
10. Complete noise measurements at the generator.
11. Confirm operation of the portable generator terminal box.

1.08 OPERATING INSTRUCTIONS

A. The engine generator set supplier shall provide a minimum of four (4) hours of operating instructions on the maintenance and operation of the emergency power system. Classes shall be open to at least six (6) representatives of the Owner's maintenance staff. Instructions shall be administered by a full-time employee of the supplier.

B. This Contractor and vendor shall video tape the training and shall submit the video to the Owner. Include written copies of all documents presented during the training sessions.

PART 2 – PRODUCTS

2.01 ACCEPTABLE COMPONENT MANUFACTURERS

A. The generator shall be a Cummins generator and is the basis of design. Contact Ed Cheung at ed.cheung@cummins.com at 718-892-2400.

B. Caterpillar is also an acceptable manufacturer pending full compliance with these specifications.

C. This entire engine generating system, shall be completely built, factory tested, and shipped by an assembler/manufacturer who has been regularly engaged in the

production of such equipment for the past ten (10) years and who has parts and service facilities locally or provides service and parts on a national basis subject to approval by the Owner and Engineer. The performance of the generator plant shall be certified by an independent test laboratory acceptable to the Engineer as to the plant's full power rating, voltage, and frequency regulation. The engine/alternator shop assembled unit shall be assembled, calibrated, and tested by Cummins Inc. Third party assemblers are not acceptable.

D. If it complies with these Specifications, specific engine generator equipment components manufactured by one (1) of the following manufacturers will be acceptable:

1. Diesel Engine: Cummins.
2. Radiator: IEA, Modine, Young, or approved equal.
3. Exhaust Silencers: Cowl, Harco, Maxim, GT Exhaust, or Nelson.
4. Fuel Tank: Simplex, Tramont, or Pryco.
5. Vibration Isolators: Kinetic Noise Control, Amber Booth Company, Ace Mountings, Mason Industries Inc., or Vibration Eliminator.
6. Batteries: C & D, Exide, Interstate, or Nife.
7. Battery Charger: LaMarche, Sens, Charles, or approved equal.
8. Generator: Cummins.
9. Governor: Basler, Woodward, or approved equal.
10. Circuit Breakers: Eaton, General Electric/ABB, Siemens, or Square D - Group Schneider.
11. Load Bank: Avtron, Loadtec, or Simplex.
12. Acoustically Treated Enclosure (Including stairs and catwalks): Robinson Enclosure Co., International Supply Co., or approved equal.

2.02 ENGINE

A. The engine shall operate on Number 2 diesel fuel, 1800 RPM, compression ignition type, four (4) stroke-cycle, water cooled, solid injection, either vertical in-line or vee configuration.

B. The brake horsepower of the engine with all attached accessories as described within shall be not less than that which is required by the full load rating of the generator, taking into consideration efficiency losses, plus a reserve factor of at least eight percent (8%) under environmental conditions as set herein.

C. Fuel consumption of the engine generator shall be substantiated by means of manufacturer's certified curves.

D. The engine shall be equipped with an electronic governor to maintain engine speed within specified limits. The governor shall be adjustable from isochronous to five percent (5%) droop. Frequency shall be factory set at rated frequency.

E. Engine safety devices, including high water temperature switch, overspeed sensing switch, low oil pressure switch, low water temperature switch, and other required devices to comply with NFPA 110 Level 1, shall be mounted on the engine and connected to the control and status panel instruments and alarms as specified herein.

F. All fuel filters and components requiring replacement or service shall be located to prevent non-accessibility issues.

G. The engine shall be equipped with an integral radiator mounted fuel oil cooler, quantities as required by the manufacturer, to reduce the return fuel temperature. They shall be installed on the generator radiator within the cooling air stream prior to entering the radiator core.

H. Engine wiring shall be industrial quality, heat resistant, insulated, copper conductors. All wiring shall be protected and shall be isolated from high temperature engine parts. All wiring for alternating current power circuits shall be installed in rigid or flexible metallic conduit, depending on the connection type.

I. The engine shall be EPA Tier 2 Certified and in accordance with the State Emissions Regulations at the time of installation.

2.03 ELECTRIC STARTING SYSTEM

A. Provide an engine mounted electric starting motor with solenoid and over-running clutch drive. The starting motor shall be of the required voltage and ampere rating.

B. Provide a system of sealed lead acid batteries sized such that the engine generator set may complete four (4) complete cranking cycles as specified in NFPA 110 at specified room temperature. Provide a metal seismic rack and cables of sufficient ampacity.

C. Provide a 120V AC battery charger (wall mounted) to recharge the batteries to full capacity within eight (8) hours. Battery chargers shall have both a high rate and float rate charging system. The battery charger shall be current limiting and shall not require cranking cutout contacts for charger protection when cranking. Accessories shall include DC ammeter, fused input, DC voltmeter, high/low DC output voltage relay, and input voltage failure relay. Battery charger output shall be rated ten (10) amperes minimum at required voltage. Charger current level shall automatically drop to a sufficiently low level to eliminate overcharging of the batteries. Circuit to the emergency panelboard serving the generator equipment.

D. The entire electric starting system shall be rated for 24 VDC operation as recommended by the manufacturer.

2.04 ENGINE HEATING SYSTEM

A. Provide jacket water heaters sized to ensure that the engine will start within the specified time period and ambient conditions per the manufacturer's recommendations. Provide thermostats, engine running heater disconnect, and all required connection wiring and boxes.

B. Provide branch circuit wiring in conduit from the emergency panelboard to the jacket water heaters. Circuit breakers shall have the appropriate ampere and pole configuration to suit the selected jacket water heaters.

C. The jacket heaters shall be equipped with isolation valves to allow the equipment to be replaced without draining the entire unit coolant system. Locate valves in an accessible location and label accordingly.

2.05 ENGINE COOLING SYSTEM

A. The engine shall be liquid cooled by means of an engine mounted vertical core

radiator. The radiator shall be sized to cool the engine on a continuous basis at the altitude specified with an ambient temperature of 122 deg. F. The radiator and fan shall be designed to properly cool the generator set with external static restraint of up to 1-inch H_20. Provide suitable expansion space by means of either a surge tank or radiator top tank. Provide an engine driven propeller type fan. Engine coolant shall be a mixture of ethylene glycol-based antifreeze and water as required to provide freeze protection at minimum ambient temperature. A cooling solution shall be provided by this Contractor. Provide duct adapter flanges for flex connections to the exhaust outlets.

B. The engine shall be equipped with a centrifugal type of water circulating pump and thermostat valve to maintain the engine at the recommended temperature level. Provide necessary water filtration to treat the coolant and prevent corrosive and other deterioration within the cooling system.

2.06 AIR INTAKE AND EXHAUST SYSTEM

A. Provide an air cleaner/silencer as recommended by the engine manufacturer. All air cleaners shall be heavy-duty, dry type with replaceable elements and capable of being monitored.

B. Engine exhaust outlets shall be coupled to the exhaust silencers by means of a sized section of stainless corrugated flex tubing. Flex connectors shall be flanged at both ends for mating to the engine and exhaust system.

C. Provide exhaust silencers rated as Super Critical Grade. Exhaust silencers shall be sized to limit exhaust back pressure to acceptable values. At a minimum, sound levels shall be rated no more than 80 dBA average when measured five (5) feet from the exhaust outlet and 60 dBA at five (5) feet. Exhaust silencers shall be suitable for horizontal mounting, equipped with flanged bottom inlet and flanged end outlet. The exhaust silencers shall be double wall construction and shall have a high temperature anti-corrosion coating applied uniformly on the outside surface. Exhaust silencers that are mounted indoors shall be insulated to limit surface temperature to not more than 100 deg. F.

D. Utilize pancake style silencers to minimize height needed at the generator.

E. Provide stainless steel bellow flexible connections between the muffler silencer inlet and the engine outlet. The flex connections shall be installed to allow for proper thermal expansion and vibration during the engine running.

F. A crankcase fumes reclamation system shall be provided to collect engine crankcase emissions, filter out airborne lube oil, and reintroduce the emissions back into the engine combustion air system.

2.07 FUEL SYSTEM

A. Fuel lines between injection pumps and valves shall be heavy seamless tubing. Provide fusible link type safety shutoff valves to fail close.

B. Provide fuel filters with replaceable elements. Fuel filters shall be located in accessible housing ahead of the injection pumps.

C. Provide an engine driven fuel transfer pump as recommended by the manufacturer.

D. Base-Mounted Fuel Oil Tank: Factory installed and piped, UL listed and labeled dual (110% rupture basin) sub-base fuel oil day tank with 2000-gallon capacity. Features include the following:

1. Tank level indicator and low fuel alarm switch for remote indication. Provide low, approach to high, and high fuel level sensors in the skid tank and connect to the generator main control panel and remote panels.
2. Capacity: Fuel for continuous operation at 100 percent rated power output and immediate start up.
3. Vandal-resistant fill cap.
4. Containment: Integral rupture basin with a capacity of 110 percent of nominal capacity of the fuel tank.
5. Leak Detector: Locate in rupture basin and connect to the remote alarm panel.
6. Provide 5-gallon catch basin at fuel fill port.
7. Fill connections shall utilize two (2) flexible metallic hoses.

E. The fuel oil tank shall comply with UL 142.

F. Vent pipes shall be extended to the exterior of the weatherproof enclosure either at the factory or by the manufacturer in the field.

2.08 ALTERNATOR

A. The engine generator set shall be rated 120/208V, wye connected, three phase, four wire, 60 Hertz, 0.8 power factor, kilowatt capacity as indicated on the Contract Drawings.

B. The alternator shall be four (4) pole, synchronous brushless type. The alternator shall be single bearing type coupled directly to the engine flywheel by means of a flexible disc coupling. The alternator shall be rated for a 2/3 pitch.

C. The voltage regulator shall be digital, microprocessor based with fully programmable operating and protection characteristics. The regulator shall maintain generator output voltage within +/- 0.25% for any constant load between no load and full load. The regulator shall be capable of sensing true RMS in three phases of alternator output voltage or operating in single phase sensing mode. The voltage regulator shall include a VAR/PF control feature as standard. The regulator shall provide an adjustable dual slope regulation characteristic in order to optimize voltage and frequency response for site conditions. The voltage regulator shall include standard the capability to provide generator paralleling with reactive droop compensation and reactive differential compensation.

D. The alternator insulation system shall be NEMA Class H and shall be a combination of epoxy coating and varnish. The alternator shall be sized and properly derated according to NEMA MG1-22 to yield a maximum temperature rise of 130 degrees centigrade by resistance above an ambient temperature of 40 degrees centigrade at rated altitude and load, in accordance with UL 220.

E. Excitation shall be provided by a direct connected brushless permanent magnetic rotating exciter. The alternator shall be of a three-phase design and connected to a full wave three phase rotating bridge. Diodes used shall be of the silicon type mounted on proper heat sinks with surge protector.

F. Exciter field power shall be provided by a separate permanent magnet generator directly connected to the brushless exciter. The PMG shall provide sufficient power to the excitation system to produce 300% current from the main operator's armature during a three-phase fault with sufficient duration for protective devices to operate.

G. The sub-transient reactions shall be 13% or less.

H. The alternator shall be protected from all types of short circuit conditions, based on the thermal damage capability of the machine under faulty conditions. The alternator shall include protection or other means to prevent overvoltage conditions on single-phase faults. This protection shall be in addition to circuit breakers that are shown on the Contract Drawings and provided for feeder protection.

2.09 UNIT MOUNTED MAIN CIRCUIT BREAKERS

A. The unit mounted main circuit breakers shall have a solid-state trip unit with true RMS current sensing. Circuit breaker shall be 100% continuous rated. The circuit breaker shall be provided with a DPDT auxiliary contact to provide a supervisory indication should the breaker be in the OFF or tripped position. The breaker shall be UL Listed of IEC construction and connected to engine/generator safety shutdowns. The breaker shall be housed in an extension NEMA 1 terminal box which is isolated from vibrations induced by the generator set. Mechanical type lugs, sized for the circuit breaker feeders shown on the Contract Documents, shall be supplied on the load side of the breaker. When required by Code or the Authority Having Jurisdiction, the generator set shall be provided with residual ground fault sensing equipment with an auxiliary contact wired to alarm light on remote control and status panels. The equipment shall be configurable for either tripping or alarm only and defaulted to provide alarm only on a ground fault condition.

B. Provide a separate unit mounted circuit breaker to serve the radiator mounted load bank. Provide wiring and conduit per the manufacturer's recommendations.

C. Provide a separate unit mounted circuit breaker to serve the fire pump bank. Provide wiring and conduit per the manufacturer's recommendations.

D. Circuit breakers shall be fully accessible and equipped with load side, a fully rated bus. A neutral disconnect link shall be provided for the neutral connection. The neutral and ground connections shall be isolated from the enclosure frame. Clearly label all breakers.

2.10 CONTROL AND STATUS PANELS

A. General:

1. Provide an audible alarm signal, silence override switch, and lamp test button on each control and status panel. Provide power for the alarm system from the generator battery system.
2. Upon alarm activation, sound the audible alarm signal and indicate, by means of individual lights at annunciator panels, which particular malfunction is initiating the alarm.
3. Provide permanent labels for all panels.

B. Control and Status Functions:

1. Provide a main control and status panel for the engine generator set. Panel shall be hinged door, mounted on the engine generator set with vibration isolators in an environmentally sealed NEMA 1 enclosure.
2. The generator set shall be provided with 3-phase line-to-line and line-to-neutral digital displays for AC voltage and AC current. The control shall display all phases of data simultaneously, to allow viewing of load and voltage balance. The display shall include frequency, RPM, and kW meters. All metering shall be .5% accuracy or better.
3. Engine data digital display shall include engine coolant temperature, oil pressure, oil temperature, and starting/control battery DC voltage.
4. Control and status points as specified under remote control and status panels.

C. Remote Control and Status Panels:

1. In addition to the control and status panel located at the generator, provide three (3) remote control and status panels per engine generator set, one (1) at each of the following locations:

   a. Fire Alarm Control Panel
   b. Main emergency electrical and ATS rooms

2. Provide control and status points and alarm indicators as required by NFPA 110 for Level 1 systems and as specified herein. Provide separate ATS status/transfer points for each automatic transfer switch.
3. At a minimum, provide control and status points as follows:

Condition	Generator & Remote Control at Emergency Electrical & ATS Rooms	Fire Alarm Control Panel Remote Control & Status Panel	Engine Shut Down
High Coolant Temperature	Alarm	Alarm	Yes
Approach to High Coolant Temperature	Alarm	Alarm	No
Low Coolant Temperature	Alarm	Alarm	No
Low Coolant Level	Alarm	Alarm	No
Overspeed	Alarm	Alarm	Yes
Approach to Low Oil Pressure	Alarm	Alarm	No
Low Oil Pressure	Alarm	Alarm	Yes
Over Crank	Alarm	Alarm	Yes
High Battery Voltage	Alarm	No	No

Condition	Generator & Remote Control at Emergency Electrical & ATS Rooms	Fire Alarm Control Panel Remote Control & Status Panel	Engine Shut Down
Low Battery Voltage	Alarm	No	No
Low Cranking Voltage	Alarm	Alarm	No
Battery Charger AC Failure	Alarm	No	No
Low Fuel Main Tank	Alarm	Alarm	No
Main Circuit Breaker Open or Tripped	Alarm	Alarm	No
Main Circuit Breaker Ground Fault	Alarm	Alarm	No
Load Bank Cooling Failure	Alarm	Alarm	No
Generator Running Indication	NA	Yes	NA
Not In Auto	Yes	Yes	NA
Generator Start/Stop Switch	Yes	Yes	NA
Generator Online	Yes	Yes	No
Generator Derangement	Yes	Yes	No
Remote Emergency Stop (Located outside of enclosure)	No	No	Yes
Lamp Test	Yes	NA	NA
Audible Alarm Silencing Switch	NA	Yes	NA
Spares (2)	-	-	-

D. Provide one (1) set of normally closed contacts for BMS interface, status, and alarm for each of the points listed above.

1. Integration with the Building Management System (BMS) shall be provided via serial interfaces with either BACnet or Modbus.
2. Provide serial port to communicate with the power monitoring system.
3. Provide data link connections to all remote data terminals.

E. Provide a remote manual emergency stop station (with plexiglass weatherproof flip

cover) located outside each exit from the outdoor generator enclosure. Coordinate actual locations in the field prior to any work. Label all emergency stop stations. Provide wiring and conduit between all devices per the manufacturer's wiring diagrams.

F. Load Shedding Control:

1. Provide load sensing (voltage sensing) control panel at the generator.
2. When the generator reaches 95% of capacity, or voltage dips below 90% due to loading, the control panel shall send a signal to automatically retransfer the 'optional standby' automatic transfer switches back to utility power.

2.11 ENGINE GENERATOR SET PERFORMANCE

A. The engine generator set shall meet or exceed the following performance criteria:

1. Voltage regulation: +/-1 percent from 0 to 100% load.
2. Steady state voltage stability: +/-0.5% rated voltage.
3. Balanced Telephone Interference Factor (TIF) shall not exceed 50.
4. Frequency regulation from no load to full load: adjustable from isochronous to 5%.
5. Steady state frequency stability shall be +/-.5%.
6. Generator set shall be capable of start-up and accepting rated load within ten (10) seconds.
7. Maximum frequency change on application change on application or removal of 100% rated load resistive and reactive load shall not exceed 15%.
8. Maximum recovery time to return to frequency stability bandwidth shall not exceed 8.0 seconds.
9. Maximum voltage dip with step application of load up to 100% rated capacity at 0.8 power factor shall not exceed 35 percent.
10. Voltage recovery time with step application of load up to 100% rated capacity at 0.8 power factor shall not exceed 1% voltage within 8.0 seconds.

2.12 WEATHERPROOF ACOUSTICALLY TREATED HOUSING

A. The engine generator set, and related equipment shall be housed in a custom factory fabricated; UL listed outdoor weatherproof acoustically treated enclosure. The design and placement of the unit shall be such that the generator will function properly without overheating in the ambient conditions specified. The generator set shall be mounted to the fuel base tank utilizing internal spring-loaded isolators. In addition, provide external spring isolators with a minimum static deflection of 3".

B. Enclosure shall be a custom-made Sound Attenuated Enclosure to provide a maximum noise level of 80 dBA at 5' from the enclosure (all around – all walls, top, and floor) and 60 dBA at 50' from the enclosure.

B. Provide a walk-in type of generator enclosure equipped with interior and exterior LED lights, vertical or horizontal air discharge, interior mounted silencer/muffler, unit mounted battery charger, heaters, fans, etc. The enclosure shall be of sufficient size and volume to accommodate acoustic attenuation and vibration isolation equipment as specified.

C. The enclosure manufacturer shall provide OSHA compliant galvanized steel bar grating type access catwalk and stairs at each exit of the enclosure. All surfaces shall be slip resistant. Coordinate exact quantity of stairs to suit field conditions. The exact finish of the stairs and catwalk shall be as selected by the Architect.

D. Roof shall be pitched for drainage and overlapping on all sides. Exhaust pipe opening shall be fitted with an approved watertight sealing material. Provide a drip shield around the exhaust pipe opening.

E. Doors shall be gasketed and mounted on hinges. Hinges shall have stainless steel pins and bushings. Provide a key lock for each door. Turn over keys to the Owner.

F. Fixed storm proof louvers shall be provided to allow the engine generator to operate at the project location at rated conditions with all enclosure doors closed. Louvers shall be configured to mitigate any rain or snow infiltration when the generator is either idle or fully operational. All intake louvers shall be motorized, parallel blade, spring open fail safe type. Discharge louvers shall be gravity actuated.

G. Provide an internal LED gasketed lighting system with ON/OFF switches and standby emergency battery packs (90-minute battery). The normal and emergency lighting illumination levels shall meet all applicable codes. Circuit illumination sources to an emergency power system panelboard in the enclosure

H. Enclosure shall be of sufficient size to allow for code required clearances, access, and maintenance.

I. Exhaust silencers shall be mounted internally of the enclosure. Silencer shall be super critical grade type. Utilize pancake style type to minimize space impacts within the enclosure. Provide stainless steel piping and fittings. All exhaust piping and mufflers shall be fully insulated within the enclosure. Provide a rain cap at the end port.

J. The radiator exhaust outlet shall be ducted through the end of the enclosure in an approved manner.

K. All exterior surfaces shall be factory painted with an ANSI 61 grey vinyl lacquer; color as selected by the Architect.

L. The enclosure shall have sufficient guards, at all openings, to prevent entrance by small animals.

M. All batteries shall fit inside the enclosure and alongside the engine (batteries shall not be installed under the generator or outdoors).

N. The enclosure shall have coolant and oil drains outside the unit to facilitate maintenance. Provide a valve located near the fluid source for all fluids. The enclosure shall be equipped with a protective barrier around all floor penetrations and the exterior enclosure wall to mitigate leaks from the enclosure. The enclosure floor shall be designed with spill containment to hold any coolant fluids or lube oils which may leak within the enclosure.

O. Provide exterior emergency break glass stations to shut down the generator at each enclosure exit door and shall be labeled accordingly. Provide weatherproof covers.

P. Fuel filter shall be mounted inside the base perimeter and located so that spilled fuel cannot fall on hot parts of the engine or generator. Provide a cleanable primary fuel filter/water separator to collect water and sediment between tank and engine fuel transfer pump.

Q. Provide a lockable fuel fill port cap and hand over keys to the Owner.

R. Crankcase fumes disposal shall terminate in front of the radiator to prevent oil from collecting on the radiator core and reducing cooling capacity.

S. Provide a minimum of two (2) 5kW space heaters with built-in thermostatic controls to maintain the interior enclosure temperature above freezing. The heaters shall be circuited to the panelboard located within the enclosure.

T. Provide deflection type spring isolators per section 3.04.

U. Bond the generator enclosure to the building lightning protection system.

V. As a minimum, provide the following distribution in the enclosure to support all equipment and loads within the enclosure:

1. 100A, 208Y/120V, 30 pole panelboard with a 100A MCB. Populate panelboard with circuit breakers to support all branch loads in the enclosure.
2. The above equipment shall be located within the enclosure and all Code mandated clearances shall be maintained.
3. Sizes shall be adjusted by the manufacturer based on the actual equipment being provided within the enclosure.
4. Coordinate incoming feeder to the panel from the building prior to any work.

2.13 VIBRATION ISOLATION AND SEISMIC RESTRAINTS

A. The installation shall be in accordance with the final approved vibration isolation and seismic restraint submittal. The submittal shall be reviewed and approved by the Acoustical Consultant.

B. Flexible fuel oil and oil lines shall be stainless steel reinforced synthetic rubber hoses. Flexible coolant lines shall be fabric reinforced rubber rated 300 degrees F minimum.

C. All electrical and control raceway connections from the generator shall be in liquid tight flexible metal conduits.

2.14 COMPANY SWITCH (PORTABLE GENERATOR POWER INPUT PANEL)

A. Basis of Design: PowerGATE Input Panel manufactured by LEX.

B. Provide a floor mounted enclosure, on a concrete housekeeping pad, with electrical characteristics as indicated on the Contract Drawings. The enclosure shall include four (4) with anchoring holes for pad mounting. Enclosure dimensions shall not exceed 35” wide x 56” high x 30” deep.

C. The upper termination chamber shall have a key lock handle door covering all exposed electrical components. The lower chamber shall have a key lock handle

main door covering all exposed cam-type components.

D. The input panel shall have the following ratings to match those indicated on the Contract Drawings:

1.	Voltage:	208Y/120V
2.	Amperes:	1600A
3.	Poles:	3 phase plus neutral
4.	AIC Rating:	65K AIC, min.
5.	All Bussing/Cables:	Copper
6.	Neutral:	100% rated
7.	Ground:	Yes
8.	Permanent Power:	Bottom feed from generator

E. The enclosure shall be NEMA Type 4X fabricated from 316 stainless steel.

F. The equipment shall be UL 1008 listed as a transfer switch accessory and fully tested by NRTL meeting such requirements.

G. Connections shall be arranged so that cables drape downward when connected.

H. Panel enclosure shall have two (2) trap key provisions.

I. The enclosed space shall have adequate space for all required conductor bending.

J. Provide oversized copper lugs to accept the feeders indicated on the riser diagrams and schedules. Coordinate number and size of lugs prior to purchase. All field wiring shall be torqued per the equipment manufacturer’s instructions.

K. All electrical devices shall be Cam-Type single pole type compatible with Marinco or Leviton 16 Series CAM Locks and available color coded as per industry standards.

L. Provide identification labels and warning labels on each enclosure.

M. Perform field testing on the enclosure to verify proper connectivity and operation per the manufacturer’s recommendations.

N. Upon delivery and prior to acceptance, perform a visual inspection to ensure all key locks and doors are functioning and that the enclosure integrity is fully intact.

2.15 LOAD BANK

A. Provide an engine radiator mounted airflow cooled permanent resistive load bank. The load bank shall be for local manual operation.

B. The load bank shall be installed within the air discharge of the engine unit mounted radiator and cooled by the radiator airflow. The load bank shall be solidly attached to the radiator and provided with a flexible coupling to attach to the discharge plenum.

C. Load bank shall be rated 50% of the full generator kW load rating. A separate load bank feeder breaker and feeder shall be provided in the generator terminal compartment.

D. The load bank shall be completely self-contained, including resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, control terminals, system protection devices, and enclosure.

E. The enclosure shall be NEMA Type 3R, galvanized steel construction. Control components shall be subpanel mounted and isolated from load elements and cooling airflow. Airflow through load elements shall be horizontal. Provide mounting adapters suitable for the installation method.

F. Load elements shall be totally enclosed, sealed, and weatherproof with an electrically grounded outer sheath such that the element cannot be electrically short-circuited by external foreign objects and personnel are protected against accidental electrical shock. Elements shall be individually replaceable.

G. Provide branch circuit fuses for each 50kW load branch circuit. Fuses shall be 200,000 RMS symmetrical amperes, current limiting type.

H. The load step control shall utilize one (1) magnetic contactor for each fused branch circuit. The load bank power wiring shall be 150 deg. C insulated.

I. Main terminals shall be copper sized at 1000A per square inch.

J. Control power shall be derived internally from the main load bus. Control and protective circuits shall operate at 120V using a control power transformer.

K. The load bank shall include a protection system to protect against overheating. The system shall disconnect the load elements from the power source and activate an alarm upon sensing a loss of cooling airflow or an exhaust air temperature greater than 300°F.

L. Site testing of the load bank shall be provided. Should utility power fail during a test, the load bank shall automatically be disconnected from the generator to allow the generator to accept all the required building emergency loads.

M. The load bank shall have an Automatic Load feature which allows you to add load should the connected load dips below 30%; and shall automatically disconnect when the connected load increases to 50%.

N. Control Panel shall be equipped with the following:

1. NEMA 1 enclosure.
2. Control power on-off pushbuttons.
3. Normal Operation LED indicator lamp.
4. Master load control switch.
5. Load step control switches.
6. Cooling Failure alarm LED indicator lamp with alarm contacts.
7. Load bank disconnect - to disconnect load bank on engine start signal.
8. Load bank disconnect - bypass to allow the load bank to supplement the actual building load.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide all necessary dedicated wiring and conduit to each remote alarm status panel and to each automatic transfer switch. Daisy chaining of automatic transfer switches or alarm status panels is not acceptable.

B. Position the generator to allow adequate ventilation over the engine block and through the radiator and to prevent short circuiting of radiator discharge air back to engine and radiator intake.

C. Provide 120V branch circuits, circuit breakers, and connections to the battery charger and local fuel day tank pump. Circuit to the emergency power supply within the enclosure panelboard.

D. Provide 208V branch circuits, circuit breakers, and connections to the jacket water heater, unit heaters, and fans. Circuit to the emergency power supply within the enclosure panelboard.

E. Install the generator enclosure such that a minimum of 48-inches clearance is provided around all sides of the generator enclosure, stairs, and catwalks.

F. Where circuit breakers or control panels are installed on the generator, maintain a minimum of 48” clearance in front of the circuit breakers or control panels within the room/enclosure.

G. Provide empty conduits, with labeled pull wires, for the elevator supply wiring. Coordinate exact quantity and sizes of conduits with the elevator vendor prior to any work. At a minimum, provide a 2” conduit from the elevator shaft to the Fire Alarm Control Panel.

H. Provide remote labeled emergency shut down buttons, with weatherproof plexiglass covers, at the exterior exit of each generator enclosure door. Locate devices, per Code, in the field and provide all required wiring and conduit.

3.02 SEQUENCE OF OPERATION

A. Engine start contacts shall signal the generator to start when the voltage of the normal source drops below 80% on any phase, after a time delay of one (1) second to allow for momentary dips. The voltage sensing relays shall be field adjustable while energized.

B. The automatic transfer switches shall transfer to emergency when 90% of rated voltage, and frequency of the emergency source have been reached. The maximum time interval from onset of the power failure and transfer to the emergency source shall not exceed ten (10) seconds.

C. After restoration of the normal power on all phases to 90% of rated voltage, an adjustable time delay period shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the automatic transfer switch shall bypass the timing relay and transfer to the normal source.

D. After retransfer to normal, the engine-generator shall be allowed to operate at no load for five (5) minutes prior to shut down.

E. A test on each automatic transfer switch shall simulate normal power failure.

F. Upon a signal to start, the generator sequence shall:

1. Open the fuel solenoids.
2. Open the air intake motorized dampers.
3. Open the air exhaust motorized dampers.

G. Upon a signal to shut down, the generator sequence shall:

1. Close the fuel solenoid valves.
2. Close the air intake motorized dampers.
3. Close the air exhaust motorized dampers.

3.03 HOUSEKEEPING PADS

A. Provide a concrete housekeeping pad beneath the generator. Coordinate the pad size, prior to any work, with the Structural Engineer based on the approved equipment submittal.

B. The generator pad reinforcements shall be grounded.

3.04 VIBRATION ISOLATION

A. Provide isolation of the generator set at the base by means of a combination spring type isolators and neoprene pads. Isolators shall be not less than 98% efficient of a sufficient quantity such that each is loaded to not more than 75% of its rated value. Provide a minimum of 3” static deflection. The isolators shall be located on top of the steel dunnage and below the generator base. The isolators shall be located mounted between the genset base rails and the custom enclosure base.

B. The entire exhaust piping system shall be supported on spring hangers or mounts such as Mason 30N or Mason Type SLF respectively or approved equal. Isolators shall be sized for a static deflection of 1” minimum.

C. All electrical and control connections to the generator shall be in 18” minimum of flexible liquid tight metal conduit.

D. All fuel oil and engine coolant lines shall be isolated by means of flexible light tight braided metallic hoses. Provide automatic fusible link valves (links to fail close) on the fuel supply connections to the engine.

E. Refer to specification section 26 05 48 for additional information.

3.05 FUEL OIL SUPPLY

A. This Contractor shall provide all fuel required for all testing and commissioning until the generator and emergency system is fully accepted by the Engineer and Owner. Additionally, refill the main tank upon final acceptance of the system by the Owner.

3.06 LOAD BANK – ON SITE TESTING

A. The following field testing shall be provided by this Contractor and respective equipment Vendor. All testing shall be performed in the presence of the Engineer.

B. Confirm functional testing of all switches, controls, and all remote operation.

C. Perform insulation resistance of the load bank bus.

D. At a minimum, the following testing shall be provided, per the manufacturer's requirements:

1. Confirm all field connections are correct, including all ground connections.
2. Confirm all control functions operate as intended.
3. Megger testing of all feeders.
4. Test results shall meet all manufacturers' values.
5. Test all shut down features and start up controls.

E. Run the generator up to four (4) hours with step loads being added per the manufacturer's recommendations. At the end of the test, the loads shall be gradually removed per the manufacturer's recommendations.

F. Prepare and submit all testing results. Perform testing until all functions are accepted by the manufacturer and Engineer.

3.07 SPARE PARTS

A. Upon successful completion of the project, the Contractor shall provide, at a minimum, the following to the Owner:

1. Air filters – two (2) sets.
2. Fuel and oil filters – two (2) sets.
3. Fuses – two (2) sets of each type.
4. Belts – two (2) sets of each type.
5. Touch up paint – one (1) quart (all colors used on the generator and enclosure).

3.08 WARRANTY REQUIREMENTS

A. The manufacturer's warranty shall be for a period of five (5) years from the date of Owner Acceptance, including all necessary labor and expenses to support the warranty.

B. The warranty shall include the full equipment, all repair/replacement parts, all accessories, and all lubricants and operational fluids used to make the equipment operational.

3.09 MANUFACTURERS SITE REPRESENTATION

A. The generator set manufacturer and distributor shall be responsible to provide coordination with the Contractor for all the generator controls, testing, start-up, and commissioning of the entire emergency power system. The manufacturer and distributor shall coordinate all project needs with the Contractor in advance of equipment being delivered to the site.

B. Provide services of the manufacturer's factory trained field representatives for a minimum of ten (10) working days to provide supervision during start-up, testing, and all required training sessions with the Owner's facility operators.

3.10 CLOSE OUT SUBMITTALS

A. The Contractor shall provide the Owner with a digital copy and a minimum of three (3) hard copies of all equipment technical data for the generator system and all ancillary equipment. Documentation shall include all operational data, preventive maintenance schedules, spare parts list, wiring diagrams, and all control manuals.

B. Provide a data sheet for all required replacement parts and tools to be maintained on site by the Owner.

C. Prepare and submit an as-built riser diagram of the entire emergency power system and display it in a frame in the main emergency electrical room. Submit a digital copy to the Owner and Engineer.

3.11 ONGOING MAINTENANCE REQUIREMENTS

A. Upon substantial completion, provide a 12-month full operational maintenance program. This shall be performed by specially trained technicians of the equipment manufacturer's service facility.

B. This shall include quarterly site visits to perform routine start-up service and preventive maintenance and adjustments as recommended by the manufacturer. Include all parts and equipment required for such maintenance.

END OF SECTION

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCHES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide Automatic Transfer Switches (ATS) and all accessories in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. Equipment supplier shall have local representation and shall have been actively engaged in the installation and service of automatic transfer switches for a period of not less than ten (10) years and have service facilities within a 50-mile radius of the project site.

B. Equipment supplier shall have full parts backup and 365/7/24-hour-per-day service availability for this equipment.

C. Equipment supplier shall be a manufacturer's local authorized dealer. Any 3rd party assembler will not be acceptable.

D. Testing Agency Qualifications: Member company of NETA or NRTL.

1.04 STANDARDS

A. Comply with all of the latest applicable Code provisions, including, but not limited to the following:

1. UL 1008 – Standard for Transfer Switch Equipment
2. UL 508 - Industrial Control Equipment
3. NFPA 70 – National Electric Code
4. NFPA 110 - Emergency and Standby Systems
5. NEMA Standard ICS10 – AC Automatic Transfer Switches
6. IEEE Standard 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
7. EN55011 - Class B Radiated Emissions
8. EN55011 - Class B Conducted Emissions
9. IEC 1000-4-5 (EN 61000-4-5) AC Surge Immunity or ANSI/IEE 62.41-1991
10. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
11. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
12. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
13. IEC 1000-4-6 Conducted Field Immunity

14. IEC 1000-4-11 Voltage Dip Immunity

B. Acceptance Testing:

1. NETA
2. NRTL
3. All manufacturers recommended testing.

1.05 SUBMITTALS

A. Detailed drawings of each automatic transfer switch with dimensioned locations of components and external connections and attachments. The drawings shall include mounting type, conduit entry points, front and side views, and any shipping splits and respective weights.

B. Detailed drawings of the emergency electrical rooms indicating the dimensioned layout of each automatic transfer switch, panelboard, and all other components within the emergency rooms. The drawings shall indicate all required Code and access clearances. Drawings shall be at ½" = 1'-0" scale, minimum.

C. Seismically restraint concrete housekeeping pads shall be sized (per the actual equipment in the submittal) and shown on the drawing submittal. This housekeeping pad submittal shall be signed and sealed by the vendor's Structural Professional Engineer in the State of the New York.

D. Submission shall be fully coordinated with the final approved overcurrent protective device coordination study submission prepared by the equipment vendor. Refer to specification section 26 05 73.

E. Manufacturer's product data sheets, specifications, and wiring diagrams for each automatic transfer switch component. Submittal shall clearly indicate the name plate data, including but not limited to:

1. Continuous current rating
2. AIC rating
3. Voltage rating
4. Number of phases and poles
5. All factory pre-set settings

F. Detailed point-to-point power and control wiring diagrams, indicating all wire and conduit sizes. For networked systems, provide all required interconnection diagrams indicating all power (normal and emergency), load control, and communication annunciation. Submission shall include floor plans indicating locations of all emergency power equipment in the building.

G. The manufacturer's statement that the overall system design and specification has been reviewed and is satisfactory for the entire system's performance or provide a list of any exceptions taken.

H. The name and location of the factory authorized service agency to approve and perform the initial installation and testing. Equipment suppliers shall be full parts backup and 24 hour/day servicing capabilities.

I. The name and location of the factory authorized service agency to perform all

warranty and service work. Suppliers shall have local representation and shall be actively capable of serving this equipment and all accessories. Technicians shall be specifically trained for all work associated with each type of automatic transfer switch.

J. The name and location of the certified testing agency to perform all field testing.

K. Certified prototype, factory, and field test reports.

L. Warranty data.

M. Installation instructions.

N. Electrical Power Systems Study (short circuit, arc flash, and coordination study) per specification section 26 05 73. This must be submitted at the time of the ATS equipment submittal. The submittal equipment ratings must be coordinated with the study results. The submittal will be returned unreviewed if the study is not included and coordinated.

1.06 SYSTEM TESTING

A. Factory Tests:

1. Factory tests shall be conducted by the manufacturer in accordance with all applicable standards.
2. Submit all test results.

B. Field Tests:

1. Field tests shall be conducted by factory certified technicians.
2. Perform testing and inspections per NETA or NRTL Acceptance Testing Standards and the manufacturer's recommendations.
3. Field inspection and testing shall occur after the installation is complete and the generator, emergency switchboard, and ATS rooms are secure.
4. Test all automatic transfer switches, engine start circuits, time delay circuits, status points, and system control points. Coordinate testing with the generator testing requirements. Demonstrate all operational sequences are functioning correctly. Repeat all tests a minimum of three (3) to ensure proper operations.
5. For bypass isolation automatic transfer switches, test all functional and operational sequences associated with the bypass switch.
6. Conduct field tests in accordance with NFPA 110 and per the manufacturer's requirements.
7. Additionally, perform a pull-the-plug test to demonstrate proper operation of the entire emergency power system. Provide all necessary temporary load banks and temporary portable cables to simulate building load.
8. Measure insulation resistance testing.
9. Submit all testing results data, including documentation of all relay settings.
10. Perform all testing until all devices and accessories successfully meet all testing requirements listed herein. Replace any parts which are not performing as specified.
11. Perform similar field testing with the portable generator connection fully operational.

1.07 OPERATING INSTRUCTIONS

A. The automatic transfer switch supplier shall provide a minimum of eight (8) hours of operating instructions on maintenance and operation of the emergency power system. Classes shall be open to at least three (3) representatives of the Owner's maintenance staff. Instructions shall be administered by a full-time employee of the equipment supplier.

B. This Contractor shall video tape the training and shall submit the video to the Owner. Provide copies of all documentation reviewed during the training session.

1.08 IDENTIFICATION

A. Provide an identification nameplate for each ATS indicating incoming power sources, normal and emergency feeder sizes, and load served.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. One (1) of the following manufacturers will be acceptable.

1. Automatic Switch Co. (ASCO), Russelectric, or ABB.

2.02 AUTOMATIC TRANSFER SWITCHES (ATS)

A. Automatic transfer switches shall be capable of switching all classes of load and shall be fully rated for continuous duty when installed in a non-ventilated enclosure. Refer to the Contract Drawings for all equipment ratings and configurations.

B. Four (4) pole switches shall have all four (4) poles connected with overlapping neutral contacts.

C. The automatic transfer switches shall not chatter or fail to transfer in any way on any switching operation within an acceptable operating voltage range.

D. The automatic transfer switches shall be electrically operated and mechanically held. The electrical operator shall be a single solenoid mechanism, momentarily energized to minimize power consumption and heat generation. The automatic transfer switches shall be capable of opening or closing to or from any source in not less than three (3) electrical cycles from initiation of a signal to operate. Operation time of the automatic transfer switch from source to source shall be configurable in a range of no intentional delay to ten (10) seconds, with a default of 0.5 seconds.

E. The use of interlocking molded case circuit breakers, contactors, or other components not rated for continuous duty, repetitive switching, or transfer between two (2) active power sources is not acceptable.

F. Automatic Transfer Switches shall be mounted in NEMA 1 enclosures as indicated on the Contract Drawings.

G. The automatic transfer switches shall have a short circuit withstand rating in

accordance with the final approved short circuit analysis report prepared by the Contractor.

H. All automatic transfer switches shall be equipped with microprocessor control modules for the transfer switch operation. Provide built-in duplex RS422 interfaces to enable all digital communications with all network supervisors and/or remote annunciators. Provide additional RS232 interfaces to allow communication with the power monitoring system.

I. The entire automatic transfer switch and relay plate assembly shall be capable of withstanding a 2500-volt crest transient per IEEE Standard 472. The transient voltage test shall be conducted across the normal source terminals, the emergency source terminals, and between adjacent normal and emergency source terminals. The minimum withstand and close-in ratings shall be as per the Power System Study.

J. Provide in line current limiting fuse protection within the automatic transfer switch where required to meet short circuit withstanding ratings.

K. Automatic Transfer Switches shall have a field adjustable programmed delay in the neutral position when transferring between live sources. In-phase monitor system is not permitted.

2.03 BYPASS ISOLATION AUTOMATIC TRANSFER SWITCH

A. Where indicated on the Contract Drawings, provide bypass isolation automatic transfer switches to allow manual bypass of the connected load to either power source – emergency or normal power.

B. The bypass isolation switch shall have equivalent ratings as the associated ATS. The isolation mode shall allow the ATS to be disconnected from all power and control sources without opening the enclosure door. The ATS shall be a draw-out type equipped with rollers to allow its removal from the enclosure.

C. The switch shall be equipped with distinct isolation and bypass handles with the following modes:

1. Bypass Handle – Provide the following three (3) operating modes which can be selected without any power interruption to the load (make-before-make contacts):

    a. Bypass to Normal Source
    b. Bypass to Emergency Source
    c. Automatic to Emergency Source

2. Isolation Handle – Provide the following operating modes:

    a. Test: Allows testing of the ATS and emergency power system without any power interruptions.
    b. Open: Allows isolation of the ATS from all power sources and load power conductors. This mode allows for ATS inspection or maintenance without conductor removals.

2.04 AUTOMATIC TRANSFER SWITCH FEATURES AND ACCESSORIES

A. Close differential solid state adjustable voltage sensing on all phases (line to neutral) of the normal source:

1. Set drop-out at 80% rated voltage.
2. Set pick-up at 90% rated voltage.

B. Three (3) phase voltage sensing (line to line and line to neutral) of the emergency source:

1. Set pick-up at 90% rated voltage.
2. Set drop-out at 80% rated voltage.

C. Frequency sensing of the emergency source:

1. Pick-up field adjustable from 90 to 100%. Factory set at 95%.

D. Time delay on engine start:

1. Field adjustable from 0.5 to 3 seconds. Factory set at 1 second.

E. Time delay on re-transfer to normal source:

1. Field adjustable from 0 to 30 minutes. Factory set at 10 minutes.
2. Immediate bypass of time delay and transfer to the normal source if the emergency source fails.
3. Cause the normally open contacts to close 10-15 seconds prior to transferring back to normal for automatic transfer switches serving elevators. Set as per the elevator vendor’s requirements.

F. Time delay on transfer to the emergency source:

1. Field adjustable from 0 to 60 seconds. Set at 0 seconds.
2. Where multiple automatic transfer switches are served by the generator, set the time delay to five (5) seconds apart between each switch, per the priorities indicated on the Contract Drawings.

G. Time delay between live sources adjustable from 0.4 to 2.0 seconds. Factory set at 1 second.

H. Unload engine run cool down time delay:

1. Field adjustable from 0 to 5 minutes. Factory set at 5 minutes.

I. Engine start contacts:

1. SPDT to operate upon failure of normal source.

J. Test Switch:

1. Mounted on the ATS enclosure door.
2. Simulates failure/return of normal source.

3. A test reset switch shall be included and shall bypass the delay on retransfer to normal.

K. Auxiliary Contacts:

1. Provide two (2) sets SPDT contacts to operate with the switch in the normal position.
2. Provide two (2) sets SPDT contacts to operate with the switch in the emergency position.
3. Contacts shall be exclusive for the respective ATS and not utilized for any other ATS or generator system functions.
4. Contacts shall be 120V AC, 10 amp rated minimum, wired to a terminal strip, and labeled.
5. Provide additional contacts or other provisions as required to display information on the remote annunciators described elsewhere in this specification.

L. Indicating LED Lights:

1. Mounted on the ATS enclosure door.
2. RED indicates the switch is in the emergency position.
3. GREEN indicates the switch is in the normal position.
4. WHITE indicates normal power source is available.
5. WHITE indicates an emergency power source is available.
6. AMBER indicates the switch is in the bypass isolation position.

M. Pre-transfer Contacts:

1. Provide a contact closure for elevator controls prior to transfer between live sources in either direction. Interval shall be adjustable from 0 to 30 seconds. Contacts shall be rated SPDT 120V AC, 10 amps.

N. Exercise Clock: Programmable cycle timer that starts and runs the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:

1. Day of week
2. Time of day to start
3. Duration of cycle

O. At a minimum provide three (3) remote annunciator panels. Remote Annunciator panels shall be located at the main emergency electrical room, ATS room, and at the Fire Alarm Control Panel. Each remote panel shall be capable of monitoring and testing each ATS individually. Provide a key switch to allow only authorized personnel access to the panel.

P. Each remote annunciator panel shall be provided with dedicated wiring and conduit. Daisy chaining of panels is not acceptable.

Q. Each remote annunciator panel shall be equipped with the following LED indicators for each automatic transfer switch:

Automatic Transfer Switch Not in Automatic Mode
Automatic Transfer Switch Connected to Normal Source
Automatic Transfer Switch Connected to Emergency Source
Automatic Transfer Switch Emergency Source Available
Automatic Transfer Switch Normal Source Available

R. Service manual and wiring diagram shall be supplied inside of each ATS enclosure when shipped. Include all documents as part of the O+M manual submission. Control wiring shall be labeled to correspond with the wiring diagram. Provide interconnecting control wiring, conduit, and programming for each ATS.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide all necessary dedicated wiring and conduit to each remote alarm panel and to each automatic transfer switch; and from each automatic transfer switch to the engine control panel, quantity and type of wiring as indicted on the final approved submittals. All control conductors shall be kept in separate raceways and junction boxes from power conductors. Daisy chaining of automatic transfer switches is not acceptable.

B. Provide wiring and conduit to each elevator machine room from the respective ATS serving the elevators, quantity, type, and termination as required by the elevator vendor. Coordinate all requirements prior to any work.

C. Conductors between the engine control panel and the fire pump controller/ATS shall be 2HR rated, similar to Mineral Insulated (MI) or MC Vitalink.

D. Provide engraved nameplates secured with rivets or screws. Nameplates shall be red bakelite plates with white lettering. Lettering shall be a minimum of 1” high. Nameplates shall be provided for all overcurrent protective devices, normal and emergency sources, and loads served.

E. Upon substantial completion, perform an infrared scan of each automatic transfer switch under load. Perform any required remediation as a result of the scan.

F. Arc Flash Protection

1. Electrical Contractor shall provide all arc flash warning labels and shall install such directly on the equipment.
2. Based on the results from the vendor’s arc flash study, the required level of protective gear shall be clearly displayed on the warning labels.

3.02 HOUSEKEEPING PADS

A. Provide a 4-inch-high concrete housekeeping pad beneath each floor mounted automatic transfer switch. Coordinate the pad size with the Structural Engineer based on the approved equipment submittal.

B. Provide an insulated mat, with a dielectric test voltage of 30,000V, at the front of all ATS. The mat shall be a minimum of 3' wide x ½" thick x the entire length of the ATS.

3.03 WARRANTY REQUIREMENTS

A. At a minimum, the manufacturer's warranty shall be for a period of two (2) years from the date of Owner Acceptance.

B. The warranty shall include the full equipment, all repair/replacement parts, all accessories, etc. to make the equipment operational.

C. Include all necessary labor and expenses to support the warranty.

3.04 MANUFACTURERS SITE REPRESENTATION

A. The automatic transfer switch manufacturer and distributor shall be responsible for providing coordination with the Electrical Contractor for all the switch controls, testing, start-up, and commissioning of the entire emergency power system. The manufacturer and distributor shall coordinate all project needs with the Electrical Contractor in advance of equipment being delivered to the site.

B. Provide services of the manufacturer's factory trained field representatives for a minimum of ten (10) working days to provide supervision during start-up, testing, and all required training sessions with the Owner's facility operators.

C. Contractor shall coordinate this training in conjunction with the engine generator training session to occur simultaneously.

3.05 CLOSE-OUT SUBMITTALS

A. The Electrical Contractor shall provide the Owner with a digital copy and a minimum of three (3) hard copies of all equipment technical data for the automatic transfer switch system and all ancillary equipment. Documentation shall include all operational data, preventive maintenance schedules, wiring diagrams, and all control manuals.

B. Prepare and submit an as-built riser diagram of the entire emergency power system and display it in a frame in the main emergency electrical room. Submit a digital copy to the Owner and Engineer.

3.06 ONGOING MAINTENANCE REQUIREMENTS

A. Upon substantial completion, provide a 12-month full operational maintenance program. This shall be performed by specially trained technicians of the equipment manufacturer's service facility.

B. This shall include quarterly site visits to perform routine start-up service and preventive maintenance and adjustments as recommended by the manufacturer. Include all parts and equipment required for such maintenance.

END OF SECTION

SECTION 26 41 00
LIGHTNING PROTECTION SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide a complete multi-point, Faraday and Master Label Lightning Protection System and all related work in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 REFERENCES AND STANDARDS

A. NFPA 780 and 70

B. UL 96 and UL 96A

C. UL 1449

D. OSHA Regulations (Standard 29 CFR)

E. NY State Building Code and Local Amendments

1.04 QUALITY ASSURANCE

A. Provide a lightning protection system consisting of air terminals, bonding, interconnecting conductors, and grounding as required under the provisions of NFPA 780 except where specified in excess thereof, herein or on the Contract Drawings.

B. Provide a UL 96A Master Labeled system consisting of air terminals, bonding, interconnecting conductors, and grounding as required under ine provisions of UL 96A except where specified in excess thereof, herein or on the Contract Drawings.

C. All equipment and materials which will be furnished and installed on this project shall be UL listed, in accordance with the requirements of the Authority Having Jurisdiction, and suitable for its intended use on this project.

D. The installation shall be performed by or under the supervision of the Electrical Contractor. The Electrical Contractor's staff and supervisors shall be certified by the Lightning Protection Institute (LPI).

E. The Electrical Contractor shall provide any corrective work required as a result of testing and inspections.

1.05 SUBMITTALS

A. Submit scaled shop drawings showing the coordinated layout of all air terminals, bonding connections to metal objects, bonding connections to structure, raceways, and grounding electrodes. Shop drawings shall include sizes for air terminals, conductors, raceways, grounding electrodes, and connection/termination details. Include all component installation details and roof attachment details.

B. Submit product data sheets showing application, dimensions, and materials of each component utilized in the lightning protection system.

C. All roof work and penetrations shall be coordinated with the roofing manufacturer and Contractor prior to any work.

D. Submit proof of the manufacturer's listing in accordance with UL 96.

E. Submit the manufacturer's installation instructions.

F. Submit OSHA approval of air terminals to be utilized in the installation.

1.06 RECORD DOCUMENTS

A. Submit project record documents including but not limited to:

1. UL Certification;
2. Testing results from the 3rd party field inspections;
3. As-built drawings (digital and paper copies);
4. Final inspection report, including videos and photographs.

B. Accurately record all air terminal, bonding, grounding, and conductor locations.

1.07 QUALIFICATIONS

A. Manufacturers:

1. Company listed in the UL Electrical Construction Directory specializing in the manufacturing of lightning protection equipment.

B. Electrical Contractor:

1. Company listed in the UL Electrical Construction Directory specializing in the installation of lightning protection systems.

1.08 FIELD QUALITY CONTROL

A. Field inspections will be performed and documented for the following:

1. All down conductors prior to being covered by interior, exterior, or other installations.
2. Lightning protection system grounds and connections prior to burial.
3. The complete ground system shall have no more than five (5) ohms of

resistance as measured per the IEEE Fall of Potential Method.

B. Obtain the services of Underwriters Laboratories, Inc. to provide the inspection and certification of the lightning protection system under the provisions of UL 96A.

C. Obtain the UL Master Label.

D. Certification that the surge protection equipment is installed on the electrical service with a minimum of 160-ka per phase surge capacity.

E. Certification that the surge protection equipment is installed on the antenna, telephone, radio, and television lead wires.

F. At the time of application for UL Master Label, a copy of the application shall be sent to the Owner's representative.

1.09 PRE-INSTALLATION CONFERENCE

A. Convene a pre-installation conference with all applicable trades and disciplines a minimum of two (2) weeks prior to commencing work under this section.

1.10 SEQUENCING AND SCHEDULING

A. Coordinate work under this section with the roof, interior, exterior, electrical, structural, and mechanical installations prior to any work to assure a neat and unobstructive installation.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Heary Brothers; National Lightning Protection Corporation; Approved Lightning Protection Co.; Erico; or Thompson Lightning Protection.

2.02 MATERIALS

A. All equipment utilized in the lightning protection system shall be new and provided by the same manufacturer.

B. Components:

1. All materials shall be copper. Aluminum materials shall be used on surface materials which are incompatible with copper. Coordinate this with the Architect prior to any work.

C. Air Terminals:

1. Solid copper nickel sized as required by structure class under provisions of UL 96A and NFPA 780 Standards for Lightning Protection System installation except where specified in excess of herein.
2. At a minimum, the perimeter roof air terminals shall be 3/8" x 12" with blunt tips. They shall be located within 18" of the roof edges of protected areas.

3. The mid-roof air terminals shall be ½" x 48" with blunt tips. Provide tripod braces as required to meet field conditions.
4. The air terminals shall project a minimum of 10" above the object of protection.

D. Air Terminal Bases:

1. Copper or bronze with bolt pressure cable connections which are securely mounted with stainless steel screws or bolts.
2. Bases located on built-up tar and gravel roofs shall be securely fastened with proper adhesives and shall have a minimum surface contact area of 18.5 square inches.

E. Ground Terminations:

1. Copper-clad Ground Rods: 5/8-inch x 10-feet, minimum, with a two-bolt copper clamp having a minimum length of 1.5" and employing stainless steel cap screws.
2. Ground Plates: 24 in square x 20-gauge, minimum, copper.
3. One (1) set of tripod ground rods shall be installed at each down conductor's location.
4. Ground Loop Conductors: 250MCM, 19 strand copper.
5. Ground Inspection Wells: Rated for traffic and vehicle areas.

F. Conductors:

1. Copper cable sized as required by structure class under the provisions of UL 96A and NFPA 780 Standards for Lightning Protection system installation.
2. UL listed No. 4/0 AWG with 28 strands, 14-gauge copper weighing 375 lbs. per 1000 feet, minimum.
3. Utilize conductors with protective coatings where conditions would cause conductor corrosion or deterioration.
4. Cable fasteners shall be compatible with the conductor and mounting surface.

G. Connectors, Fasteners, Splices, and Bases:

1. Above grade - cast bronze or cast aluminum.
2. Concealed - exothermic connections.
3. Fasteners shall be spaced at a maximum of 3'-0" on center.
4. All miscellaneous bolts, nuts, and screws shall be stainless steel.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that all surfaces are ready to receive work.

B. Verify dimensions and measurements shown on the shop drawings with all field conditions.

C. Verify that all systems that may influence the lightning protection system design are

included or referenced on the shop drawings.

D. Verify adequate guards against impalement are in place or will be implemented as required by the job progress.

3.02 PROTECTION OF SURROUNDING ELEMENTS

A. Protect elements under other sections from damage or disfiguration during work under this section.

B. Coordinate all below grade lightning protection system installation with the General Contractor prior to any work.

3.03 INSTALLATION

A. Install the entire system in accordance with the manufacturer's instructions.

B. The lightning protection system shall be installed in a neat and orderly manner.

C. Install the entire system in accordance with the NFPA 780 Lightning Protection Installation standard and UL 96A.

D. Cable conductors shall be concealed at all locations throughout the building. Cable conductors in parapets shall be coordinated with the window wall installation.

E. Connection of supports, clamps, devices, and other appurtenances to rust protected metal structures exposed to the weather shall be made using rust protected devices and shall be installed in a manner to preserve the rust protection of the structure. Coordinate material selections with the Architect prior to installation.

F. Down conductors shall interconnect with the grounding ring of the grounding electrode system. Refer to Specification Section 26 05 26 titled "Grounding System" for additional information. Coordinate the ground rods, plates, and ground ring installation with the existing foundation prior to any work.

1. Structural steel columns may be used as the main down conductor from the roof to ground providing the pathway is a continuous electrical path, does not exceed 60' spacing separation, and follows all Codes.
2. Utilize fiberglass conduits where raceways are required. PVC conduits are not acceptable.
3. Provide a minimum of one (1) down conductor for every 100 feet of roof perimeter to be protected, with a minimum of two (2) separate pathways.

G. Metals of conductance at any point within six (6) feet of the lightning conductor system shall be securely bonded and made a part thereof, and materials for these interconnections shall be equivalent in quality to the main conductor and fittings. Such metal objects shall include:

1. Mechanical piping, ductwork, and equipment.
2. Telecommunication equipment – satellites, antennas, dishes, etc.
3. Vents, stacks, downspouts, etc.
4. Roofing components, such as eaves, ladders, dunnage, drains, etc.
5. Photovoltaic panels and supports.

H. Cable conductors shall interconnect all air terminals offering a two-way path to the grounding electrodes.

I. Do not utilize materials that can form an electrolytic couple causing corrosion due to moisture.

J. All required sealing, flashing, pitch pans, pavers, slip sheets, or pads required for the lightning protection system shall be furnished and installed by the roofing Contractor to maintain roof warranty.

K. Ground rods or plates shall be installed a minimum of 12” below grade and a minimum of 24” from the foundation wall. Locate ground inspection wells in the field at the down conductors.

L. Surge suppression for the electrical system shall be installed by the Electrical Contractor.

M. Surge protection for the telephone, radio, or radio lead wires shall be furnished and installed by the respective system vendor.

3.04 SYSTEM TESTING

A. The Contractor shall perform ground resistance testing of the completed installation in accordance with IEEE and all applicable Codes.

B. Assure the ground resistance is five (5) ohms or less. Provide additional ground rods until the required levels are achieved.

C. The Contractor shall provide videos and photos of the installation prior to burial of the ground loop, concealment conductors, and upon completion of the exposed devices. Submit all documentation to the equipment manufacturer, Owner, and Engineer.

D. Submit all testing data and reports.

E. Upon completion of all inspections and acceptance, provide the Owner with all certifications.

END OF SECTION

SECTION 26 43 13
SURGE PROTECTION DEVICES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide the materials and installation requirements for Surge Protective Devices (SPD) in accordance with the Contract Drawings. These devices shall be used to protect sensitive electronics from the effects of lightning induced transients, substation switching transients, and internally generated transients resulting from inductive and/or capacitive load switching.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. All SPD on the project shall be provided by a single manufacturer.

1.04 STANDARDS

A. The specified systems shall be designed, manufactured, tested, and installed in compliance with the latest requirements of the following:

1. UL 1449 - Surge Protective Devices
2. UL 1283 - Electromagnetic Interference Filters
3. UL 96A – Lightning Protection System Master Label
4. ANSI/IEEE C62.41.1 - IEEE Guide on the Surge Environment in Low Voltage (1000 V and Less) AC Power Circuits; C62.41.2 - IEEE Recommended Practice on Characterization of Surge Voltages in Low Voltage AC Power Circuits; and C62.45 - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
5. Federal Information Processing Standards Publication 94 (FIP PUB 94)
6. National Electrical Manufacturer Association (NEMA)
7. National Fire Protection Association (NFPA 20, 70, 75, and 780)

B. The individual SPD units shall be UL listed under UL 1449 Standard for Surge Protective Devices and the surge ratings shall be permanently affixed to the SPD. The unit shall also be complimentary listed to UL 1283 Standard for EMI/RFI Facility Filters.

1.05 SUBMITTALS

A. Product data and manufacturer's installation instructions shall be submitted concurrently with switchboard and panelboard submittals.

B. The submittals shall include:

1. Dimensional drawings of each SPD type, including weights.
2. Drawings illustrating mounting locations and arrangements within the switchboards and panelboards.
3. Ratings for each device including voltage, fusing, capacity, connection requirements, and conductor lengths and types.
4. Certified testing data from the manufacturer, including compliance with UL 1449.
5. Wiring diagrams including grounding requirements.

1.06 WARRANTY

A. Provide a full ten (10) year warranty from the date of acceptance by the Owner/Operator against any part failure (and the entire device) when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable codes. Make available the local field engineering service support. Where direct factory employed service Engineers are not locally available, travel time from the factory or nearest dispatch center shall be indicated.

1.07 FACTORY TESTING

A. The specified systems shall be thoroughly factory tested before shipment. Submit all testing results.

1.01 IDENTIFICATION

A. Provide engraved nameplates secured with rivets or screws for all equipment. Nameplates shall be black bakelite plates with white lettering. Utilize red nameplates for emergency systems. Lettering shall be a minimum of 1” high. Nameplates shall be provided for all surge protective devices at the switchboards, distribution panelboards, and panelboards.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

A. Eaton, Square D Schneider Electric, ASCO, General Electric/ABB, Surge Suppression Inc, or Siemens.

2.02 SERVICE ENTRANCE AND DISTRIBUTION EQUIPMENT

A. Internal SPD

1. All SPD installed within electrical distribution equipment shall be equipped with an integrated disconnect switch rated for the maximum surge current rating of the respective SPD device.
2. SPD shall be listed in accordance with UL 1449 and UL 1283.
3. Integrated surge protective devices shall be component recognized in accordance with UL 1449 at the highest short circuit current rating (SCCR) of 200 kA, including intermediate level of fault current testing.
4. SPD shall be tested with the ANSI/IEEE Category C High exposure waveform (20kV-1.2/50μs, 10kA-8/20μs).

5. SPD shall provide suppression for all modes of protection: L-N, L-G, and N-G in WYE systems – total of seven (7) modes.
6. The manufacturer of the SPD shall be the same as the manufacturer of the service entrance and distribution equipment in which the devices are installed and shipped. Also, this distribution equipment shall be fully tested and certified to the following UL standards:

   UL 67 Panelboards
   UL 891 Switchboards

7. Recommended SPD ratings:

   a. The single impulse surge current rating shall be a minimum of 300k amperes/phase (150k amperes per mode) at the service entrance.
   b. The single impulse surge current rating shall be a minimum of 80k amperes per mode at the secondary distribution.
   c. Minimum Surge Life Rating of 20,000 pulses at the service entrance; 5,000 pulses at the secondary distribution.
   d. Discharge Current Rating (In) shall be 20kA.
   e. UL 1449 clamping voltage shall not exceed the following at the service entrance:

VOLTAGE	L-N	L-G	N-G	L-L
208Y/120	1200V	1200V	1200V	1500V

   f. UL 1449 clamping voltage shall not exceed the following at the secondary distribution:

VOLTAGE	L-N	L-G	N-G	L-L
208Y/120	700V	700V	700V	1200V

8. SPD shall be designed to withstand a Maximum Continuous Operating Voltage (MCOV) of not less than 125% for 208Y/120V systems.
9. SPD shall be constructed of one (1) self-contained suppression module per phase.
10. A visible LED indication of proper SPD connection and operation shall be provided. The indicator lights shall indicate which phase as well as which module is fully operable. The status of each SPD module shall be monitored on the front cover of the enclosure as well as on the module. A push-to-test button shall be provided to test each phase indicator. Push-to-test button shall activate a state change of dry contacts for testing purposes.
11. SPD shall be equipped with an audible alarm which shall activate when any of the surge current modules has reached an end-of-life condition. An alarm ON/OFF switch shall be provided to silence the alarm. The switches and alarm shall be located on the front cover of the enclosure.
12. A connector shall be provided along with dry contacts (normally open or normally closed) to allow connection to a remote monitor or other system. The output of the dry contacts shall indicate an end-of-life condition for the complete SPD or module.
13. Terminals shall be provided for the required power and ground connections.
14. The SPD shall be equipped with the following optional items:

a. A surge counter shall be located on the diagnostic panel on the front cover of the enclosure. The counter shall be equipped with a manual reset and battery backup to retain memory upon loss of AC power.
b. A remote monitoring device shall be provided to directly connect to the SPD with a dry contact connector for simple installation. The device will have indicator lights and an audible alarm to monitor for normal and faulty conditions.

2.03 SURGE SUPPRESSION COMPONENTS

A. Each array shall be capable of withstanding over 1,250 pulses of the 10kA IEEE 62.41 Category C surge current without failure when tested per C62.11and C62.45 suggested wait times. The array shall consist of multiple gap-less Metal Oxide Varistors (MOV), with each MOV individually fused. The fusing shall open in the event of a high fault current condition which must be a standard feature for the SPD. Individually fused MOV is not acceptable where more than one (1) MOV is provided per array module.

B. The arrays shall be designed and constructed in a manner that ensures MOV surge current sharing. No gas tubes, silicon avalanche diodes, or selenium plates/rectifiers shall be used. The status of each array shall be continuously monitored, and a green LED shall be illuminated if the array is in full working order. All protection modes, including N-G, shall be monitored and internally fused, for compliance with NEC Articles 110.9, 110.10, and 280.22.

2.04 CONNECTIONS

A. Each unit shall be designed to be installed directly to the switchboard bus, distribution panel, or panel branch circuit breaker. All parallel connections to the SPD shall be kept as short as possible. The connection to the SPD shall be made using No. 10 AWG minimum.

2.05 ACCESSORIES

A. Unit Status Indicators: The unit shall have an integral status circuit that monitors the operational status of all modes of protection, including Line to Neutral, Line to Ground, and Neutral to Ground. No manual testing is required to confirm the integrity of the suppression and filter systems. If the unit does fail, the green LED will go out and the red LED will be lit.

B. Summary Alarm Relay Contacts: In addition to the LED indicators, the unit shall be equipped with a summary alarm relay with one (1) set of Normally Open and Normally Closed (Form C) dry contacts rated for 125 VAC, 1 Amp (minimum). The contacts shall allow for remote monitoring and will change state and indicate a failure of the unit, a phase loss condition, or a full power loss condition.

C. Provide NEMA 1 enclosures where mounted external of the switchboards and panelboards.

PART 3 – EXECUTION

3.01 GENERAL

A. The equipment manufacturer shall install the SPD in the power distribution equipment for use at the utility service entrance to the facility and in each distribution panel to be protected, as indicated on the Contract Drawings.

B. The SPD shall be installed on the load side of a service disconnect overcurrent device per the NEC.

C. Where the internal SPD is connected to the power system utilizing conductors with lengths as short as possible with no sharp bends. The Contractor shall reconfigure breaker positions and locations to allow the conductor lengths to be minimized.

D. The SPD's ground shall be connected to the power system ground utilizing a separate ground path. The equipment ground shall not be used as a transient ground path. Bond the SPD ground to the ground bar in the main electrical room.

E. In addition to the main service entrance, provide SPDs at all switchboards, distribution panels, and branch circuit panelboards that comprise the Emergency System (NEC Article 700).

3.02 INSTALLATION

A. Where located in a switchboard, the manufacturer shall bus connect the SPD in parallel to the power source. Where located in a breaker panel, connect to a circuit breaker, keeping conductor length as short as practically possible.

B. The unit shall be bussed to the switchboard and be supplied by a 30-amp or 60-amp service fused disconnect switch or circuit breaker as required by the SPD manufacturer. All overcurrent protective devices shall comply with UL 1449.

C. Coordinate with the switchboard vendor and flush-mount User interface panel integral into the respective switchboard front panel.

D. The Contractor shall follow the SPD manufacturer's recommended installation practices and comply with all applicable codes. Assure all clearances are maintained.

E. Upon completion, all units shall be cleaned, adjusted, and aligned in accordance with the manufacturer's recommendations.

F. The Contractor shall retain the manufacturer's authorized technician to perform a system evaluation prior to energizing. The Contractor and a factory authorized technician shall schedule an operational and maintenance training session with the Owner's engineering staff.

G. The Contractor shall confirm that the electrical system bonding jumper has been connected between the neutral and ground prior to any SPD or system being energized.

END OF SECTION

SECTION 26 50 00
LUMINAIRES AND ACCESSORIES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide luminaires, lighting controls, and accessories in accordance with the Contract Documents.

1.02 RELATED DIVISIONS

A. The General Conditions and Supplementary General Conditions accompanying these specifications are hereby made a part of the requirements of the work under this division. Where General Conditions and Supplementary General Conditions clauses are repeated in these specifications, it is to call special attention to them or as a further qualification. No General Conditions and/or Supplementary General Conditions clause referring to the work of this division shall be considered waived unless specifically stated herein.

1.03 QUALITY ASSURANCE

A. All lamps and drivers shall be of the same manufacturer, for each fixture type.

B. Manufacturers shall have a minimum of three (3) years of documented experience.

C. Lighting Controls Manufacturer Qualifications: Firms regularly engaged in manufacture of lighting controls and wall plates of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years.

D. Occupancy/Vacancy/Daylighting sensors shall be certified for operation with drivers utilized in controlled lighting fixtures.

E. Occupancy/Vacancy/Daylighting sensors and all wiring devices shall have a minimum five (5) year warranty.

F. All equipment shall meet the NY State Energy Code and local energy ordinances.

1.04 STANDARDS

A. Luminaires:

1. Testing: IES LM-79 and LM-80.
2. Cords: UL 62.
3. Exit Signs and Emergency Luminaires: NFPA 70 and UL 101 & 924.
4. Luminaires: UL 57, 676, 1570, 1571, and 1572.
5. Photometric data: Independent testing laboratory certified.

B. Lighting Controls

1. Switches: UL 20, Federal Specifications WS-896, and NEMA WD1
2. Wall Dimmers: ANSI C62.41 and UL 20 & UL 1472

3. NFPA 70

1.05 SUBMITTALS

A. Manufacturer's product data sheets for each luminaire indicating luminaire type, driver quantities and types, LED module quantities and types, photometric data, materials, finishes, accessories, voltage, input watts, and photographic image of each luminaire.

1. LED Modules shall indicate voltage, load (watts), lamp life, photometrics, color rendering index (CRI), correlated color temperature (CCT), and integral or remote driver requirements.
2. Remote drivers (normal and emergency type) shall be clearly identified and shop drawing plans shall be prepared and submitted by the Contractor indicating proposed locations. Such plans shall indicate all access requirements and shall be reviewed by the Architect and Engineer prior to any work.

B. Manufacturer's data sheets for each integrated and remote component.

C. Detailed drawings indicating all fixture components, dimensions, weights, details, wiring diagrams, mounting, and connections.

D. All power and control wiring diagrams shall clearly indicate all required field wiring and connections.

E. Perform all operational and control field testing. Submit all field-testing results.

F. Lighting Control Devices

1. Submit the manufacturer's standard catalog pages and data sheets, including termination method and available ratings, configurations, instruction sheets, certificates, qualification statements, and colors.
2. Occupancy/Vacancy/Daylighting sensors layout drawings, 1/8-inch scale, including wiring details of power packs and control devices.
3. Submit samples as requested by the Architect of any cover plates and devices for color selection.

1.06 FIELD TESTING

A. Lighting Controls Acceptance Testing: Provide acceptance testing for all occupancy/vacancy sensors and daylight controls as required by the manufacturer.

B. Submit all field test results and reports.

1.07 COLORS

A. Device and cover plate colors shall be as selected by the Architect. Catalog numbers, where included in this specification, are not to be used to determine the colors of devices or cover plates.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Luminaires: Refer to the luminaire schedule on the Contract Drawings.

B. Lighting Controls:

1. Catalog numbers shall not be used to determine colors of devices and cover plates. Catalog numbers are used to establish a minimum acceptable standard.
2. Switches: Leviton, Hubbell, Cooper, Legrand, or Pass & Seymour.
3. Wall Dimmers: Legrand/Watt Stopper, Lutron, Leviton, Hubbell, or approved equal.
4. Light Sensors (Occupancy/Vacancy/Daylighting): Legrand/Watt Stopper, Lutron, Hubbell, Leviton, or approved equal.

2.02 LED LUMINAIRES

A. LED Luminaires shall be as follows (refer to fixture schedule for additional information):

1. Luminaires shall be certified by a NRTL.
2. Correlated Color Temperature (CCT) shall be 3000K - 5000K.
3. The Color Rendering Index (CRI) shall be 90 or better per IES LM-79-08.
4. Luminaire efficacy shall be as measured by IESNA LM-79-08.
5. A minimum of 50,000 hours rated life for all LED modules, and a minimum of 50,000 hours rated life for all LED drivers.
6. Luminaires shall maintain 70% lumen output for a minimum of 50,000 hours.
7. LED driver voltage shall be universal 120 - 277V (+/- 10%) and have a power factor greater than 0.9, having a Total Harmonic Distortion (THD) of less than 20%.
8. All LED drivers shall be capable of providing 0-10V dimming controls.
9. Power supplies shall be equipped with current limiting protection.
10. All LED luminaires, drivers, and controllers shall provide a minimum warranty of five (5) years including all labor and materials.

B. Emergency Drivers: Provide for all fixtures designed as emergency and where indicated on the Contract Drawings. Coordinate if drivers are factory assembly integrated or remote prior to any work as indicated above.

2.03 LUMINAIRE MATERIALS AND FABRICATION

A. Luminaires shall be completely factory assembled, wired, and equipped with the necessary LED modules, power supplies, drivers, wiring, shielding, enclosures, lenses, and other parts necessary to complete the luminaire installation.

B. Construct luminaires with a minimum number of joints. Cast or extruded parts of luminaires shall be close grained and free from imperfections, rigid, true to pattern, of ample weight and thickness, and properly fitted, filed, and buffed to provide finished surfaces and joints free of imperfections.

2.04 LUMINAIRE FINISHES

A. Luminaire finishes shall provide a durable, wear resistant surface. Surfaces shall be chemically cleaned and treated with corrosion inhibiting (phosphating) material to assure positive paint adhesion. Exposed metal surfaces (brass, bronze, aluminum, etc.) and finished castings (except chromium plated or stainless-steel parts) shall have an even coat of high-grade methacrylate lacquer or transparent epoxy. Anodize exposed aluminum surfaces in a 20-minute bath for corrosion resistance. Sheet steel luminaire housings, and iron and steel parts which have not received phosphating treatment, or which are to be utilized in exterior applications, shall be UL listed for wet locations, and shall be zinc or cadmium plated, or hot dip zinc galvanized after completion of all forming, welding, and drilling operations.

B. Screws, bolts, nuts, and other fastening or latching hardware shall be cadmium plated.

C. Provide luminaires with a high temperature baked enamel coating of selected color and finish, unless otherwise noted. White baked enamel finished surfaces shall have a minimum reflectance of 86%, unless otherwise noted.

2.05 LUMINAIRE REFLECTORS

A. Aluminum Reflectors:

1. Reflectors and reflecting cones or baffles shall be fabricated from No. 12 aluminum reflector sheet, minimum 0.057 inches thick (15-gauge). Materials shall be free of any marks or indentations caused by assembly techniques.
2. Reflectors shall be fully cleaned, polished, buffed, and anodized (Alzak), with finish color as selected by the Architect.

B. Painted Reflectors:

1. Painted reflectors shall be formed before the application of primer and paint. Reflectors and reflector bodies for luminaires with baked white enamel finish shall meet the following requirements and tests:
   a. After 100 hours of exposure to fade-o-meter, reflectance shall be not less than 86%, and finish shall show no visible color change.
   b. After 100 hours of exposure to 100% humidity at 100 deg. F, (cook box test) finish shall show no blistering or other degraded effects.
   c. After 150 hours of exposure to salt spray (20% sodium chloride) shall cause no breakdown of film.

2.06 LUMINAIRE LENSES, FACEPLATES, AND TRIMS

A. Plastic lenses shall be of virgin methyl methacrylate, unless otherwise indicated. Polystyrene lenses are not acceptable.

B. Lenses, louvers, and other light diffusing components shall be contained in the frames. Lenses shall be removable but positively held within the frames.

C. Faceplates on recessed luminaires shall open for access to the interior of the luminaire, serve as a ceiling trim, and positively held to the luminaire body by adjustable means that permit the faceplate to be drawn up to the ceiling as tight as necessary to ensure complete contact of faceplate with the finished ceiling.

D. Provide ceiling trims for rectangular recessed luminaires with mitered corners, continuously welded and smoothed before shop finishing. Lapping of trim metal is not acceptable.

2.07 EMERGENCY AND EXIT LIGHTING

A. Provide emergency lighting as indicated on the Contract Drawings. Connect to the emergency power distribution system or to the battery systems indicated on the Contract Drawings.

B. Provide integral emergency battery power supplies with maintenance free nickel cadmium batteries when a building emergency power distribution system is not available.

C. Provide factory installed integral emergency drivers in luminaires shown on the Contract Drawings. Where remote drivers are utilized, provide all required wiring and conduit to the accessible location. Locations shall be coordinated with the Architect prior to any work.

D. Upon normal power failure, the battery power supplies shall immediately provide full illumination. Battery supplies shall provide 100% full output for a minimum of 90 minutes.

E. Coordinate access points for all battery test switches prior to installation.

F. Exit signs shall be equipped with aluminum enclosures with edge-lit faces and LED light sources. Exit sign lettering shall be RED with 8” high letters. All exit signs shall have maintenance free batteries rated for a minimum of 90 minutes meeting UL 924.

2.08 LUMINAIRE ACCESSORIES

A. Luminaires channels shall be suitable for use as raceways. Provide feed through splice boxes where necessary.

B. Provide installation and all supporting hardware including stems, plates, plaster frames, hangers, and similar items, for support of luminaires for the ceiling construction in which they shall be installed. Provide plaster frames made of non-ferrous metal, or of steel that has been suitably rustproofed after fabrication.

C. Provide fastening devices of a positive locking type, which do not require special tools to apply or remove them. Do not use tie wires in place of fastening devices.

D. Attach reflectors to housing by means of safety chains to prevent reflectors from falling. No part of the chain shall be visible after installation.

E. Provide a ceiling canopy for each stem. Canopy finish shall match stem finish.

F. Luminaires installed in air plenums shall be enclosed and gasketed.

2.09 SWITCHES

A. General:

1. Switches shall be of the types indicated on the Contract Drawings.
2. Switches shall be commercial specification grade, 20A, 120/277V, 1HP rated at 120V, 2HP rated at 240V, side wired up to No. 10 AWG conductors, and silent handle operation.
3. Decora rocker type – rectangular.

B. Light Switches:

1. Toggle Handle Type:

   a. Single pole: Leviton 1221-2, Hubbell DS120, or Cooper 2221.
   b. Double pole: Leviton 1222-2, Hubbell DS220, or Cooper 2222.
   c. 3-way: Leviton 1223-2, Hubbell DS320, or Cooper 2223.
   d. 4-way: Leviton 1224-2, Hubbell DS420, or Cooper 2224.

2. Rocker Handle Type:

   a. Single pole: Leviton Decora 5621-2, Hubbell HBL2121, or Cooper 7621.
   b. Double pole: Leviton Decora 5622-2, Hubbell HBL2122, or Cooper 7622.
   c. 3-way: Leviton Decora 5623-2, Hubbell HBL2123, or Cooper 7623.
   d. 4-way: Leviton Decora 5624-2, Hubbell HBL2124, or Cooper 7624.

C. Illuminated Handle Switches (Illuminated in OFF position):

1. Toggle Handle Type:

   a. Single pole: Leviton 1221-LHC, Hubbell HBL1221ILC, or Cooper 2221LTW.
   b. 3-way: Leviton 1223-LHC, Hubbell HBL1223-ILC, or Cooper 2223LTW.

2. Rocker Handle Type:

   a. Single pole: Leviton Decora 5631, Hubbell DS120IL, or Cooper 7631.
   b. 3-way: Leviton Decora 5633, Hubbell DS320IL, or Cooper 7633.

D. Pilot Light Switches:

1. Toggle handle, single pole, LED pilot light: Leviton 1201PL, Hubbell HBL1221PL, or Cooper 2221-PL.

E. Weatherproof Switches:

1. Weatherproof while “In-Use” rated cover plate with a hinged door.

F. Time Clocks:

1. Digital, programmable type time clock with LED display.
2. Capable of 365-day x 24-hour control and equipped with override functions.
3. Ratings:

a. 120V or 277V
b. NEMA 1 enclosure indoors; NEMA 3R enclosure outdoors or in wet locations
c. UL 917

4. Tork or approved equal.

2.10 WALL DIMMERS

A. Wall dimmers shall be suitable for controlling the load type (low voltage electronic, or LED), load capacity, and branch circuit voltage of the light fixtures controlled.

B. Dimmer switches shall be modular, full wave, solid state units with integral quiet ON/OFF switches, with audible frequency and EMR/RFI suppression filters, compatible with 0% LED dimming drivers. Switches shall be capable of zero to 10 VDC for direct control of 3rd party LED drivers without the use of separate power packs. All dimmers shall be capable of dimming 0-10 volts.

C. The Electrical Contractor shall be responsible for to coordinate all loads, load types, and ganging of wall dimmers. Provide corresponding coordinated junction box and single cover plate for all ganged applications.

D. Dimmers shall be ganged with adjacent switches to allow for a multi-gang cover plate where multiple devices are installed in a common wall. Where ganged, the Electrical Contractor shall ensure the de-rated dimmers (where heat fins are removed) are suitable for the load controlled.

E. Dimmers shall be continuously slide-to-off with a single pole or three-way switching. All 3-way dimmers shall be capable of operating from either 3-way switch location.

2.11 OCCUPANCY SENSORS

A. Occupancy sensors shall be suitable for the control of the load type (low voltage, electronic, or LED), load capacity, and branch circuit voltage of the light fixtures and/or receptacles being controlled.

1. Ceiling Mounted: Dual technology Passive Infrared (PIR) with a minimum coverage area of 30’ x 30’ and full 360-degree view. Sensors shall be adjustable time delay type up to 30 minutes.
2. Wall Mounted: Dual technology Passive Infrared (PIR) with a minimum coverage area of up to 1200 square feet and 180-degree view coverage. Sensors shall be adjustable time delay type up to 30 minutes.
3. Power Packs: Provide power packs either integral or remote to the sensors. When remote, the Electrical Contractor shall provide all wiring and conduit between the devices. Coordinate remote locations with the Architect prior to any work.
4. All sensors shall be equipped with a spare auxiliary dry contact for BMS system monitoring of occupancy.
5. Operating Environment: Operating temperature 32-104 degrees F with a relative humidity (non-condensing) of 0% to 95%.

B. Acceptable Manufacturers: Legrand/Watt Stopper, Lutron, Hubbell, Leviton, Cooper, or approved equal.

C. Wall Switch:

1. Manual ON, auto OFF control switches.
2. Single level control switch or matching dual level switching type as indicated on the Contract Drawings.
3. Bypass override ON switch in the event of a product failure.
4. 120/277V operation.
5. Provide sensors appropriate for the room size coverage.

D. Ceiling Mounted:

1. Provide One way type; Two-way type; or Corridor type sensors to suit field conditions.
2. 120/277V operation.
3. Provide sensors appropriate for the room size coverage.

E. Power Packs:

1. Provide power packs as required for circuiting and control zones as shown on the Contract Drawings.
2. Power packs controlling receptacles shall be capable of switching receptacles and / or lighting and be rated to support plug loads and bi-level switching.
3. 120/277V operation.
4. Power packs serving multiple loads shall be labelled accordingly.

2.12 OCCUPANCY/VACANCY SENSORS

A. Same as listed above for Occupancy Sensors.

B. Operational as an occupancy sensor (automatically turns ON and OFF) or as a vacancy sensor (manually turns ON and automatically turns OFF).

C. Acceptable Manufacturers: Legrand/Watt Stopper, Lutron, Hubbell, Leviton, Cooper, or approved equal.

2.13 DAYLIGHTING CONTROLS

A. All Daylighting sensors shall provide automatic dimming lighting controls within a space utilizing 1-10V dimming. Sensors shall allow full ON capabilities when inadequate natural lighting is available.

B. The sensors shall be factory set to turn ON at 2 – 3 footcandles; and turn OFF at 4 – 10 footcandles with a 30 second minimum time delay.

C. Power Packs: Provide power packs either integral or remote to the sensors. When remote, the Electrical Contractor shall provide all wiring and conduit between the devices. Coordinate remote locations with the Architect prior to any work.

D. All sensors shall be equipped with a spare auxiliary dry contact for BMS system monitoring of occupancy.

E. Acceptable Manufacturers: Legrand/Watt Stopper, Lutron, Hubbell, Leviton, Cooper, or approved equal.

2.14 COVER PLATES

A. Provide cover plates for all wiring devices. Provide multiple gang cover plates where multiple devices are installed in a common location.

B. Provide screw-less type cover plates for all wiring devices located in all areas except back of house spaces.

C. Provide stainless steel Type 430, smooth face cover plates in equipment rooms. Provide nylon thermoplastic, smooth face cover plates in other areas. Thermoset cover plates are not acceptable.

D. Wet-Locations: Provide weatherproof “In-Use” cover plates complying NEMA 3R, weather resistant, die cast aluminum with lockable covers.

PART 3 – EXECUTION

3.01 GENERAL

A. All luminaire locations and quantities shall be as indicated on the Architectural Contract Drawings. Verify exact dimensional ceiling dimensions on the Architect’s reflected ceiling plans prior to installation. Coordinate clearances with other Trades for other equipment such as ducts, pipes, conduits, or structural elements prior to any installations. Bring conflicts to the Architect’s attention before proceeding with any work. Where conflicts in the light fixture locations or quantities exist, the Architect’s reflected ceiling plans will govern.

B. Confirm ceiling construction and furnish appropriate luminaire mounting supports, hardware, trim, and accessories for each luminaire.

C. Install luminaires in mechanical/electrical equipment rooms after the ductwork, conduits, and piping installation. Locate and mount the luminaires as indicated on the Contract Drawings unless mechanical/electrical equipment prohibits or makes it impractical to do so. In such cases; chain or wall mount the luminaires so that serviceable equipment is illuminated.

D. In all mechanical, electrical, telecommunication, elevator, etc. equipment rooms where ductwork, piping, and conduits will not allow ceiling surface mounted light fixtures, provide hangers, cables, and related appurtenances to suspend the fixtures at no cost to the Owner. The exact light fixture locations shall be coordinated in the field once all other suspended utilities are installed.

E. Luminaires shall be installed free of light leaks and all deficiencies.

F. Install reflector cones, aperture plates, lenses, diffusers, louvers, and decorative elements of luminaires after the completion of wet work, plastering, painting, and general clean up in the area of the luminaires. Provide final focusing and adjusting of lighting equipment. Focusing and adjusting shall be performed under the Architect’s supervision after normal working hours.

G. Luminaires shall be installed with mylar cover over louvers. Covers shall be UL listed for temporary lighting. Upon completion of work, remove mylar covers with white gloves.

H. Visible hanging devices shall be finished to match the luminaire finish, unless otherwise noted. Suspended fixtures shall hang level and aligned when installed in rows.

I. Provide fire rated enclosures around all recessed luminaires that are installed in fire rated ceilings. Enclosure rating to match the ceiling rating.

J. All recessed fixtures shall be IC rated.

K. Provide attachment devices, brackets, plaster rings, saddle hangers, and tie bars made of formed, rolled, or cast metal shapes with the requisite rigidity and strength to maintain continuous alignment and support of the installed luminaires.

L. Coordinate the placement of exit signs such that they are not obstructed from view by structural elements, architectural elements, mechanical systems, and other obstacles. Provide additional suspension stem and mounting accessories for exit lights that require lowering at no cost to the Owner. Provide stems which will be field coordinated to ensure the bottom is equal to the surrounding fixtures.

M. The Contractor shall provide a bid allowance for a total of six (6) additional exit signs to be installed at the time of the Fire Inspector's inspection or Building Department inspection walkthroughs at no cost to the Owner. This shall include provisions of the LED exit lights and the electrical circuits (wiring and conduit) required from the panelboards (circuit breakers) serving the specific areas.

N. Luminaires mounted in suspended ceilings shall be attached to the main runners of the ceiling system with appropriate mounting hardware. Provide independent 45 deg. slack support cables from the corners of each luminaire to the structure above.

O. Provide at least two (2) supports for linear LED luminaires. Where luminaires are continuously mounted in rows, provide support at maximum intervals of eight (8) feet, or closer if necessary to prevent visible deflection and per manufacturers' recommendations.

P. Equipment requiring access for service and maintenance shall be installed so that components requiring access are readily accessible.

Q. Immediately prior to occupancy clean all fixtures in their entirety.

R. Provide all required wiring and conduit between the LED modules and the respective drivers. Metallic raceways are required between all fixtures and drivers.

S. Luminaires with emergency drivers connected to switched circuits shall be controlled ON and OFF by the controlling device and shall go into the emergency mode upon loss of normal power to the emergency driver (provide switched and unswitched leads to these luminaires).

T. Where a lighting control system utilizes integral fixture mounted sensors, coordinate and provide the installation of the lighting control system sensor into each luminaire for wireless control and for integration of the luminaire into the networked digital lighting control system. Lighting control sensors shall be installed within the luminaire at the factory and shipped to the site fully assembled.

U. For all luminaires in the generator room, boiler room, fire pump room, emergency electrical room, and main electrical room, provide integral emergency battery driver and circuit to the emergency system. At each stair landing, provide one (1) of the luminaires with an integral emergency driver and circuit to the emergency panel.

V. Provide final focusing and luminaire adjusting.

3.02 LIGHTING CONTROLS

A. General:

1. Verify the exact location and mounting height of all wiring devices with the Architect prior to any work.

B. Switches:

1. Mount switches vertically with the ON position on top.
2. Mount switches on the strike side of doors.
3. Provide toggle handle type lighting switches in equipment rooms. Provide rocker handle type lighting switches in other areas.

C. Occupancy / Vacancy Sensors:

1. It shall be the Electrical Contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of the controlled areas per the manufacturer's recommendations as the range of coverage of occupancy sensors may vary from one manufacturer to another.
2. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the Contract Drawings are diagrammatic and indicate only the rooms which shall be provided with sensors. The Contractor shall provide additional sensors if required to cover the respective room properly and completely. Where two (2) or more occupancy sensors are indicated within a room or space, they shall be arranged so that the coverage overlaps an adjacent sensor’s coverage by not less than 25%.
3. It is the Contractor’s responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the Owner's facility, to verify placement of sensors and the installation criteria.
4. Proper judgment shall be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
5. Face plate colors shall be selected by the Architect. Submit samples of standard colors to the Architect for review.
6. Provide power packs as required for multiple sensor locations and multiple control circuits. All power packs shall be located in accessible locations.
7. Provide override switches at wall for ceiling mounted occupancy sensor locations.

D. Cover Plates:

1. Install device cover plates in full contact with wall surface. Plates shall not project out from the wall.
2. Cover plates for multiple gang wall dimmers shall be continuous flush type tailored to match wall dimmer physical dimensions.
3. Clean all cover plates and wiring devices.

3.03 FIELD TESTING

A. Perform all field testing to verify proper equipment operation.

B. Submit all test results and reports.

3.04 CONTROL DEVICE COMMISSIONING

A. Upon completion of the installation, all control systems and devices shall be commissioned. Occupancy/Vacancy sensors shall be completely commissioned by the manufacturer's factory authorized technician who shall verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system.

B. The Electrical Contractor shall provide both the manufacturer and the Engineer with ten (10) working days' written notice of the scheduled commissioning date.

C. Upon completion of the controls system fine tuning, the factory authorized technician shall provide the training necessary to familiarize the Owner's personnel with the operation, use, adjustment, and problem-solving diagnosis of the occupancy sensing devices and systems.

D. Assure all sensors are clean and view lens are unobstructed.

3.05 SPARE COMPONENTS

A. Provide spare components as follows:

1.	LED Modules:	Three (3) for every 50 of each type installed.
2.	LED Drivers:	One (1) for every 50 of each type installed.
3.	Emergency Drivers:	One (1) for every 30 of each type installed.
4.	Exit Signs:	Ten (10).
5.	Sensors & Power Packs:	Six (6) of all types installed.

END OF SECTION

SECTION 28 31 00
FIRE ALARM SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Provide a fully addressable fire alarm system in accordance with the Contract Documents.

B. The requirements of the Contract Documents, including the General and Supplementary General Condition and Division 1 - General Requirements, shall apply to the work of this section.

C. At the time of bid, all exceptions taken to these Specifications, all variances from these Specification and all substitutions of operating capabilities or equipment called for in these Specification shall be listed in writing and forwarded to the Engineer. Any such exception, variances or substitutions which were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment.

D. The entire system shall be installed with aesthetics in mind. All control panels and remote annunciators installed in public spaces shall be semi-flush mounted with no exposed conduit or cable trays.

E. The system shall support approved smart-infrastructure integration (SII) and be capable of bi-directional data exchange with other building systems where required.

F. The Electrical Contractor shall provide Fire Watches for all areas of the building that will be unprotected during removals and reinstallation of the fire alarm system as required by Westchester County officials.

1.02 WORK INCLUDED

A. The work covered by this Section of the Specification shall include all labor, equipment, materials, and services to furnish and install a complete fire alarm detection system of the addressable, analog detecting, low voltage and modular, with digital communication techniques, in full compliance with all applicable codes and standards. It shall be complete with all necessary hardware, software, and memory specifically tailored for this installation. It shall be possible to permanently modify the software on site by using a plug-in programmer. The system shall consist of, but not be limited to, the following:

1. Fire Alarm Control Panel and related remote data gathering panels.
2. Remote Annunciators with semi flush backbox.
3. Addressable manual fire alarm pull stations.
4. Addressable analog area smoke detectors.
5. Addressable analog duct smoke detectors.
6. Addressable analog heat detectors.
7. Magnetic door/card access release override control.
8. Audible notification appliances - horns.
9. Visual notification appliances - strobes.
10. Station alarm connection control – direct to the Airport Main Terminal Operations Bridge.

11. Air handling systems shutdown control.
12. Magnetic door holder release.
13. Dry pipe sprinkler release valve/deluge valve control.
14. Sprinkler supervisory switches and tamper switch supervision.
15. Battery standby.
16. Capacity for future Kitchen Ansul System Monitoring

1.03 APPLICABLE CODES AND STANDARDS

A. All equipment shall be UL listed for its intended use and conform to the latest UL Standards.

B. Underwriters Laboratories Inc.: The system and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

UL 864/UOJZ, APOU	Control Units for Fire Protective Signaling Systems.
UL 268	Smoke Detectors for Fire Protective Signaling Systems.
UL 268A	Smoke Detectors for Duct Applications.
UL 217	Smoke Detectors Single Station.
UL 521	Heat Detectors for Fire Protective Signaling Systems.
UL 228	Door Holders for Fire Protective Signaling Systems.
UL 464	Audible Signaling Appliances.
UL 1638	Visual Signaling Appliances.
UL 38	Manually Activated Signaling Boxes.
UL 346	Waterflow Indicators for Fire Protective Signaling Systems.
UL 1971	Standard for Signaling Devices for the Hearing Impaired
UL 1481	Power Supplies for Fire Protective Signaling Systems.
UL 1711	Amplifiers for Fire Protective Signaling Systems.

C. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code.
2. NFPA 72 National Fire Alarm Code.
3. NFPA 90A Standard for The Installation of Air Conditioning and Ventilating Systems.
4. NFPA 101 Life Safety Code.
5. NFPA 720 Standard for the Installation of Carbon Monoxide (CO) Detection and Warning Equipment.

D. This installation shall comply with:

1. Americans with Disabilities Act (ADA).
2. ICC A117.1-2009 Handicap Compliance.
3. National Electric Code, Article 760.
4. Local and NY State Building Codes and the Local Authorities Having Jurisdiction.
5. FM Global (Factory Mutual (FM): FM approval guide.
6. International Standards Organization(ISO): ISO-9002.

1.04 RELATED DOCUMENTS

A. Secure and pay for all required permits and approvals prior to installation.

B. Prior to commencement and after completion of work notify Authorities Having Jurisdiction.

C. Submit letter of approval for installation before requesting acceptance of system.

1.05 SYSTEM DESCRIPTION

A. Basic Desigo® Fire Safety (a Siemens Product) – The system shall be a complete, electrically supervised fire detection and notification system, with a microprocessor-based operating system having the following capabilities, features, and capacities:

1. Up to 32 nodes shall be networkable in a peer-to-peer configuration.
2. Communications between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide display. Any network node shall be capable of supporting a local system with the same capacities and features specified herein.
3. The local system shall provide status indicators and control switches for all of the following functions:

   a. Audible and visual notification alarm circuit zone control.
   b. Status indicators for the sprinkler system water-flow and valve supervisory devices.
   c. Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking, and security with bypass capabilities, etc.

1.06 PERFORMANCE REQUIREMENTS

A. General Performance: The entire fire alarm system and all devices shall comply with NFPA 72 and all Contract Documents and specification requirements.

B. The system shall have Class B (Former Style 4) circuits for each floor. The system shall operate in the alarm mode upon actuation of any alarm initiating device. The system shall remain in the alarm mode until all initiating devices are reset and the fire alarm control panel is manually reset and restored to normal.

C. The system shall be capable of the following configurations. Both configurations are permitted on the same network.

1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
2. The system shall support two (2) loops of 252 addressable devices, each of which may be divided in any ratio on one (1) or two (2) isolated Class A circuits.

D. The system shall support H-series devices and Desigo® series devices

E. The system shall support X-Series I/O modules & X-Series manual pull stations with built-in isolation capability with ISOtechnology™.

F. The system shall have an optional digital alarm communication transmitter.

G. The system shall provide an off-normal warning prior to reset for all active devices.

H. The system shall be capable of remote monitoring via Desigo® FS View®, a proprietary software system that provides a graphical representation of the fire alarm control panel at a remote PC when connected via Ethernet to the system. The display will show the exact state of the panel, including blinking LEDs, and with menu buttons for control. The remote connection shall be coordinated with the Airport Facilities and Security staff. Utilize fiber cable connection to the Airport Central Fire Alarm Management System.

I. The system shall be capable of being configured via a PC Tool.

J. In networked systems, each fire alarm control panel (where shown on the Contract Drawings) shall be configured to be a global annunciator, capable of viewing all other control panels on the network. This shall be coordinated with the Airport Facilities and Security staff.

K. The system shall provide the following functions and operating features:

1. The FACP and auxiliary power panels shall provide power, annunciation, supervision, and control for the system.
2. Provide Class B (formerly style 4) initiating device circuits.
3. Provide Class B (formerly style 4) signaling line circuits for the network.
4. Provide two (2) Class B (formerly style 4) notification appliance circuits. Arrange circuits to allow individual, selective, and visual notification by zone. Notification appliance circuits shall be zoned to correspond with the building fire barriers and other building features.
5. Audibles shall be synchronized throughout the entire building.
6. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

L. The system shall provide a field test function where one (1) person can test the complete system or a specific area while maintaining full operational function of other areas not being tested. All alarms, supervisory signals, trouble signals shall be logged in system history during the walk-test.

M. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.

N. Fire alarm signal initiation shall be by one (1) or more of the following devices:

1. Manual pull stations
2. Heat detectors
3. Addressable multi-criteria, dual optical smoke detectors
4. Addressable Carbon Monoxide (CO) sensors
5. Addressable Duct smoke detectors
6. Specialized Duct Smoke detectors
7. Automatic sprinkler system water flow and tamper switches.

O. Activation of any system fire, supervisory, trouble, or status initiating device shall cause the following actions and indications at all network Person Machine Interfaces (PMI) using an LCD display with multiple detail screens.

1. Fire Alarm Condition:

    a. Sound an audible alarm and display a custom message defining the building in alarm and the specific alarm point initiating the alarm on an LCD display.
    b. Log into the system history archives all activity pertaining to the alarm condition.
    c. Sound the ANSI 117-1 signal with synchronized audible notification appliances and synchronized strobes throughout the facility.
    d. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmable to flash until system reset or alarm silencing, as required.
    e. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
    f. Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall, in addition to the actions described, cause the recall of that elevator to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first-floor lobby, the recall shall be to the alternate floor as determined by the AHJ.
    g. The heat detectors in the elevator shaft and machine room shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to ensure that the power shall be shut off before activation of sprinkler system.
    h. System operated duct detectors as per local requirements shall accomplish HVAC shut down.
    i. Door closure devices shall operate by floor or by local requirements.

2. Supervisory Condition:

    a. Display the origin of the supervisory condition report at the local fire alarm control panel LCD display.
    b. Activate supervisory audible and dedicated visual signal.
    c. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
    d. Record within system history the initiating device and time of occurrence of the event.

3. Trouble Condition

    a. Display at the local fire alarm control panel LCD display, the origin of the trouble condition report.
    b. Activate trouble audible and visual signals at the control panel.
    c. Audible signals shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
    d. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and shall not require operator intervention. This feature shall be software selectable and shall not preclude the logging of trouble events to the historical file.
    e. Trouble reports for primary system power failure to the master

control shall be automatically delayed for a period of time equal to 25% of the system standby battery capacity to eliminate spurious reports as a result of power fluctuations.

f. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.

P. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1.07 RELATED WORK

A. The Contractor shall coordinate work in this Section with all related trades. Work and/or equipment provided in other Sections and related to the fire alarm system shall include, but not be limited to:

1. Sprinkler waterflow and supervisory switches shall be furnished and installed by the Fire Protection Contractor but wired and connected by the Electrical Contractor.
2. Duct smoke detectors shall be furnished, wired, and connected by the Electrical Contractor. The HVAC Contractor shall furnish necessary duct opening to install the duct smoke detectors.
3. Air handling and smoke exhaust system fan control circuits and status contacts shall be furnished by the HVAC control equipment.
4. Elevator recall control circuits shall be provided by the elevator control equipment. Any shunt trip circuit breakers and related wiring required for ANSI A17.1 compliance shall be provided by the Electrical Contractor.
5. Dry pipe sprinkler system release valve control circuits and supervision contacts shall be provided by the dry pipe sprinkler system control equipment.
6. Future Kitchen hood extinguishing systems status monitoring.
7. Fire pump status monitoring.

    a. Pump failure (fail to start) indication
    b. Pump running indication
    c. Phase reversal indication

8. Emergency generator status monitoring.

    a. Running indication
    b. Fail to start indication

9. Raceways and Boxes: Section 26 05 33
10. 600V Wire and Cable: Section 26 05 19.
11. Provide a dedicated outgoing data fiber lines and conduits to the main tele/data room for airport central monitoring. Quantities and cables as required.

1.08 SUBMITTALS

A. Provide list of all types of equipment and components provided. This shall be incorporated as part of a Table of Contents, which will also indicate the manufacturer’s part number, the description of the part, and the part number of the manufacturer’s product datasheet on which the information can be found.

B. Provide a fire alarm system function matrix as referenced by NFPA 72, Figure A-7-5.2.2 (9). Matrix shall illustrate alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions. Include any and all departures, exceptions, variances or substitutions from these specifications and/or drawings at time of bid.

C. Provide manufacturer's original printed product data, catalog cuts, and description of any special installation procedures. Photocopied and/or illegible product data sheets shall not be acceptable. All product data sheets shall be highlighted or stamped with arrows to indicate the specific components being submitted for approval.

D. Provide manufacturer's installation instruction manual for specified system.

E. Provide samples of various items when requested.

F. Provide copy of NY State License to perform such work.

G. Provide shop drawings as follows:

1. Cover sheet with project name, address and drawing index.
2. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.
3. Device riser wiring diagram, which individually depicts all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed point descriptor above each addressable device. Shall include a specific, discrete point address that shall correspond to addresses depicted on the device layout floor plans. Drawing shall provide wire specifications, and wire tags shown on all conductors depicted on the riser diagram. All circuits have designations that shall correspond with those required on the control panel and floor plan drawings. End-of-line resistors and values shall be depicted.
4. Control panel termination drawings shall depict internal component placement and all internal and field termination points. Drawings shall provide a detail indicating where conduit penetrations shall be made, so as to avoid conflicts with internally mounted batteries. For each additional data gathering panel, a separate control panel drawing shall be provided, which clearly indicated the designation, service, and location of the control enclosure. End-of-line resistors and values shall be depicted.
5. See section 3.05 DOCUMENTATION AND TRAINING for other documents relating to this section.
6. Typical device wiring diagram drawings shall be provided which depict all system components, and their respective field wiring termination points. Wire type, gauge, and jacket shall also be indicated. Diagrams shall indicate all conduit sizes and types. When an addressable module is used in multiple configurations for monitoring or controlling various types of equipment, different device typical diagrams shall be provided. End-of-line resistors and values shall be depicted.
7. Device layout floor plans shall be created for every area served by the fire alarm system. CAD Files (AutoCAD – latest edition) shall be provided by the Engineer for the fire alarm system equipment vendor in the preparation of the floor plans. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be no less than 1/8" scale. All

addressable devices shall be depicted with a discrete address that corresponds with that indicated on the Riser Diagram. All notification appliances shall also be provided with a circuit address that corresponds to that depicted on the Riser Diagram. If individual floors need to be segmented to accommodate the 1/8" scale requirements, key plans, and break-lines shall be provided on the Contract Documents in an orderly and professional manner. End-of-line resistors and values shall be depicted.

8. Contained in the title block of each drawing shall be symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the cover sheet drawing. A section of each drawing's title block shall be reserved for revision numbers and notes. The initial submission shall be Revision 0, with Revision A, B, or C as project modifications require.
9. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from the respective Contractors of the items involved:

    a. Light fixtures.
    b. HVAC registers
    c. Fire protection equipment interfaces
    d. Special suppression system interfaces

H. Battery calculations shall be provided on a per power supply/charger basis. Battery sizing shall be a minimum of 125% of the calculated requirement. NAC circuit design shall incorporate a 20% spare capacity for future expansion. These calculations shall clearly indicate the quantity of devices, the device part numbers, the supervisory current draw, the alarm current draw, totals for all categories, and the calculated battery requirements (which reflect a 20% degrade, for 24 hours supervisory 5-minute alarm operation). Battery calculations shall also reflect all control panel component, remote annunciator, and auxiliary relay current draws. Voltage drop calculations for wiring runs demonstrating worst-case condition. Failure to provide these calculations shall be grounds for the complete rejection of the submittal package.

I. Table of contents, product data sheets, sequences of operation, battery calculations, installation instructions, licenses, NICET certifications and B-Size reduced shop drawings shall be provided by the fire alarm vendor as part of a single, spiral bound submittal book. The submittal book shall have laminated covers indicating the project address, project number, system type, and the Contractor. The book shall consist of labeled dividers, and shall not exceed 9 ½" in width, and 11 ½" in height. No less than three (3) sets of submittal booklets shall be provided to the Engineer for review and comment. Additional copies may be required at no additional cost to the project.

J. Scale drawing sets shall be submitted along with the submittal booklets. These drawings may be either D-Size or E-Size Blueline drawings and of a sufficient resolution to be completely read. Sets shall be bound and folded so as to not take up more than 100 square inches of space. No less than three (3) sets of scale drawing sets shall be provided to the Engineer for review and comment. Additional copies may be required at no additional cost to the project.

1.09 SUPPLIER QUALIFICATIONS

A. Prior to any fire alarm work, the Contractor shall contact the County fire alarm Contractor.

B. The manufacturer of the supplied products must utilize multi-channel product distribution on a national basis to be considered for this bid. The manufacturer must have factory branches as well as independent distributors to allow the end user with the ability to utilize factory trained and authorized competitive service providers after system installation and commissioning.

1. Provide the services of a factory trained and certified representative or technician, experienced in the installation and operation of the type of system provided. The representative shall be licensed in the State of New York.
2. The technician shall supervise installation, software documentation, adjustment, preliminary testing, final testing, and certification of the system. The technician shall provide the required instruction to the owner's personnel in the system operation and maintenance.
3. The suppliers shall furnish evidence they have an experienced service organization, which carries a stock of spare and repair parts for the system being furnished.
4. The equipment supplier shall be authorized and trained by the manufacturer to calculate, design, install, test, and maintain the air sampling system and shall be able to produce a certificate stating such upon request.

C. Installer Qualifications:

1. Before commencing work, submit data showing that the manufacturer has successfully installed fire alarm systems of the same scope, type, and design as specified.
2. The Contractor shall submit copies of all required Licenses and Bonds as required in NY State.
3. The manufacturer representative shall employ on staff a minimum of one (1) NICET certified designer, technician, and/or a professional engineer, registered in the State of New York, as required by the AHJ.
4. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

D. Testing Agency Qualifications: Qualified for all the testing indicated.

E. Source Limitations for fire alarm equipment: Obtain fire alarm equipment from a single source.

F. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.
3. Combustion Characteristics: ASTM E 136.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in

NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Pre-installation Conference: Schedule and conduct conference with all stakeholders at the Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, and shelf life if applicable.

B. Store materials inside, under cover, above ground, and kept dry and protected from physical damage until ready for use. Remove from site and discard wet or damaged materials.

1.11 WARRANTY

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least two (2) years from the date of acceptance or approval by AHJ. The full cost of maintenance, labor and materials required to correct any defect during this one-year period shall be included in the submittal bid.

1.12 SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for one (1) year.

B. Upgrade Service: Update software to latest version at the Project completion. Install and program software upgrades that become available within two (2) years from the date of AHJ approvals. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to the Owner to allow scheduling and access to system and to allow the Owner to upgrade computer equipment if necessary.

1.13 SPARE MATERIALS

A. Furnish 10% extra spare materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. The parts shall include, but are not limited to, main system equipment (motherboards, processors, cards, etc.) and peripheral components (field devices such as initiating devices and notification appliances).

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

1. Siemens NYC Branch Office - Jeff Toldo 732-757-7847

B. If equipment of another manufacturer is to be submitted for approval as equal, the Contractor shall, at the time of bid, list all exceptions taken to these Specifications, all variances from these Specifications and all substitutions of operating capabilities or equipment called for in these Specifications and forward said list to the Engineer. Any such exceptions, variances, or substitutions that were not listed at the time of bid and are identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination of compliance with these Specifications shall rest with the Engineer, who, at his discretion, may require proof of performance.

C. Alternate product submissions made without proof of no less than three (3) factory authorized and certified manufacturer's distributors residing within 50 miles of the project job site shall be rejected. These distributors must not only provide installation support but must have a service organization capable of 24-hour emergency call service and must have completed no less than five (5) accepted projects using the submitted products.

D. Alternate product submissions based upon use of a product line considered proprietary in its distribution, design, application software, or ongoing maintenance and repair shall not be acceptable. Proof of a product's non-proprietary nature shall be the burden of the contractor at the time of Bid and shall be in the form of written documentation. The determination of a product's compliance to this requirement shall be exclusively that of the Engineer.

E. All products used shall be of a single manufacturer. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.

2.02 CONTROL PANEL

A. The fire alarm control panel shall be microprocessor based using multiple microprocessors throughout the system providing rapid processing of smoke detectors and other initiation devices information to control system output functions.

B. There shall be a watchdog circuit, which shall verify the system processors and the software program. Problems with either the processors or the system program, the panel shall activate a trouble signal and reset the panel.

C. The system modules shall communicate with an RS-485 network communications protocol. All module wiring shall be to terminal blocks.

D. The Desigo® Fire Safety FC and FV2025 system shall be capable of the following configurations. Both configurations are permitted on the same network.

1. The system shall support up to 252 addressable devices, which may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
2. The system shall support 252 addressable devices, each of which may be divided in any ratio on one or two separate isolated Class A circuits.

E. The Desigo® Fire Safety FC and FV2050 system shall be capable of the following configurations. Both configurations are permitted on the same network.

1. The system shall support up to 504 addressable devices, which includes a second SLC configuration and each may be divided in any ratio on one, two, three, or four separate, isolated Class B circuits.
2. The system shall support 504 addressable devices, each of which includes a second SLC configuration and each may be divided in any ratio on one or two separate isolated Class A circuits.

F. The system shall be capable of supporting unshielded wiring applications.

G. The system shall be compliant with the requirements of NFPA 720 as a Carbon Monoxide Detection Control Unit and shall meet the UL 2075 listing requirements. All inputs from CO sensors shall be indicated visually and audibly at the control panel. CO sensor inputs shall be distinct and descriptively annunciated from other signals.

H. System Components:

1. The System Periphery board shall be capable of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits. Any trouble on one (1) circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on-board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LEDs on the board shall provide annunciation for the following; Power, Ground Fault, Alarm, and Trouble. This board is integral to the system. The board shall be model number FCI2016-U1.
2. The system periphery board shall be capable of supporting two (2) system drivers of 252 intelligent devices distributed between one, two, three, or four Class B SLC circuits, for a total panel capacity of 504 addressable devices. Any trouble on one (1) circuit shall not affect the other circuit. This module controls the signaling from the initiation devices reporting alarms and troubles to the control panel. This module shall also provide the signaling to the field devices for the controlling the output of specific initiation devices. The on-board microprocessor provides the periphery board with the ability to function even if the main microprocessor fails. LEDs on the board shall provide annunciation for the following: Power, Ground Fault, Alarm, and Trouble. This board is integral to the system. The board shall be model number FCI2017-U1.
3. The Signal Line Circuits (SLC) shall be tested for opens, shorts, and communications with all addressable devices installed before connection to the control panel. Systems without this capability shall have a test panel installed for initial testing to eliminate any possible damage short term or long term to the control panel. After initial testing replace the test panel and proceed with complete testing.
4. The standard Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Desigo® Fire Safety control panels, when configured as a global PMI. The standard operator interface can acknowledge, silence, and reset panels via Global PMI.
5. The LED Operator Interface shall have the ability to view events, acknowledge, silence, and reset the system and any networked Desigo® Fire Safety control panels, when configured as a global PMI. Additionally,

the operator interface provides twelve multicolored configurable LEDs for annunciating system status.

6. The System Periphery Board shall contain two (2) Class B NAC circuits rated at 3 amps each with power-limited outputs. The zones shall be isolated and independently supervised. There shall be at least six (6) unique codes/signals for each circuit based on system logic. These signals shall be Temporal Code 3 (Evacuation), Steady (Such as “Recall”), Temporal Code 3 (for CO alarms), March Time 120ppm, March Time 60ppm, and March Time 30ppm. The card shall have the following LEDs to provide trouble shooting and annunciation, Power, Ground Fault, Zone Activation, or Trouble. This functionality shall be integral to the system. The card shall be model number FCI2016-U1/FCI2017-U1.
7. The control panel shall be equipped with four (4) Form C relays for alarm, trouble, supervisory, and programmable output. The system shall provide the mounting of all system cards, field wiring, and panel’s inter-card wiring. All power limited field wiring shall be separated from all non-power limited internal wiring. The card shall be model number FCI2016-U1/FCI2017-U1.

I. System response time from alarm to output shall comply with UL requirements.

J. All system cards and modules shall have Flash memory for downloading the latest module firmware.

K. Passwords:

1. Technician Level Password - There shall be an 8-character password that a User must enter into the control panel in order to perform such maintenance- and control-related functions at the panel as:

    a. Arming and disarming devices.
    b. Activating, deactivating, or modifying detector ASD and sensitivity settings.
    c. Activating and deactivating the History Log function and deleting obsolete entries.
    d. Changing the system time and date.

2. Maintenance Level Password - There shall be an 8-character password that a User must enter into the control panel in order to access the panel's reporting functions and walk test functions.
3. Acknowledge Silenceable Reset Access - There shall be a key required to open a locked cabinet that a system User must use in order to acknowledge events, turn silenceable audibles and visuals ON and OFF, and perform panel resets.

L. Networking:

1. Digital communication capabilities supporting Class B or Class A communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with up to 4 16 FACPs.
2. Digital communication capabilities supporting Class B or Class A communications using either DC digital or fiber optics technologies or combinations of both as required for the control panel to communicate with up to 32 network nodes.

3. Communication protocol shall be of the RS-485 type.

M. Network Fiber Modules

1. Desigo® Fire Safety model FN2007-U1 (multimode) and FN2006-U1 (single mode).
2. The network fiber interface modules shall be used to transmit RS-485 communications between Desigo® Fire Safety intelligent addressable fire alarm control panels. Each module shall have power, transmit, and receive status LEDs. The module can act as a repeater or end-point unit, in a daisy chain configuration.
3. Model FN2006-U1 / FN2007-U1 can be mounted in a Desigo® Fire Safety one-height-unit or two-height unit enclosure and can operate in a daisy-chain configuration. The connection between single-mode fiber-optic modules uses two (2) high-quality duplex 9/125 fiber optic cables and ST-style fiber connectors. The duplex fiber-optic cable has two (2) cables in a single shield similar to an electrical zip cord. Each segment of the fiber network can be up to approximately 10 miles. The connection between multi-mode modules uses two (2) high-quality duplex 50/125 or 62.5/125 fiber-optic cables and ST-style fiber connectors. The duplex fiber-optic cable has two (2) cables in a single shield similar to an electrical zip cord. Each segment of the fiber network can stretch up to 3,937 ft. For both single-mode and multi-mode installations, overall system fiber length is limited by the communication delay across the entire fiber network. Total network length should not exceed approximately 63,000 ft. Each segment of the fiber network can be up to 1.9 miles. The fiber module shall have a minimum operating power output budget of -13dB for 62.5/125 cable and -9dB for 50/125 cable.
4. The Network Card FN2001-U1 shall provide internode (SafeDLink) communication between enclosures. SafeDLink communication shall support Class B or Class A wiring (in a ring configuration). This card shall plug into the system operator interface.
5. The Modular Ethernet Switch (Model FN2012-A1) serves as a network connector between Models FC2025, FC2050, and FT2050 fire-only Desigo® Fire Safety FACPs and with Model FV2025 / FV2050 Desigo® Fire Safety intelligent systems. Panel-to-panel communication is transmitted via CAT5, single-mode fiber or multi-mode fiber. One (1) or two (2) Ethernet modules are supported by each Modular Ethernet Switch.
6. The Electric Ethernet Module (Model VN2001-A1) serves as a network connector between Siemens' fire-only FACPs and with intelligent voice-communication systems.
7. The Multi-Mode Ethernet Module (Model VN2002-A1) serves as a network connector between Siemens' fire-only FACPs and with intelligent voice-communication panels, via multi-mode fiber-optic cables.
8. The Single-Mode Ethernet Module (Model VN2003-A1) serves as a network connector between Siemens' fire-only FACPs and with intelligent voice-communication panels, via single-mode fiber-optic cables.

N. Degrade Mode Alarm Activation:

1. Each Desigo® Fire Safety panel shall operate as a stand-alone fire alarm control panel with complete functionality in the event of loss of communications with other Desigo® Fire Safety panels on a network.

O. Software Modifications: The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made. Systems that require the use of external programmers or change of EPROMs are not acceptable.

P. Logic: The fire alarm system shall support generic functions that deal with binary states (True/False, high/low) and produce desired outputs from one (1) or more binary inputs (for example, alarm outputs from detector or manual station inputs). AND, OR, NOT, Any N, Latches, Start Timer, Delay Timer, Restart Timer are generic functions. Generic functions can be used as inputs to other function. The system shall support 500 logic functions.

Q. History: The system shall store 10,000 events in history. Trouble warnings will occur when the history buffer is full.

R. Reports:

1. The system shall have the ability to provide configuration, status, queue, and history reports.
2. Configuration reports shall provide the following information:

    a. Custom Messages
    b. Database Information
    c. Entity Type
    d. Zone usage
    e. Device Category
    f. Firmware revision
    g. Status reports shall provide the following information:
    h. Disarmed cards and devices
    i. ASD settings
    j. Sensitivity in %/foot
    k. Alarm threshold in %/foot
    l. Temperature in degrees F.
    m. Walk test

3. Status reports shall provide the following information:

    a. Disarmed cards and devices
    b. ASD settings
    c. Sensitivity in %/foot
    d. Alarm threshold in %/foot
    e. Temperature in degrees F.
    f. Walk test

4. Queue reports shall provide the following information:

    a. Alarm events with custom message and event time
    b. Mass notification events with custom message and event time
    c. Gas alarm events with custom message and event time
    d. Supervisory events with custom message and event time
    e. Trouble events with custom message and event time
    f. Status events with custom message and event time
    g. Information events

5. History reports shall provide Address, History Type, Description, Time & Date and Custom Message. The following event types shall be reported:

   a. Alarm events
   b. Gas alarm events
   c. Supervisory events
   d. Status changes
   e. Alarm verification
   f. Output activation from logic
   g. System Reset
   h. Event Acknowledgements
   i. Block Acknowledgements
   j. Audible Silence System Flag Changes
   k. Sensitivity Changes
   l. Arm / Disarm Commands
   m. Arm / Disarm By Logic
   n. Manual Output Overrides
   o. Output Overrides By Logic
   p. Time Changes
   q. Menu Logins
   r. ASD Changes
   s. Walk test
   t. Device Input to Logic Activations/Deactivations

2.03 POWER SUPPLY

A. The system Power Supply FP2011-U1 shall be a 170 Watt, 6-amp that provides 24VDC power for system operation. The power supply shall be filtered and regulated. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated 120/240VAC 50/60Hz. The module shall be model number FP2011-U1.

B. The system Power Supply FP2012-U1 shall be a 300 Watt, 9-amp that provides 24VDC power for system operation. The power supply provides power for all system operation, including signaling line circuits, notification appliance circuits, auxiliary power, battery charger, and all optional modules. The power supply shall be rated 120/240VAC 50/60Hz. The module shall be model number FP2012-U1.

C. For applications requiring greater than 300W of power, the Model FP2013-U1 power supply can optionally power a Model FV2025 or FV2050 system. Model FP2013-U1 consists of two (2) power supply units and one (1) interconnection cable, in order to balance the power from Model FP2013-U1. Consequently, this power-supply configuration can provide up to 600W at 24VDC.

D. The battery charger shall be able to charge the system batteries up to 100AH batteries. Battery charging shall be microprocessor controlled and programmed to select battery sizes.

E. Transfer from AC to battery power shall be instantaneous when AC voltage drops to a point where it is not sufficient for normal operation.

2.04 REMOTE POWER SUPPLY FOR NON-VOICE NOTIFICATION APPLIANCES

A. The PAD-5 power supply unit shall be used with a Siemens Desigo® System. It shall an addressable NAC distributed controller to provide power to visual strobe circuits or supply auxiliary power to such items as door holder circuits.

B. The PAD-5 shall communicate on the SLC loop to the Siemens Desigo® Control Panel. It shall provide status monitoring, device level fault indications, and individual NAC control using a single address on the SLC. The PAD-5 unit shall provide a constant 24VDC nominal output voltage to each NAC-independent of voltage fluctuations on the primary or secondary power source.

C. The PAD-5 shall be a self-contained unit with 24VDC power supply and batteries housed in its own locked enclosure. Enclosure shall be made of 16 GA cold rolled steel, lockable, and having the same key as the other control enclosures. Shall have two (2) sizes (1-unit and a 2-unit) and colors (red and black).

D. The power supply shall be UL 864 listed and available in 6A and 9A models and 120VAC.

E. The power supply is able to support up to 18AH batteries in a single unit and 35AH in a 2-unit enclosure. Shall be able to support up to 100AH batteries in a separate enclosure.

F. The power supply shall have four (4) independent 3 amp rated NAC circuits, expandable to a total of eight (8) Class B or four (4) Class A circuits or a mixture of each with an expansion CLSA card.

G. The power supply shall have the ability to add one (1) of two (2) types of expansion cards which take one (1) additional address on the SLC:

1. CLSA expansion card provides additional NAC circuits and can be configured with two (2) Class B or one (1) Class A releasing circuits with on board service disconnect switches.
2. CDC Conventional Zone Module is an expansion card that provides four (4) Class A or B conventional detection zone input circuit or shorting device (non-alarm) input circuits

H. The power supply shall be a Class X isolating device residing on the SLC loop.

I. Each NAC output can be configured as an Aux Power output or a non-alarm closure input circuit.

J. Complete status monitoring to the individual circuit level at the main FACP and on-board LED status and diagnostic indicators.

K. The PAD-5 is fully configurable through the Siemens system configuration tool.

L. Output circuits shall be configured individually as Steady On, Temporal 3, Temporal 4, March Time 30, 60, or 120PPM.

M. All NAC circuits have synchronized strobe outputs, any combination of PAD-5 Main Boards and Expansion cards up to 32 can be synchronized on the same addressable loop.

N. A dedicated Bell Follower circuit shall be used to achieve synchronization across multiple SLC loops.

O. Shall be able to accept a range of End of the Line (EOL) resistor values (2.2K to 24KΩ) without having to program or configure unit.

2.05 SYSTEM ENCLOSURE

A. Provide the enclosure as specified. Provide the color as to the local AHJ requirements.

B. Provide two-height-unit backbox as part of the Desigo® Fire Safety intelligent non-voice-communication system hardware for use with 2HU system enclosures. Specifically, each backbox is used to fasten with a 2HU outer door.

C. Provide black cabinet enclosure.

2.06 REMOTE ANNUNCIATOR

A. LED annunciator panels: Provide Siemens Model FT2008 (16-zone) or FT2009 (32-zone) LED annunciators. Each LED annunciator shall provide the LED indicators for each zone including alarm, supervisory, and trouble per zone. System status LEDs shall also be provided indicating Reset, Audibles ON, Silenced, Acknowledge, Ground Fault, System Fault, and Power. Key-switch lock protected buttons shall provide system control for Reset, Silence/Un-silence, Acknowledge, and Lamp Test. Both versions of the LED annunciator shall be available with red and black housings.

2.07 DIGITAL COMMUNICATOR

A. The Multi-Point Digital Alarm Communicator FCA2015-U1 shall be UL864 listed to provide point identification of alarm, supervisory, security, and trouble events to a Central or Remote Receiving Station. The DACT shall support the following:

1. Ademco Contact ID or SIA protocol.
2. Ademco Contact ID selection shall provide the ability to transmit events for up to 999 individual zones.
3. SIA selection shall provide the ability to transmit events for up to 10000 individual points.
4. Programming of accounts and phone numbers.
5. Cellular connectivity.
6. Line fault monitoring.
7. Automatic 24-hour test
8. The DACT supports configurable alarm, alarm restoral, trouble, trouble restoral, supervisory, supervisory restoral and reset events.
9. The DACT supports Ademco Contact ID alarm event codes for general alarm, smoke detector alarm, waterflow alarm, duct alarm, and manual alarm events.
10. Optionally, the DACT can be programmed to report events by event queue only.

2.08 REMOTE CONNECTIVITY

A. The Remote Access feature shall provide automatic notification of system faults and

remote diagnostics of system status for responding technicians prior to arrival on site.

B. A UL listed Connect Device with a built-in firewall to connect to a TCP/IP network for remote connectivity to the internet or intranet.

C. The remote connection shall support a building existing network infrastructure with existing proxy servers and firewalls and shall not require any special changes or modifications.

D. The Connected device shall have an option for connecting to the internet via a cellular network.

E. The remote access solution shall be able to connect to the cloud applications without the need for a VPN account or similar tunnel.

F. Connect Device BIOS is password protected.

G. Connect Device USB and display ports are restricted to keyboard, 4G dongle or display only; support for memory drives or any similar devices on USB ports is disabled.

H. Operating system on the Connect Device is a Linux distribution protected by encryption keys where SSH connections are disabled.

I. To verify the authenticity of the gateway, each Connect Device is required to register and authenticate with cloud applications using a 32-digit unique Activation key before it can be used for normal operation.

J. As a part of initial setup, a login to the Connect Device web application is required where:

1. User is forced to change default password when logging in for the first time.
2. Strong password is required with at least 8-characters, upper-case and lower-case letters, numbers, special characters.

K. One (1) Connect Device per fire network is required that connects to a fire system via ethernet.

L. The use of non-listed external third-party interfaces is not acceptable.

M. Remotely view the system status information using a color-coded dashboard and obtain the panel’s event information including event type, custom message, address, and status prior to arriving on site outside of the fire system thorough a PC, tablet, or mobile phone.

N. Remote notifications through Email and SMS messages shall be available.

O. Remotely access and download the panel’s event history.

P. Remotely access the fire panel’s application version information.

Q. Host cloud application services through AWS and Azure.

R. The system transmits encrypted data using AWS Standard Encryption 256-AES and HTTPS/TLS 1.2 Encryption.

S. The AWS encryption meets or exceeds with the Federal Information Processing Standard (FIPS) 140-2 standards.

T. Provides a secure authentication to verify the identity of the User.

U. Sensitive information shall not be logged to history or displayed on service tools (e.g., Password, PINs, etc.).

V. A role-based access control (RBAC), limiting a user to applications and features. Access to sites and devices is limited by organizations and scopes.

2.09 INTELLIGENT INITIATING DEVICES

A. General

1. All initiation devices shall be insensitive to initiating loop polarity. Specifically, the devices shall be insensitive to plus/minus voltage connections. Except when built-in isolation with ISOtechnology™ is used, polarity sensitivity is required for the devices configured in isolation mode.

B. Smoke Detectors – S-Line - Addressable FDOO-Series

1. The detectors shall be guaranteed in writing not to false alarm when configured by the factory trained certified technician. The detectors shall provide at least 19 different environmental algorithms that allow the detector to provide superior false alarm immunity without the need for additional alarm verification delays.
2. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: GREEN for normal operation, AMBER for maintenance required, and RED for alarm.
3. Detectors shall utilize state of the art forward/backward light scattering technology, with improved detection for smoldering and flaming fire signatures. The detectors shall replace the need for ionization detectors due to improved response characteristics to flaming fires.
4. Detectors shall provide pre-alarm signal at 0.2% obs./ft. and a full alarm at 1.0% obs./ft. to meet the performance requirements of NFPA 76 - National Fire Protection Association Standard 76, Fire Protection of Telecommunications Facilities as a Very Early Warning Fire Detector (VEWFD).
5. The forward/backward light scattering technology shall provide improved immunity to spurious activation (deceptive phenomena). The detectors shall have a “No False Alarm Guarantee.”
6. The detectors shall be RoHS-compliant: The detectors shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.
7. The multi-criteria detector with CO input shall be UL 2075 compliant as a gas and vapor detector.
8. The multi-criteria fire detectors shall be an intelligent digital photoelectric detector with a programmable heat detector. Detectors shall be listed for use as open area protective coverage, induct installation, and sampling

assembly installation and shall be insensitive to air velocity changes. The detectors' communications shall allow the detectors to provide alarm input to the system and alarm output from the system within four (4) seconds. So as to minimize the effort required by the installation and maintenance technician to appropriately configure the detector to ensure optimal system design, the detectors shall be programmable as application specific. Application settings shall be selected in software for a minimum of 19 environmental fire profiles unique to the devices installed location.

9. The detectors shall be designed to eliminate the possibility of false indications caused by dust, moisture, RFI/EMI, chemical fumes, and air movement while factoring in conditions of ambient temperature rise, obscuration rate changes, and hot/cold smoke phenomenon into the alarm decision to give the earliest possible real alarm condition report.
10. The detectors shall be capable of being field programmed for simultaneous and /or independent functionality, depending on the application. For example, the detectors shall be capable of utilizing the optical, heat, and/or CO sensors together for enhanced fire detection (multi-criteria) and simultaneously provide independent outputs for CO gas life-safety, smoke, and heat detection. Any combination of the sensors is possible.
11. The detectors shall be UL listed for operation in a 95% relative humidity (RH) environment.
12. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
13. The detectors shall support the use of a relay, or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
14. The detectors shall support the use of an ambient temperature warning signal at the panel. This temperature shall be User-configurable for the set temperature of the warning and the event type generated by the warning. This event can be used to trigger system logic.
15. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
16. UL Listed as "direct in-duct" mounting.
17. Detectors shall include optional built-in short circuit isolation, ISOtechnology.
18. Available models:

    a. FDOOT441. Multi-Criteria incorporating two (2) Optical sensors and two (2) Thermal sensors with an operating temperature range of 32°F to 120°F. Nineteen selectable profiles. Polarity insensitive installation wiring. Three (3) color LED.

C. Smoke Detectors – C-Line - Standard Addressable FD-Series:

1. The smoke detectors shall provide at least two (2) environmental parameter sets to assist in device sensitivity configuration.
2. The detectors shall have a tri-color LED to streamline system maintenance/inspection by plainly indicating detector status as follows: GREEN for normal operation, AMBER for maintenance required, RED for alarm.
3. The detector shall be RoHS-compliant and shall meet standards for Reduction of Hazardous Substances (RoHS) by reduction in lead content and other restricted substances.
4. The detectors shall be UL listed for operation in a 95% relative humidity

(RH) environment.

5. The detectors shall be designed to eliminate calibration errors associated with field cleaning of the chamber.
6. The detectors shall support the use of a relay or LED remote indicator without requiring an additional software address. Low profile, white case shall not exceed 2.5 inches of extension below the finish ceiling.
7. For the detectors where required, there shall be available a locking kit and detector guard to prevent unauthorized detector removal.
8. Detectors shall include optional built-in short circuit isolation, ISOtechnology.
9. Available models:

    a. Model FDOT421 - Multi-Criteria incorporating one (1) Optical sensor and one (1) Thermal sensor with an operating temperature range of 32°F to 100°F. Available in four (4) parameter sets. Polarity insensitive installation wiring. Three (3) color LED.
    b. Model FDO421 - Photoelectric Smoke detector with an operating temperature range of 32°F to 120°F. Available in three (3) parameter sets. Polarity insensitive installation wiring. Three (3) color LED.

D. Carbon Monoxide Detectors – Addressable

1. Addressable Carbon Monoxide (CO) sensor. The CO sensor shall have a 10-year lifetime from the date of installation. The CO sensor shall be an independent life-safety CO gas detector (in compliance with NFPA 720).
2. The sensor shall support the use of an ambient Carbon Monoxide (CO) warning signal at the panel. This ambient CO level shall be user-configurable in parts per million (PPM) for the set threshold of the warning and event type generated by the warning. This event can be used to trigger system logic.

E. Heat Detectors – Addressable

1. Thermal Detectors shall be rated at 135°F fixed temperature and 15°F per minute rate of rise. Detectors shall be constructed to compensate for the thermal lag inherent in conventional type detectors due to the thermal mass, and alarm at the set point of 135°F. The choice of alarm reporting as a fixed temperature detector or a combination of fixed and rate of rise shall be made in system software and be changeable at any time without the necessity of hardware replacement.
2. The detectors furnished shall have a listed spacing for coverage up to 2,500 square feet and shall be installed according to the requirements of NFPA 72 for open area coverage. The thermal detector shall be Model number FDT421.
3. Detectors shall include optional built-in short circuit isolation, ISOtechnology.
4. Model FDT421 heat detectors shall have the following temperature settings:

    a. Fixed temperature at 135°F, 145°F, 155°F, 165°F, or 174°F
    b. Rate of Rise at 15°F/ min at 135°F
    c. Rate of Rise at 15°F/ min at 174°F
    d. Low temperature warning at 40°F

F. Duct Smoke Detectors – Addressable

1. For duct detector applications, the smoke detector shall be an intelligent digital photoelectric detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes.
2. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds. The detector shall be mounted in a duct detector housing listed for that purpose. The duct detectors shall support the use of a remote test switch, relay, or LED remote indicator. The duct detector shall be supplied with the appropriate sampling tubes to fit the installation.
3. Where duct detectors are exposed to the weather a weatherproof enclosure shall be available. A NEMA-4X option shall be available. The duct housing cover shall include a test port for functional testing of the detector without cover removal. The duct housing shall include a cover removal switch capable of indicating cover removal status to the fire alarm control panel.
4. The intelligent duct detector shall have a Model number from the FDBZ-Series. Where required there shall be available a duct housing with an on-board relay. Also, where required, there shall be a standalone housing available with its own power supply and test/reset switch that does not require connection to a fire alarm control panel. It shall be Model FBZ492-PR.
5. Duct smoke detector housing shall allow use in duct systems with air velocity ranging from 100 to 4,000ft/min, within temperature ranges of 32°F to 120°F per minute, and with relative humidity ranging from 0 to 95%.
6. Detectors shall include optional built-in short circuit isolation, ISOtechnology.
7. Duct Housings and Accessories:

    a. FDBZ492 Global Air Duct Housing for Conventional and Addressable Detectors.
    b. FDBZ492-HR Global Air Duct Housing for Addressable P2 Detectors with Relay Application.
    c. FDBZ492-R Global Air Duct Housing for Conventional Detectors with Relay Application.
    d. FDBZ492-RP Global Air Duct Housing for Conventional Detectors with Relay Application and Built-in Power Source.
    e. FDBZ-WP Weather-Proof housing to accommodate all versions of Global Air Duct Housings.
    f. FDBZ-RTL Remote Test Lamp for Conventional Detectors.

G. Detector Bases – Addressable

1. Detector bases shall be low profile twist lock type with screw clamp terminals and self-wiping contacts. Bases shall be installed on an industry standard, 4” square or octagonal electrical outlet box.
2. Multi-Criteria Fire Detector Model FDOOTC441 shall be listed as providing CO detection in duct application.
3. The Model number for the standard base shall be DB-11 – 6” version.
4. The Model number for the standard base shall be DB-11E – 4” version.
5. The Model ABHW-4B houses a pre-wired, audible (sounder) device capable of generating a 3,000Hz tone that provides a signal up to 85dBA at 10ft for localized annunciation. With the exception of the 520Hz low frequency

square wave, the ABHW-4B shall meet the requirements of UL464. When used with a Desigo® Fire Safety intelligent detector, Model ABHW-4B has the option of being powered directly from a signal line circuit (SLC) in a two-wire configuration. All Model ABHW-4B bases are capable of sounding simultaneously, individually, or in any combination — depending upon the system configuration used on a Siemens FACP.

6. The Model ABHW-4S is a UL / ULC Listed supplementary smoke-detection device that meets or exceeds the 85dB at 10ft audibility requirement, including the low-frequency requirement of 520 Hz for 'Sleeping Areas'. The ABHW-4S shall meet the requirements of UL464. All Model ABHW-4S bases are capable of sounding simultaneously, individually, or in any combination: it is based upon the detector type, and when it is used and configured with a compatible Siemens FACP.

H. Manual Pull Stations – Addressable

1. Provide addressable manual pull stations which shall be flush or surface mounted as required. Manual pull stations shall contain the intelligence for reporting address, identity, alarm, and trouble to the fire alarm control panel. The manual pull station communications shall allow the station to provide alarm input to the system and alarm output from the system within less than four (4) seconds.
2. The manual pull stations shall be equipped with terminal strip and pressure style screw terminals for the connection of field wiring. Surface mounted stations shall be mounted using a manufacturer's prescribed matching red enamel outlet box.
3. The double action pull stations shall be Model number XMS-D. It shall provide built-in isolation capability with ISOtechnology™. The operator display shall indicate which specific device has detected a wiring fault on the data communication line.
4. Where required, there shall also be available pull stations with break glass, capable of weatherproof installation, reset key operation, and metal housings.
5. Manual pull stations shall include optional built-in short circuit isolation, ISOtechnology.

I. Addressable Interface Devices

1. Addressable Interface Devices shall be provided to monitor inputs (contacts) and control outputs (relays) to and from the fire alarm system and associated devices. These interface devices shall be able to monitor single or dual contacts. An individual address will be provided for each contact. Where a remote supervised relay is required, the interface shall be equipped with a SPDT relay rated for 4 amps resistive and 3.5 amps inductive. The addressable interface modules shall be Model FDCIO Series, XTRI Series, ILED-X series, TSM-1X, or HCP series.
2. Conventional Zone Modules shall connect to the Signal Line Circuit, which will allow the use of conventional initiation devices. The modules shall have the ability to support up to 15 conventional smoke detectors and an unlimited number of contact devices. The module shall be Model HZM.
3. Model XTRI Series devices shall provide input and outputs as needed by specific model numbers. The devices shall also provide built-in isolation capability with ISOtechnology™. The operator display shall indicate which specific device has detected a loop short on the data communication line.

4. Model FDCIO422 devices shall provide built-in isolation capability with ISOtechnology™. The addressable input/output modules shall be insensitive to polarity except when built in isolation ISOtechnology™ is used in which case polarity sensitivity is required for the devices configured in isolation mode. Additionally, the FDCIO422 devices shall have the capability for up to four (4) separate inputs (Class B); or two (2) separate Class A inputs; and four (4) separate outputs (Class B).
5. Model ILED-X addressable remote LED alarm indicators shall provide a visual notification for remote or concealed initiating devices. The devices shall also provide built-in isolation capability with ISOtechnology™.
6. Model TSM-1X addressable remote test switch shall provide an addressable normally open (N.O.) momentary switch with a tricolor light-emitting diode (LED) indicator. The LED indicator shall provide visual notification of the status of the tested device. The device shall also provide built-in isolation capability with ISOtechnology™.
7. Model HCP addressable control point shall provide remote, independent control of a single device.
8. Monitoring applications shall include, but is not limited to:

    a. Water flow switches
    b. Tamper switches
    c. PIV switches
    d. Damper position – All three (3) states on one (1) input
    e. Conventional devices (e.g., smoke detectors, heat detectors, etc.)
    f. Duct Detectors

9. Control applications shall include, but is not limited to:

    a. Notification Appliance Circuits (NAC)
    b. Telephone zones
    c. Speaker zones
    d. Damper position
    e. Solenoids for sprinklers

10. All interface devices shall meet NFPA 72 Class X requirements for survivability.

2.10 DEVICE PROGRAMMING UNIT

A. Device Programming Unit: The programming tool shall program the intelligent devices with addresses. The unit shall test the device to respond to its address. Dip switches and rotary switches shall not be acceptable. The programmer shall be Model DPU with carrying case.

2.11 ACEND ADVANCED FIRE ALARM NOTIFICATION APPLIANCES (LED BASED)

A. Series SC-HN, SC-ST, and SC-HS Horns, Strobes, and Horn/Strobes

1. The notification appliances shall be Siemens SC-HN Audible appliances, SC-ST Strobe appliances with LED strobe, and SC-HS Horn/Strobe appliances for wall and ceiling mount applications.
2. SC-ST and SC-HS Strobes and Horn/Strobes shall be listed for UL Standard 1971 (Emergency Devices for the Hearing Impaired) for Indoor Fire Protection Service.

3. The SC-HN Horns shall be UL Listed under Standard 464 (Fire Protective Signaling).
4. All Series shall meet the requirements of FCC Part 15 and ICES-003.
5. The SC-HS Horn/Strobe and SC-ST Strobe appliances shall produce a flash rate of one (1) flash per second over the 16-33 VDC Special Application Voltage Range and shall incorporate a Light Emitting Diode (LED) as the light source which can be used for ceiling and wall mount applications.
6. The appliances shall be of low current design.
7. The LED strobe flash duration shall be 20ms. The strobe intensity shall have field selectable settings at 15, 30, 75,110 candelas for wall and ceiling mount applications.
8. The selector switch for selecting the candela shall be a tamper resistant slider type.
9. Appliances with candela settings shall show the candela selection in a visible location at all times when installed.
10. The horn shall have a minimum of two (2) field selectable settings for dBA levels and shall have ten (10) synchronized audible outputs including

    a. Continuous
    b. Bell
    c. March Time Horn
    d. Code 3 Horn
    e. Code 3 Tone
    f. Code 4 Tone
    g. Slow Whoop
    h. Siren
    i. HI/LO
    j. Canadian March Time 30

11. The SC-HS Horn/Strobe, SC-ST Strobe, and SC-HN Horn mounting options shall include single-gang, 4” square, and double-gang backboxes for wall mount applications and an adapter trim kit for compatibility with 4” square and double-gang backboxes. Ceiling mount versions shall be compatible with 4” square and double gang backboxes.
12. All notification appliances shall be backwards compatible with Siemens’ legacy notification appliances.
13. The SC-HS, SC-ST, and SC-HN wall models shall have a low-profile design.
14. Synchronization is possible when using the Desigo® Modular panels including FC2005, FC2025, FC 2050, FV2025, FV2050, or PAD-3, PAD-4, or PAD-5 SERIES power supply with built-in sync protocol
15. The strobes shall not drift out of synchronization at any time during operation. If the sync protocol fails to operate, the strobe shall revert to a non-synchronized flash rate and still maintain one (1) flash per second over its UL listed Voltage Range.
16. The appliance shall also be designed so that the audible signal may be silenced while maintaining strobe activation.
17. The Strobe, Horn, and Horn/Strobe shall include a mounting plate and included jumper for pre-test of wiring prior to installation of the appliance.
18. The appliances shall be compatible with ACEND Advanced Mass Notification Text Cover and Lens Accessories.

2.12 CONDUCTORS

A. Each conductor shall be identified as shown on the submittal drawings at wire markers at terminal points. Attach permanent wire markers within 2 inches of the wire termination. Marker legends shall be visible.

B. All wiring shall be supplied and installed in compliance with the requirements of the National Electric Code, NFPA 70, Article 760, and that of the manufacturer.

C. Wiring for strobe and audible circuits shall be a minimum 14 AWG, signal line circuits minimum 18 AWG twisted.

D. All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer's recommendations.

E. Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

F. The Contractor shall submit for approval prior to installation of wire, a proposed color code for system conductors to allow rapid identification of circuit types.

G. Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

2.13 SUPPORT FOR INSTALLER AND OWNER MAINTENANCE

A. Provide a coded one-man walk test feature. Allow audible or silent testing. Signal alarms and troubles during test. Allow receipt of alarms and programmed operations for alarms from areas not under test.

B. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.

C. Provide loop controller diagnostics to identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions, and conventional open, short, and ground conditions. Ground faults on the circuit wiring of remote module shall be identified by device address.

D. Allow the User to display/report the condition of addressable analog detectors. Include device address, device type, percent obscuration, and maintenance indicator. The maintenance indicator shall provide the User with a measure of contamination of a device upon which cleaning decisions can confidently be made.

E. Allow the User to report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity. Include Facility Name, Licensee, Project Program Compilation date, Compiler Version, Project Revision Number, and the time and date of the History Report.

F. Allow the User to disable/enable devices, zones, actions, timers, and sequences. Protect the disabled function with a password.

G. Allow the User to activate/restore outputs, actions, sequences, and simulate detector smoke levels.

H. Allow the service User to enter time and date, reconfigure an external port for download programming, initiate auto programming and change passwords. Protect these functions with a password.

I. The End-User shall retain complete ownership to the programming database running in the system. The fire alarm equipment vendor shall provide useable hard and soft copies of the software database to the End-User at the end of the warranty period. The database provided shall be useable by any authorized and certified distributor of the product line and shall include all applicable passwords necessary for total and unrestricted use and modification of the database. The Engineer shall define the extent of hardcopy database documentation to be provided.

PART 3 – EXECUTION

3.01 INSTALLATION

A. The entire system shall be installed in a workmanlike manner, in accordance with the approved manufacturer's wiring diagram. The Contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets, and similar devices necessary for the complete installation. All wiring shall be of the type recommended by the manufacturer, approved by the County Fire Inspector and specified within.

B. The Electrical Contractor shall provide Fire Watches for all areas of the building that will be unprotected during removals and reinstallation of the fire alarm system as required by Westchester County officials.

C. All penetration of floor slabs and firewalls shall be sleeved (1" conduit minimum) fire stopped in accordance with all local fire codes.

D. End of Line Resistors shall be furnished as required for mounting as directed by the manufacturer. Devices containing end-of-line resistors shall be appropriately labeled. Devices shall be labeled so removal of the device is not required to identify the EOL device.

E. All manual pull stations shall be mounted 48 inches above the finished floor, as measured to the handle.

F. All audio/visual devices shall be mounted 80 inches above the finished floor, as measured to the lens. Devices shall be mounted no less than 6 inches from the ceiling. All audiovisual devices shall have lexan covers in all areas.

G. No area smoke detectors shall be mounted within 36 inches of any HVAC supply and return air registers, or light fixtures.

H. No area smoke or heat detector shall be mounted within 12 inches of any wall. All detectors shall be installed in strict accordance with NFPA 72 guidelines for such devices.

I. All mechanical rooms, boiler room, MEP closets, janitor's closets, etc. or areas with no hung ceilings shall be piped with 3/4" conduit, minimum. All device plenum rated

wiring shall be mechanically protected with conduit. All boxes shall be painted red and labeled “FIRE ALARM.”

J. All addressable modules shall be mounted within 36 inches of the monitored or controlled point of termination. This shall include, but is not necessarily limited to, fan shutdown, elevator recall, shunt trip, sprinkler status points, or door release. Label all addressable modules as to their function.

K. New door holders shall derive their 24VAC/VDC power from a separate power supply housed in a dedicated metal enclosure. The power supply shall have a 120VAC feed and is to be centrally located to serve door holders on a per floor or area basis. Locations and quantities of door holder power supplies shall be referenced and submitted in the submission package for approval by the Engineer.

L. All low voltage wiring terminated to the fire alarm system shall be plenum rated with no exceptions and no less than No. 18 AWG in size, and solid copper.

M. All line voltage (120VAC) wiring shall be no less than No. 12 AWG in size, and solid copper. This shall include all system grounding. FACP shall have a dedicated 20-amp circuit marked back at the emergency power panel via a lockable type breaker painted red.

N. All wiring shall be color-coded throughout, to National Electrical Code standards.

O. Power-limited/Non-power-limited NEC wiring standards shall be observed.

P. All junction box covers shall be painted federal safety red and labeled FIRE ALARM SYSTEM ONLY in black letters.

Q. Fire alarm system wiring shall not co-mingle with any other system wiring in the building. Conduits shall not be shared under any circumstance. Only when fire alarm wiring enters the enclosure of a monitored or controlled system will co-habitation be permitted (i.e., at fan starters or elevator controller).

R. Fire alarm control panel enclosures shall have engraved labels indicating, “FIRE ALARM SYSTEM,” and the areas of the building served by that panel.

S. Auxiliary relays shall be appropriately labeled to indicate “FIRE ALARM SYSTEM” and their specific function (i.e., FAN S-1 SHUTDOWN).

T. All fire alarm wiring shall be continuous and un-spliced. Terminations shall only occur at fire alarm devices or control panel enclosures under terminal screws. All other splicing methods are specifically disallowed (i.e., plastic wire nuts).

U. All fire alarm wiring shall be installed using a dedicated system of supports (i.e., bridle rings). Fire alarm wiring shall not be bundled or strapped to conduits, pipes, or wires in the building.

V. All fire alarm wiring shall be sleeved when passing through any wall, using conduit sleeves (1” min.) with bushings, and fire stopped in accordance with Code.

W. All fire alarm devices shall be accessible for periodic maintenance. Should a device location not meet this requirement, it shall be the responsibility of the Contractor to bring it, in writing, to the attention of the Engineer. Failure to bring such issues to the

attention of the Engineer shall be the exclusive liability of the Electrical Contractor.

X. The existing fire alarm system shall remain in operation until such time that approval has been granted for its removal. The installing Electrical Contractor shall be responsible for the upkeep of the existing system until such time that it can be removed.

Y. The Electrical Contractor shall be responsible for the removal of entire existing fire alarm system components and controls on the demolition drawing shown or not, upon approval of the AHJ and the Engineer. The End-User reserves the right to retain any existing fire alarm system components, upon their request. All existing fire alarm system components requiring special handling for disposal (due to radioactivity) shall be the responsibility of the Contractor. Written proof of proper disposal by the Contractor shall be required prior to release of outstanding retainage.

3.02 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Testing General:

1. All Alarm Initiating Devices shall be observed and logged for correct zone and sensitivity. These devices and their bases shall be tagged with adhesive tags located in an area not visible when installed, showing the initials of the installing technician and date.
2. Wiring runs shall be tested for continuity, short circuits, and grounds before system is energized. Resistance, current, and voltage readings shall be made as work progresses.
3. The acceptance inspector shall be notified before the start of the required tests. All items found at variance with the Contract Documents during testing or inspection by the acceptance inspector shall be corrected.
4. Test reports shall be delivered to the acceptance inspector as completed.
5. All test equipment, instruments, tools, and labor required to conduct the system tests shall be made available by the Electrical Contractor. The following equipment shall be a minimum for conducting the tests:

    a. Ladders and scaffolds as required to access all installed equipment.
    b. Multi-meter for reading voltage, current, and resistance.
    c. Two-way radios and flashlights.
    d. A manufacturer recommended device for measuring air flow through air duct smoke detector sampling assemblies.
    e. Decibel meter.
    f. In addition to the testing specified to be performed by the Contractor, the installation shall be subject to test by the acceptance inspector.

3.03 IDENTIFICATION

A. Permanently label or mark each conductor at both ends with permanent alphanumeric wire markers.

B. Color code all fire alarm conductors throughout the installation.

C. Provide permanent labels of the device address on all devices.

3.04 ACCEPTANCE TESTING

A. A written acceptance test procedure (ATP) for testing the fire alarm system components and installation will be prepared by the Engineer in accordance with NFPA 72 and this specification. The Contractor shall be responsible for the performance of the ATP, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and programming.

B. A program matrix shall be prepared by the Contractor referencing each alarm input to every output function affected as a result of an alarm condition on that input.

C. The Contractor prior to the ATP shall prepare a complete listing of all device labels for alphanumeric annunciator displays.

D. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the Owner and test results recorded for use at the final acceptance test.

E. Preliminary Testing: Conduct preliminary tests to ensure that all devices and circuits are functioning properly. After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that all panel functions were tested and operated properly. The Contractor and an authorized representative from each supplier of equipment shall attend the preliminary testing to make necessary adjustments.

F. Final Acceptance Test: Notify the Owner in writing when the system is ready for final acceptance testing. Submit request for test at least 14 calendar days prior to the test date. A final acceptance test will not be scheduled until megger test results, the loop resistance test results, and the submittals required in Part 1 are provided to the Owner. Test the system in accordance with the procedures outlined in NFPA 72.

1. Verify that the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
2. Test each initiating and indicating device and circuit for proper operation and response. Disconnect the confirmation feature for smoke detectors during tests to minimize the amount of smoke or test gas needed to activate the detector.
3. Test the system for all specified functions in accordance with the contract drawings and specifications and the manufacturer's operating and maintenance manual.
4. Visually inspect all wiring.
5. Verify that all software control and data files have been entered or programmed into the FACP.
6. Verify that Shop Drawings reflecting as-built conditions are accurate.
7. Measure the current of all circuits to ensure that there is the calculated spare capacity for the circuits.
8. Measure voltage readings for circuits to ensure that voltage drop is not excessive.

9. Measure the voltage drop at the most remote appliance on each notification appliance circuit.

G. The acceptance inspector shall use the system record drawings in combination with the documents specified in this specification during the testing procedure to verify operation as programmed. In conducting the ATP, the acceptance inspector shall request demonstration of any or all input and output functions. The items tested shall include but not be limited to the following:

1. System wiring shall be tested to demonstrate correct system response and correct subsequent system operation in the event of:

(1) Open, shorted, and grounded signal line circuits.
(2) Open, shorted, and grounded notification circuits.
(3) Primary power or battery disconnected.

2. System notification appliances shall be demonstrated as follows:

(1) All alarm notification appliances actuate as programmed
(2) Audibility and visibility at required levels.

3. System indications shall be demonstrated as follows:

(1) Correct message display for each alarm input at the control display.
(2) Correct history logging for all system activity.

4. System off-site reporting functions shall be demonstrated as follows:

(1) Correct zone transmitted for each alarm input.
(2) Trouble signals received for disconnect.

5. Secondary power capabilities shall be demonstrated as follows:

(1) System primary power shall be disconnected for a period of time as specified herein. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period as specified.
(2) System primary power shall be restored for forty-eight hours and system-charging current shall be normal trickle charge for a fully charged battery bank.
(3) System battery voltages and charging currents shall be checked at the fire alarm control panel.

6. Tests

(1) Introduce Smoke into the Detector Assembly to provide a basic functional test.
(2) Introduce smoke to the least favorable Sampling Point in each Sampling Pipe. Transport time is not to exceed two minutes.
(3) Activate the appropriate Fire Alarm zones and advise all concerned that the system is fully operational. Fill out the logbook and commissioning report accordingly.

(4) If more than two (2) bar graph divisions illuminate under normal conditions (no smoke), review event log for two (2) weeks from date of commissioning and make appropriate adjustments to the alarm and delay thresholds.

3.05 DOCUMENTATION AND TRAINING

A. The Contractor shall compile and provide to the Owner three (3) complete manual on the completed system to include site specific operating and maintenance instruction, catalog cuts of all equipment and components, as-built wiring diagrams, and a manufacturer's suggested spare parts list. An operational video, on DVD media, shall also be included.

B. In addition to the above manuals, the Electrical Contractor shall provide the services of the manufacturer's trained representative for two (2) separate calendar days for a period of four (4) hours per day to instruct the Owners designated personnel on the operation and maintenance of the entire system.

C. As-built drawings shall consist of the following:

1. Complete revision of all previously submitted drawings.
2. Point-to-point depiction of all device wiring on the device layout floor plans.
3. One (1) set of B-size, laminated as-built drawings.
4. Two (2) sets of 30" x 42" 1/16"=1' scale drawings showing all points of fire alarm. One (1) set shall be submitted with the close-out documents. Second set shall be mounted in frame with a lexan cover. These drawings shall be submitted to the Engineer or approval.

D. Turnover of all software database hard/soft copies shall be required. This shall include all possible programming software logs, CDs containing exported project files, hard copies of all device maps, the revision number of the version of programming utility used, and all required passwords. The turnover of all database information shall occur prior to the end of the One (1) warranty period (or period as amended earlier in this specification).

END OF SECTION

SECTION 27 00 00
TECHNOLOGY TABLE OF CONTENTS

Section No.	Title
27 00 00	Technology Table of Contents
27 00 01	Communications Basic Requirements
27 05 28	Pathways for Communications Systems
27 11 01	Communication Equipment Rooms
27 13 00	Communications Backbone Cabling
27 15 00	Communications Horizontal Cabling
27 41 16	Integrated Audio-Video Systems and Equipment
28 10 00	Access Control and Intrusion Detection
28 23 00	Video Surveillance

END OF SECTION

SECTION 27 00 01
COMMUNICATIONS BASIC REQUIREMENT

PART 1 - GENERAL

1.01 DESIGN-BUILD SUMMARY

A. Work included in 27 00 01 applies to Division 27, Communications work to provide materials, labor, tools, permits and incidentals to make communications systems ready for Owner's use for proposed project.

1.02 DESIGN-BUILD INSTRUCTIONS

A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete Communications system for this project.

B. Alternates to this Document may be offered as a separate proposal.

1.03 DESIGN-BUILD DESIGN APPROACH

A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.

B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).

C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.04 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

A. Related Work Specified Elsewhere:

1. Contents of Section apply to Division 27 Specifications.
2. Requirements of Section are a minimum for Division 27 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.

B. Communications Utility Criteria:

1. Refer to Section 27 05 28, Pathways for Communications Systems.
2. Utility services for telecom and CATV enter building via overhead service. Provide fire-rated plywood backboards for incoming service provider terminations. Install a telecommunications ground bus bar and connect to building steel and the main electrical panel with a proper sized ground wire.

C. Communications Backbone System, Horizontal System, and Telecommunications Room Criteria: Refer to Section 27 10 01, Backbone and Horizontal Communications Systems.

D. Communication Equipment Rooms Criteria:

1. Refer to Section 27 11 01, Communication Equipment Rooms.
2. A wall-mounted, swing gate equipment rack will be installed for cable terminations. Rack-mounted horizontal wire managers will be provided between patch panels. A telecommunications ground bus bar will be installed and connected to building steel and the main electrical panel with a proper sized ground wire. The equipment rack will be grounded to the ground bus with a size 6 ground wire.

E. Communications Backbone Cabling Criteria:

1. Refer to Section 27 13 00, Communications Backbone Cabling.
2. Extend the incoming voice service from a wall-mounted 110 block to the equipment rack for plug and play cross connections. Coordinate copper pair counts to be extended with the service provider.

F. Communications Horizontal Cabling Criteria:

1. Refer to Section 27 15 00, Communications Horizontal Cabling.
2. Telecommunications cabling will be a Category 6 solution with a minimum 20-year manufacturer's warranty. Each telecom location will have three Category 6 cables for use of voice or data. Cabling will be terminated in the Telecom Room on rack mounted Category 6 patch panels. Three foot and five-foot patch cords for each telecom cable will be provided for patching at the Telecom Room as well as work area outlet end. CATV cabling will be RG-6 and terminated with F connectors on each end. The work area outlet will be integrated into the telecom faceplate. CATV signal will be amplified if necessary, based on the output of the incoming service.

G. Communications Area of Refuge Criteria: Refer to Section 27 51 30, Area of Refuge Two-Way Communication System.

H. Communications Distributed Antenna System Criteria: Refer to Section 27 53 19, Distributed Antenna System.

I. Cable Television Distribution System Criteria: Refer to Section 27 53 20, Cable Television Distribution System.

1.05 SECTION INCLUDES

A. Work included in 27 00 01, Communications Basic Requirements applies to Division 27, Communications work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of communications systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.

2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.
6. Entrance Facility (EF): Area or location that contains entrance point (demarcation) cable and associated equipment for telecommunication services entering the building.
7. Equipment Room (ER): Area or location that contains backbone cabling associated with interbuilding cable or cable that connects buildings together in a campus environment. ERs may contain Main Cross-Connects, Intermediate Cross-Connects, Horizontal Cross-Connects, and Telecommunication Rooms.
8. Main Cross-Connect (MC): Area or location that contains telecommunications equipment for connecting backbone cable to/from Intermediate Cross-Connects and Horizontal Cross-Connects. Active telecommunications equipment will often be contained in this area to serve as the telecommunications hub or headend. Backbone cable from Local Exchange Carrier's point of demarcation will connect to building backbone cable or active telecommunications equipment at this location.
9. Intermediate Cross-Connect (IC): Area or location that contains telecommunications equipment for connecting backbone cable from the MC to backbone cable distributing to one or many Horizontal Cross-Connects. This location may contain active telecommunications equipment.
10. Horizontal Cross-Connect (HC): Area or location that contains telecommunications equipment, cable terminations and cross-connect wiring. HC is the recognized connection point between backbone and horizontal pathway facilities.
11. Telecommunications Room (TR): Area or location containing telecommunications equipment, cable terminations and cross-connect wiring. Three applications serviced by TRs are horizontal cable connections, backbone system interconnection and entrance facilities. The TR provides facilities (space, power, grounding, etc.) for housing telecommunications equipment. TR may contain a MC, IC or HC and a demarcation point or an interbuilding entrance facility.
12. Interbuilding Cable: Backbone cable associated with connecting buildings together in a multibuilding or campus environment.
13. Intrabuilding Cable: Backbone cable associated with connecting Entrance Facility, Equipment Rooms, Main Cross-Connects, Intermediate Cross-Connects, Horizontal Cross-Connects, and Telecommunication Rooms together on single floor or multifloor building.

1.06 GENERAL REQUIREMENTS

A. Contents of Section applies to Division 27, Communications Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:

a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
b. Drawings
c. Addenda
d. Owner/Architect Agreement
e. Owner/Contractor Agreement
f. Codes, Standards, Public Ordinances and Permits

C. Related Products/Systems within Division 28, Electronic Safety and Security:

1. Section 28 10 00, Access Control and Intrusion Detection
2. Section 28 23 00, Video Surveillance

1.07 REFERENCES AND STANDARDS

A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 27, Communications Sections and those listed in this Section.

B. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act
2. ADA - Americans with Disabilities Act
3. ANSI - American National Standards Institute

a. ANSI/TIA-568-C.0 - Generic Telecommunications Cabling for Customer Premises
b. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Cabling Standard
c. ANSI/TIA-568-C.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
d. ANSI/TIA-568-C.3 - Optical Fiber Cabling Components Standard. Commercial Building Telecommunicating Cabling Standard
e. ANSI/TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces
f. ANSI/TIA-570-B - Residential Telecommunications Infrastructure
g. ANSI/TIA-942 - Telecommunications Infrastructure Standard for Data Centers
h. ANSI/TIA/EIA-606-A - Administration Standard for Commercial Telecommunications Infrastructure
i. ANSI-J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

4. APWA - American Public Works Association
5. ASCE - American Society of Civil Engineers
6. ASHRAE Guideline 0, the Commissioning Process
7. ASTM - ASTM International
8. BICSI - Building Industry Consulting Service International

    a. BICSI TDMM - Telecommunications Distribution Methods Manual
    b. BICSI ESSDRM - Electronic Safety & Security Design Reference Manual

    c. BICSI AVDRM - AV Design Reference Manual

9. CFR - Code of Federal Regulations
10. CSA - CSA International
11. EIA - Electronic Industries Association
12. EPA - Environmental Protection Agency
13. ETL - Electrical Testing Laboratories
14. FCC - Federal Communications Division
15. FDA - Food & Drug Administration
16. FM - FM Global
17. IBC - International Building Code
18. ICC - International Code Council
19. IEC - International Electrotechnical Commission
20. IEEE - Institute of Electrical and Electronics Engineers
21. ISO - International Organization for Standardization
22. LEED - Leadership in Energy and Environmental Design
23. MSS - Manufacturers Standardization Society
24. NEC - National Electric Code
25. NEMA - National Electrical Manufacturers Association
26. OSHA - Occupational Safety and Health Administration
27. TIA - Telecommunications Industry Association 28. UBC - Uniform Building Code
28. UBC - Uniform Building Code
29. UL - Underwriters Laboratories Inc.
30. USDA - United States Department of Agriculture
31. USGBC - United States Green Building Council

C. See Division 27, Communications individual Sections for additional references.

1.08 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:

1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will

confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
3. Product Data: Provide manufacturer's descriptive literature for products specified in Division 27, Communications Sections.
4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the specifications and Drawings.

    a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
    b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 27, Communications specification Sections for specific items required in product data submittal outside of these requirements.
    c. See Division 27, Communications individual Sections for additional submittal requirements outside of these requirements.

5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer’s comments. Identify Engineer’s comments and provide an individual response to each of the Engineer’s comments. Cloud changes in the submittals and further identify changes which are in response to Engineer’s comments.
7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 27, Communications Coordination Documents. For

equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
10. Substitutions and Variation from Basis of Design:

    a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
    b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals." For any product marked "or approved equivalent," a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings:

    a. Provide coordinated Shop Drawings which include physical characteristics of all systems, device layout plans, and control wiring diagrams. Reference individual Division 27, Communications specification Sections for additional requirements for Shop Drawings outside of these requirements.
    b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.

12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:

    a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Changes made for the resubmittal will be indicated in a cover letter with reference to page(s) changed and will reference response to comment. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
    b. Resubmit for review until review indicates no exception taken, or "make corrections as noted."
    c. When submitting Drawings for Engineers re-review, clearly indicate changes on Drawings and "cloud" any revisions. Submit a list describing each change.

14. Operation and Maintenance Manuals, Owner's Instructions:

    a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

        (1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
        (2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: batteries, lamp lenses, speakers and filters.
        (3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Sections.
        (4) Include product certificates of warranties and guarantees.
        (5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and subassemblies.
        (6) Include copy of burn-in and test reports specific to each piece of equipment.
        (7) Include copy of software/appliance programming.
        (8) Include commissioning reports.
        (9) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

    b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Submit copy of material used for Owner instruction. Field instruction per Section 27 00 01, Communications Basic Requirements Article titled "Demonstration."
    c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:

a. Maintain at site at least one set of drawings for recording “as-constructed” conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of conduit, and location of concealed communication items. Include items changed by field orders, supplemental instructions, and constructed conditions.

b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.

c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line Drawings created from CAD Files in version/release equal to Contract Drawings. Submit CAD disk and Drawings upon substantial completion.

d. At completion of project, show changes and deviations from the Drawings in red on one set of black-line drawings. Include written Addendums, RFIs, and change order items. Make changes to Drawings in a neat, clean, and legible manner.

e. Invert elevations and dimensioned locations for incoming utilities and site raceways below grade extending to 5-feet outside building line.

f. See Division 27, Communications individual Sections for additional items to include in Record Drawings.

1.09 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., conduit) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

G. Contractor Qualifications:

1. Minimum of five years' experience in the design, installation, testing and maintenance of communications systems.
2. Must employ at least one full time BICSI certified Registered Communications Distribution Designer (RCDD) who is involved in reviewing work performed by contractor on this project.
3. Maintain a local service facility which stocks spare devices and/or components for servicing systems.
4. Have performed successful installation and maintenance of at least three projects similar in scope and size. Be able to provide project references for these three projects, including scope of Work, project type, Owner/user contact name and telephone number.
5. The contractor selected for this project must be certified by the manufacturer of the approved products and utilize these components for completion of work.

1.10 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

A. Prior to construction, prepare and submit coordinated layout Drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 27, Communications to combine information furnished by other trades onto master coordination documents.

B. Prepare Drawings as follows:

1. Coordination models/drawings may be created using Revit 3D modeled elements or a 3D CAD software. The modeled elements to be graphically represented within the model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the model elements. Model elements must have the ability to be spatially coordinated with other modeled elements using either Revit, Autodesk Navisworks or Autodesk A360.
2. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
3. Review and revise, as necessary, section cuts in Contract Drawings after verification of field conditions.
4. Incorporate addenda items and change orders.
5. Provide additional coordination as requested by other trades.

C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

D. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.12 COORDINATION DOCUMENTS

A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, lights, cable trays and electrical services with architectural and structural requirements, and other trades (including ceiling suspension and tile systems), and provide maintenance access requirements.

B. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.

D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.13 LEED REQUIREMENTS

A. Project seeks LEED certified V4.0 status, as outlined by the United States Green Building Council (www.usgbc.org).

B. Obtain list of credits sought by project. Be familiar with requirements for credits. See Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for requirements.

C. Provide materials and services as outlined in appropriate LEED Reference Guide.

D. Provide documentation as outlined in appropriate LEED Reference Guide.

E. Coordinate start-up, testing, training, and installation with Commissioning Agent as required to meet commissioning requirements.

F. Provide adequate schedule for construction activities.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to jacks, patch panels, equipment connection cords and wall plates.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities. Equipment/fixture supplier is responsible for obtaining state, county, and city acceptance on equipment/fixture not UL approved or not listed for installation.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of New York, and Federal regulations relating to hazardous materials.
2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General R3equirements for this project relating to hazardous materials.
3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

2.03 ACCESS PANELS

A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.

B. Confirm Access Panel requirements in Division 01, General Requirements and 08. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. Provide flush mounting access panels for service of systems, equipment and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.

a. Ceiling access panels to be minimum of 24-inch by 24-inch required and approved size.
b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.

c. Provide screwdriver operated catch
d. Manufacturers and Models:

(1) Drywall: Karp KDW.
(2) Plaster: Karp DSC-214PL.
(3) Masonry: Karp DSC-214M.
(4) 2 hour rated: Karp KPF-350FR.
(5) Manufacturers: Karp, Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

B. Install equipment requiring access (i.e., amplifiers, taps, zone controllers, volume controls, and storage devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Earthwork:

1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

    a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
    b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
    c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

E. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

    a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

F. Plenums: In plenums, provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents and individual Division 27 Communications Sections.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

B. Notify Architect*,* in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Underground conduit installation prior to backfilling.
2. Prior to ceiling cover/installation.
3. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. During remodeling or addition to existing structures, or addition of a structure to existing structure, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new wiring to point of connection.
3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
4. Organize work to minimize duration of power interruption.

3.05 CUTTING AND PATCHING

A. Confirm Cutting and Patching Requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
2. Protect all equipment and conduit to avoid damage. Close conduit openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.

3.08 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

D. Training and Demonstration per Section 01 91 13, General Commissioning Requirements.

3.09 CLEANING

A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

B. Install equipment and devices in accordance with manufacturer's installation instructions, plumb and level and firmly secured to mounting surfaces. Maintain manufacturer's recommended clearances.

C. Startup equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test operation and demonstrate compliance with requirements. Replace damaged or malfunctioning equipment.

D. Provide miscellaneous supports/metals required for installation of equipment.

3.11 PAINTING

A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. Ferrous Metal: After completion of communications work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in telecommunications rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
2. In a telecommunications room, on roof or other exposed areas, equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
3. See individual equipment Specifications for other painting.
4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
5. Conduit: Clean, primer coat and paint interior conduit exposed in finished areas with two coats paint suitable for metallic surfaces. Color selected by Architect.
6. Covers: Covers such as manholes, vaults and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCESS PANELS

A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. Scope:

   a. It is the intent of these documents to provide necessary information and adjustments to communications systems required to meet code and accommodate installation of new work.
   b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
   c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work. Compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.

2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
3. Unless specifically indicated on Drawings, remove exposed, unused raceways behind finished surfaces (floor, walls, ceilings, etc.). Cap raceways and patch surfaces to match surrounding finish.
4. Unless specifically indicated on Drawings, remove unused equipment, electrical boxes, fittings and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).
5. Examination:

   a. Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to locate and preserve utilities. Replace damaged items with new material to match existing.
   b. Verify that abandoned wiring and equipment serve only abandoned facilities.
   c. Demolition Drawings are based on casual field observation and existing record documents.

      (1) Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish work.
      (2) Verify location and number of communications outlets, racks, panels, etc. in field.

   d. Report discrepancies to Architect before disturbing existing installation.

6. Promptly notify Owner if utilities are found which are not shown on Drawings.

7. Execution:

   a. Remove existing connectors, backboxes, wall plates and other communications equipment and devices and associated wiring from walls, ceilings, floors, and other surfaces scheduled for remodeling, relocation, or demolition unless shown as retained or relocated on Drawings.
   b. Provide temporary wiring and connections to maintain communications continuity of existing systems during construction. Remove or relocate communications boxes, conduit, wiring, equipment, and the like, as encountered in removed or remodeled areas in existing construction affected by this work.
   c. Remove and restore cable which serves usable existing outlets clear of construction or demolition.
   d. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing communications equipment which is being retained, provide new conduit and cable to bypass abandoned outlets.
   e. If existing conduits pass through partitions or ceiling which are being removed or remodeled, provide new conduit and cable to reroute clear of construction or demolition and maintain service to existing equipment. If these are conduits which require a new cable home run, e.g. telecom cable, request clarification from Architect or Engineer prior to proceeding with demo.
   f. Extend cable slack and devices in existing walls to be furred out.
   g. Remove abandoned cable to originating telecom room.
   h. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
   i. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
   j. Disconnect and remove abandoned panelboards and distribution equipment.
   k. Maintain access to existing communications installations which remain active. Modify installation or provide access panel as appropriate.

   l. Existing communications outlets and devices are indicated on technology demolition plans. Verify exact location and number of existing communications outlets and devices in field. Only partial existing communications shown. Locations of items shown on Drawings as existing are partially based on Record and other Drawings which may contain errors. Verify accuracy of information shown prior to bidding and provide such labor and material as is necessary to accomplish intent of Contract Documents.
   m. Remove abandoned cable to leave site clean.

B. Existing Communication Systems: Maintain existing systems in service until new system is complete and ready for service. Disable system only to make switchovers and connections

1. Notify Owner at least 10 working days before partially or completely disabling system.
2. Make temporary connections to maintain service in areas adjacent to work area.

C. Existing System: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections.

1. Obtain permission from at least working days before partially or completely disabling system.
2. Make temporary connections to maintain service in areas adjacent to work area.

3.14 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 27, Communications Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:

a. Testing Reports
b. Cleaning
c. Operation and Maintenance Manuals
d. Training of Operating Personnel
e. Record Drawings
f. Warranty and Guaranty Certificates, including extended manufacturer's warranties.

3.15 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 27 00 01, Communications Basic Requirements and individual Division 27, Communications Sections.

B. Tests:

1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.16 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that Communications items were installed

in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

END OF SECTION

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. The work included under this specification consists of furnishing all labor, equipment, materials supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. This Section specifies the requirements to provide communications conduit raceways, boxes, cable trays, innerduct and fittings.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

B. References and Standards as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

1.03 SUBMITTALS

A. Submittals as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. Provide plan drawings showing completions and as-built corrections which indicate type, size, placement, routing and/or length for raceway and cable tray components; e.g., manholes, handholes, conduit, boxes, enclosures, etc.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 RACEWAYS

A. Manufacturers:

1. Koppers Bitumastic
2. Scotch wrap

3. Or approved equivalent.

B. Raceways: Labeled and/or listed as acceptable to the AHJ as suitable for the use intended.

C. Table 1: Product Identification:

Product Designation	Product Type
RGS	Rigid Galvanized Steel
CRS	PVC Externally Coated RGS
EMT	Galvanized Steel Tubing
PVC	Polyvinylchloride Conduit
LMC	Liquidtight Metal Conduit
LNC	Liquidtight Nonmetal Conduit

D. The product identification codes used for the Communications Raceways and Boxes in Part 2, Products, are summarized in Table 1.

E. Bitumastic material or plastic tape.

2.02 RIGID METAL CONDUIT AND FITTINGS

A. Acceptable Manufacturers:

1. Sealing Fittings:

a. Crouse-Hinds
b. Or approved equivalent.

B. Conduit:

1. Type RGS: Rigid galvanized steel.
2. Type CRS: PVC externally coated conduit; rigid steel conduit with external PVC coating and internal galvanized surface.

C. Fittings and Conduit Bodies: In-line straight-through, threaded, galvanized steel fittings and Type C conduit bodies only; do not use bends or tees, e.g., Lbs.

1. Bonding and Grounding Locknuts and Wedges: Malleable iron with set screws and lug screws.
2. Insulated Bushing: Malleable iron with integral insulated throat, rated for 150C.
3. Bonding and Grounding Bushing: Malleable iron with integral insulated throat, rated for 150C, with solderless lugs or lug screws.
4. Sealing Fittings: Threaded type conduit seal fittings and sealing compound suitable for hazardous location installations in accordance with NEC:

a. Crouse-Hind retrofit sealing fitting EYSR.
b. Crouse-Hind CHICO A sealing compound.

2.03 ELECTRICAL METALLIC TUBING AND FITTINGS

A. Acceptable Manufacturers:

1. Allied Tube and Conduit
2. Wheatland Tube
3. Appleton
4. Or approved equivalent.

B. Type EMT: Electrogalvanized steel tubing.

C. Fittings and Conduit Bodies:

1. In-line straight-through steel or malleable iron fittings and Type C conduit bodies only; do not use bends or tees, e.g. Lbs.
2. Wet Areas: Steel compression-type couplings and nipples.
3. Dry Areas: Set screw-type couplings and nipples.
4. Bonding Locknuts:

    a. Malleable iron with set screws and lug screws.
    b. Insulated Bushing: Malleable iron with integral insulated throat, rated for 150C.
    c. Bonding and Grounding Bushing: Malleable iron with integral insulated throat, rated for 150C, with solderless lugs or lug screws.

2.04 CONDUIT ACCESSORIES

A. Duct Spacers:

1. Acceptable Manufacturers:

    a. Carlon
    b. Allied Tube and Conduit
    c. Or approved equivalent.

2. Nonmetallic base and intermediate duct spacers with locking keyways designed specifically for use with nonmetallic conduit; e.g., Carlon SNAP-LOC duct spacers for 4-inch diameter conduit with 1-1/2-inch separation.
3. Base Spacer: S288NHN.
4. Intermediate Spacer: S289NHN.

B. Expansion/Deflection Fittings:

1. Acceptable Manufacturers:

    a. Appleton
    b. Emerson
    c. Or approved equivalent.

2. Similar to Crouse-Hinds XD expansion/deflection coupling or Appleton DF Series deflection and expansion coupling.

C. Pulltape:

1. Acceptable Manufacturers:

a. George-Ingraham
b. Greenlee
c. Or approved equivalent.

2. Measuring and pulling tape constructed of synthetic fiber with plastic jacket, printed with accurate sequential footage marks; e.g., George-Ingraham 1/2-inch tape 9216-JK.

D. Duct Plugs:

1. Acceptable Manufacturers:

a. Carlon
b. Vikimatic
c. Or approved equivalent.

2. Aboveground Conduit Openings: Tapered PVC plugs with tab for pulltape; e.g., Carlon 4-inch PVC plugs with pull tab, P258NT.
3. Underground or Underslab Conduit Openings: Removable screwtight compression type duct plugs with wingnut and corrosion resistant hardware; e.g. Vikimatic 4-inch, Part Number 40D402U. Use appropriate part number according to duct size.

2.05 PENETRATION SEALING SYSTEMS

A. Acceptable Manufacturers:

1. SEMCO
2. Or approved equivalent.

B. Firestopping: Provide fire barrier penetration sealing materials as specified in Division 07, Firestopping Section.

C. Duct Water Seal: Products suitable for closing underground and entrance duct openings, where innerduct or cable is installed, to prevent entry of gases, liquids, or rodents into the structure; e.g., SEMCO PR 851.

2.06 TELECOMMUNICATIONS OUTLET BOXES

A. Acceptable Manufacturers:

1. Raco
2. Or approved equivalent.

B. Sheet Metal Outlet Boxes: Minimum 4-inch square by 2-1/8-inch deep, galvanized steel for use with single gang plaster rings.

C. Five Square Outlet Boxes: Minimum 5-inch square by 2-7/8-inch deep with built-in cable management for use with single gang plaster rings. Randl P/N T-55017 approved.

D. Nonmetallic Outlet Boxes: Minimum 4-inch square by 2-1/2-inch-deep. Provide gasketed, watertight single gang cover.

E. Cast Boxes: 4-inch square by 2-1/8-inch deep cast Feralloy, gasketed single gang cover, threaded hubs.

F. Floor Boxes for Installation in Cast-In-Place Concrete Floors: Flush mounted and fully adjustable formed steel as shown on the Drawings. Floor boxes provided by Division 26, Electrical.

G. Plaster Rings: Single gang as shown on the Drawings.

2.07 PULL BOXES

A. Acceptable Manufacturers:

1. Hoffman
2. Oldcastle (concrete)
3. Or approved equivalent.

B. Construction: NEMA Standard No. 250. Type 1 galvanized steel enclosures designed for use as junction boxes and pull boxes with flat screw-applied covers, with or without knockouts and gray enamel finish.

2.08 J-HOOKS

A. Acceptable Manufacturers;

1. Erico
2. Or approved equivalent.

B. Constructed of galvanized steel, stainless steel or hot dipped zinc.

C. Wires or all-thread supports mounted to structure.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Workmanship:

1. Provide, condition, apply, install, connect and test manufactured products, materials, equipment and components in accordance with the manufacturer's specifications and printed instructions.
2. The installation of system components to be carried out under the direction of qualified personnel. Appearance to be considered as important as mechanical and electrical efficiency. Workmanship to meet or exceed industry standards.

3. Place support for raceways, cable trays, backboards, equipment racks and cabinets.

B. Protection During Construction: Protect products from the effects of moisture, corrosion and physical damage during construction. Except during installation activity in a section, keep openings in conduit, tubing and wireway capped with manufactured seals during construction.

C. Concrete Sleeves: Conduits routed perpendicular through floors, walls, or other concrete structures to pass through cast-in-place conduit sleeve openings wherever possible, or appropriate size holes to be bored to accommodate the installation of conduit sleeves. The size and location of the holes to not impair the structure's integrity.

1. Concrete Boring: Bore a hole in the concrete with a diameter of 1/2 to 1-inch larger than the conduit sleeve to be installed. Grout around the conduit sleeve and finish to match existing surroundings.
2. Conduits that rise vertically through a slab to be stubbed 6-inches above the floor and capped pending future use.

D. Drywall/Gypsum Board Sleeves: Install insulating throat bushings on both ends of conduit sleeves placed in fire-rated walls using drywall construction.

E. Where conduit enters a structure through a concrete roof or membrane waterproofed wall or floor:

1. Provide a watertight seal.
2. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
3. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
4. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

F. Provide continuous sleeving through walls, floors and ceilings separating each telecom outlet from its respective MER/TR room, using sleeve conduit size as required per Standards. Restore penetrations through rated assemblies to original fire rating per NFPA and local codes.

G. Locate sleeves as shown on Drawings. Where sleeves are not shown on Drawings, install sleeves above suspended ceilings and locate to minimize length of pathway for future cable from telecom outlet to MER/TR rooms.

H. Where sleeves are routed between rooms with floating ceilings, extend conduits horizontally 2-feet over edge of floating ceiling to avoid exposed cabling from being seen at floor level.

I. Make floor penetrations no more than 4-inches from wall. Install conduit stubs to extend 4-inches from floor base. Cap conduits for protection.

J. Provide removable heat-expanding pillows at fire barrier penetrations as specified in Firestopping section and described as Firestop Material Type 7 (indicated as FSM-7).

K. Grounding: Provide ground connections and bonding continuity between raceway and wire basket runway sections, boxes, enclosures, cabinets and fittings as required per code and industry standard.

L. Provide plenum rated products, components and accessories for installation in plenums.

3.02 RACEWAYS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. Raceway Identification Banding:

1. Degrease and clean surfaces to receive tape labels.
2. Exposed conduits and wireway, including raceways above lay-in or accessible ceilings, together with associated pull boxes to be banded at intervals of not over 10-feet and at direction changes. Two-band identification to be different contrasting colors as follows:

Raceway Use	Color
Grounding	Green
Telecom/datacom	Yellow
CCTV	White
Building monitoring and security	Grey

3.03 RIGID METAL CONDUIT AND FITTINGS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. Conduit Type:

1. Install the following types of circular communications raceway in the locations listed unless otherwise indicated on the Drawings.

    a. Exterior, Exposed Including Roof: Rigid steel conduit.

D. Conduit Bends and Sweeps:

1. Make changes in direction of communications conduit runs with sweeps of the longest possible radius.
2. Make sweeps in parallel or banked runs of conduits, 2-inches and larger in diameter, from the same center or centerline so that sweeps are parallel and of neat appearance.
3. Field-Made Bends and Sweeps:

    a. Use an acceptable hickey or conduit-bending machine.
    b. Do not heat metal raceways to facilitate bending.

c. Before installing 4-inch field-made sweeps in duct banks, pull a 3-1/2-inch diameter by 12-inch long mandrel through duct sections to verify circularity and sweep radius.

4. The angular sum of the bends between pull points and/or pull boxes to not exceed 180 degrees.
5. Minimum Inside Bend Radius for Communications Conduit Bends, Sweeps, Boxes and Fittings:

   a. One-inch conduit, 11-inches
   b. Two-inch conduit, 21-inches
   c. Three-inch conduit, 36-inches
   d. Four-inch conduit, 48-inches
   e. Other sizes, 10 times the inside diameter of the conduit.

6. Do not install boxes, bends, elbows, tees, conduit bodies and other conduit fittings, which do not provide for the minimum inside cable bend radius specified in paragraph E above.

   a. Conduit Bodies: In-line straight-through Type C conduit fittings can be used as pull boxes for conduit up to a maximum of 2-inches ID. Other conduit fittings, which include direction changes such as E, L, LB, LR, LL, LRT, TA, TB and X, are not allowed.
   b. Refer design or installation conflicts with these requirements to the Architect.

E. Aboveground Conduit Installation:

1. Support conduit installed in aboveground interior and exterior locations at a maximum of 7-feet on center.
2. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.
3. Securely attach aboveground conduit under the provisions of this Section.
4. Only conduit servicing elevator equipment can be installed through elevator shafts or equipment rooms. These conduits may only enter the room and go directly to the equipment being supplied.
5. Keep power wiring independent of communication system wiring.
6. Arrange conduit to maintain headroom and present neat appearance.
7. Do not install conduits on surface of building exterior, across roof, on top of parapet walls, or across floors, unless otherwise noted on drawings.
8. Exposed conduits are permitted only in the following areas:

   a. Mechanical rooms, electrical rooms or spaces where walls, ceilings and floors will not be covered with finished material.
   b. Existing walls that are concrete or block construction.
   c. Where specifically noted on drawings.
   d. Route exposed conduit parallel and perpendicular to walls, tight to finished surfaces and neatly offset into boxes.

9. Do not install conduits or other electrical equipment in obvious passages, doorways, scuttles or crawl spaces which would impede or block area passage's intended usage.

10. Keep conduits a minimum of 12-inches away from steam or hot water radiant heating lines (at or above 104 degrees F) or 3-inches away from waste or water lines.
11. Run exposed and concealed conduits parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible.
12. No section of conduit located within buildings to exceed 100-feet in length between pull points and/or pull boxes.
13. Expansion/Deflection Joints:

    a. Where indicated on the Drawings, provide specific purpose expansion/deflection fittings for conduit crossing building expansion/deflection joints in structures or concrete slabs. Expansion fittings to have copper bonding jumper.
    b. For PVC conduit, provide expansion/deflection joints for 25 degrees F maximum temperature variation. Install in accordance with manufacturer's written instructions.
    c. For rigid steel conduit located in exterior areas, provide expansion/deflection joints for maximum site temperature variation, installed in accordance with manufacturer's written instructions.

14. Provide each conduit passing from a nonhazardous or noncorrosive area to a hazardous area and each conduit entering an enclosure within a hazardous area with a sealing fitting in accordance with NEC Article 500. The sealing fitting is to be UL listed and to be filled with approved sealing compound of the same manufacture.
15. Hubs, Bushings and Insulating Sleeves:

    a. Interior Box and Cabinet Connections: Install insulating throat connectors wherever conduit terminates in boxes or cabinets. In addition, install bonding type locknuts at metallic conduit terminations.
    b. Wet Box and Cabinet Connections: Use watertight threaded conduit sealing hubs with insulated throat and bonding type locknuts for fastening rigid steel conduit to cast or sheet metal pull boxes.
    c. Exposed Conduit Terminations: Cap exposed steel communication conduit ends with bushings or smooth collars to protect cable sheath.

F. Pulltape and Duct Plugs:

1. Following conduit installation, install pulltape (muletape) with preprinted foot markers in each empty conduit containing a bend or over 10-feet in length, except sleeves and nipples. Tie the pull-tapes securely at each end.
2. Immediately after pull-tape installation, install removable manufactured plugs in empty conduit and wireway openings. For underground conduit openings, use screw-tight, removable, watertight and dust-tight duct plugs.
3. Verify lengths at the time of installation and provide as-built documentation.

3.04 ELECTRICAL METALLIC TUBING AND FITTINGS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. Minimum Conduit Size: Size recessed conduits to surface raceway serving multiple data outlets as follows. Sizing is based on TIA/EIA 569-B for 28 percent conduit fill, assuming Category 6 cables (nominal outer diameter 0.24-inch) to each data outlet. Provide recessed backbox between surface raceway and recessed conduit sized for conduit.

1 to 6 cables	1-inch conduit
7 to 10 cables	1-1/4-inch conduit
11 to 15 cables	1-1/2-inch conduit
16 to 20 cables	2-inch conduit
Above 20 cables	Use multiple runs of conduit from surface raceway based on above table

D. Minimum Backbone Conduit Requirements: Install three 4-inch conduits from MER to each TR, unless otherwise noted on Drawings.

E. Conduit Type:

1. Install the following types of circular communications raceway in the locations listed unless otherwise indicated on the Drawings.

   a. Interior Dry Locations, Exposed: EMT with set screw fittings.
   b. Interior Dry Locations, Concealed (Not Embedded in Concrete): EMT with set screw fittings.
   c. Interior Wet Locations: EMT with compression fittings.

F. Conduit Bends and Sweeps:

1. Make changes in direction of communications conduit runs with sweeps of the longest possible radius.
2. Make sweeps in parallel or banked runs of conduits, 2-inches and larger in diameter, from the same center or centerline so that sweeps are parallel and of neat appearance.
3. Field-Made Bends and Sweeps:

   a. Use an acceptable hickey or conduit-bending machine.
   b. Do not heat metal raceways to facilitate bending.
   c. Before installing 4-inch field-made sweeps in duct banks, pull a 3-1/2-inch diameter by 12-inch long mandrel through duct sections to verify circularity and sweep radius.

4. The angular sum of the bends between pull points and/or pull boxes to not exceed 180 degrees.
5. Minimum Inside Bend Radius for Communications Conduit Bends, Sweeps, Boxes and Fittings:

a. One-inch conduit, 11-inches
b. Two-inch conduit, 21-inches
c. Three-inch conduit, 36-inches
d. Four-inch conduit, 48-inches
e. Other sizes, 10 times the inside diameter of the conduit.

6. Do not install boxes, bends, elbows, tees, conduit bodies and other conduit fittings, which do not provide for the minimum inside cable bend radius specified in paragraph E above.

a. Conduit Bodies: In-line straight-through Type C condulet fittings can be used as pull boxes for conduit up to a maximum of 2-inches ID. Other conduit fittings, which include direction changes such as E, L, LB, LR, LL, LRT, TA, TB and X, are not allowed.
b. Refer design or installation conflicts with these requirements to the Architect.

3.05 CONDUIT ACCESSORIES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. Duct Spacers: Install per manufacturer's recommendation.

D. Expansion/Deflection Fittings: Install per manufacturer's recommendation.

E. Pulltape: Install per manufacturer's recommendation.

F. Duct Plugs: Install per manufacturer's recommendation.

3.06 PENETRATION SEALING SYSTEMS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. Seal conduit entering structures at the first box or outlet to prevent the entrance of gases, liquids, or rodents into the structure.

1. Empty Conduits: Removable screwtight duct plugs.
2. Innerduct Installed: Suitable duct water seal between conduit and innerduct. Manufactured seals in empty innerduct.
3. Cable Installed: Suitable duct water seal between conduit and cable, or between innerduct and cable.

3.07 TELECOMMUNICATIONS OUTLET BOXES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. Provide 4-inch by 4-inch by 2-1/8-inch deep outlet boxes for mounting telecommunications outlets with single-gang plaster rings as required, or as indicated on the Drawings.

D. Do not install outlet boxes back to back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.

E. Locate outlet boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for outlet boxes. Use boxes with sufficient depth to permit conduit hubs to be located in masonry void spaces.

F. Provide knockout closures for unused openings.

G. Support telecommunications outlet boxes independently of conduit.

H. Use multiple-gang boxes where more than one device is mounted together; do not use sectional outlet boxes.

I. Install outlet boxes in walls without damaging wall insulation.

J. Coordinate mounting heights and locations of outlet boxes mounted above counters, benches and backsplashes.

K. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlet boxes in hollow stud wall.

L. Provide cast outlet boxes in exterior and wet locations.

3.08 PULL BOXES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's written instructions and recommendations.

C. In-Ground: Size and install per manufacturer's recommendations.

D. Aboveground: Size and install per manufacturer's recommendations.

3.09 J-HOOKS

A. Install J-hooks rated for Category 6 cable for support of cabling from the wire basket tray to the outlet location.

B. J-hooks are to be installed on dedicated wires or all thread rods mounted to structure. J-hooks are not to attach to ceiling grid wires.

END OF SECTION

SECTION 27 11 01
COMMUNICATION EQUIPMENT ROOMS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. The work included under this specification consists of furnishing all labor, equipment, materials, supplies, and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

B. The telecommunications equipment room is intended to house racks, cabinets and equipment necessary for the support of the voice and data cabling infrastructure as well as other low-voltage systems.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

B. References and Standards as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

C. Use this Section in conjunction with the other Division 27, Communications Sections and related Contract Documents to establish the total general requirements for the project technology systems and equipment.

1.03 SUBMITTALS

A. Submittals as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Shop Drawings that include, but are not limited to, the following: Telecommunication Room layout, Telecommunication Room wall elevations, equipment rack elevations, cable routing, cable connecting diagrams, termination pin outs, supporting hardware details, block diagrams, riser diagrams and cable pathways. Work may not begin until shop drawings are approved. Note: Intent of submitting shop drawings is for contractors to display a conceptual understanding of the issued Engineer drawings. Do not submit Engineer Drawings on your title block.
2. Procedures for cable labeling and identification, long term documentation methods and numbering scheme in accordance with ANSI/TIA/EIA- 606-A.
3. A copy of certified installer certificates and warranty certificates for products proposed.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

1.06 SYSTEM DESCRIPTION

A. The communications room distribution subsystem refers to the passive components used to terminate cabling subsystems and distribute technology services. This subsystem includes but is not limited to installations in the Main Equipment Room (MER), Telecommunications Rooms (TR) and Entrance Facility (EF).

PART 2 - PRODUCTS

2.01 TELECOMMUNICATIONS BACKBOARDS

A. Acceptable Manufacturers:

1. Reference 2.02A for requirements.
2. Or approved equivalent.

B. 3/4-inch minimum thickness, A/C grade or better, void-free plywood, fire treated backboard.

2.02 EQUIPMENT RACKS

A. Acceptable Manufacturers:

1. Chatsworth; Model 46353-703.
2. B-Line; Model SB-556084-XUFB.
3. Hoffman; Model EDR 19FM45U.
4. Or approved equivalent.

B. 7-foot high, 19-inches wide, EIA free-standing rack, UL listed, black finish.

2.03 WALL MOUNT EQUIPMENT RACKS

A. Acceptable Manufacturers:

1. Chatsworth; Model 11791-718.
2. Ortronics; Model19-35-T25DHYDT.
3. B-Line; Model SB-708193018FB.
4. Or approved equivalent.

B. 38-1/2-inches high, 18-inches deep, 19-inches wide, swing gate, UL listed, black finish.

2.04 WALL MOUNT CABINETS

A. Acceptable Manufacturers:

1. Chatsworth; Model 11840-724.
2. B-Line; Model VWM242424.
3. Hoffman; EWMW 242425.
4. Or approved equivalent.

B. 24-inches high, 24-inches deep, 24-inches wide, wall mounted cabinet with solid hinged door.

2.05 FREE STANDING CABINETS

A. Acceptable Manufacturers:

1. Chatsworth; Model FF LH-113C-C42.
2. B-Line; Model V452442ACWWTSSSB.
3. Hoffman; Model NS2161ONS.
4. Or approved equivalent.

B. 84-inches high, 30-inches deep, 24-inches wide, free standing cabinet with hinged door.

2.06 VERTICAL WIRE MANAGERS

A. Acceptable Manufacturers:

1. Chatsworth; Model 35522-703.
2. Panduit; Model WMPVHC45E.
3. B-Line; Model SB 8601010D084FB.
4. Or approved equivalent.

B. 7-feet high, 8-inches wide, 12-inches deep with front and rear doors and horizontal managers built in, black finish.

2.07 HORIZONTAL WIRE MANAGERS

A. 19-inches wide, two rack units high.

1. Acceptable Manufacturers:

a. Chatsworth; Model 35441-702.
b. Panduit; Model NCMH2.
c. B-Line; Model SB 87019DX2FB.
d. Or approved equivalent.

B. 19-inches wide, one rack unit high.

1. Acceptable Manufacturers:

a. Chatsworth; Model 35441-701.
b. Panduit; Model WMPLSE.

c. B-Line; Model SB87019DX1FB.
d. Or approved equivalent.

2.08 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Main Grounding Busbar (TMGB): Solid copper busbar kit, 20-inches long, 1/4-inch thick, wall mounted with standoffs.

1. Acceptable Manufacturers:

a. Chatsworth; Model 40153-020.
b. B-Line; Model SB-476.
c. Or approved equivalent.

B. Telecommunications Grounding Busbar (TGB): Solid copper busbar kit, 10-inches long, 1/4-inch thick, wall-mounted with standoffs.

1. Acceptable Manufacturers;

a. Chatsworth; Model 13622-010.
b. B-Line; Model SB-477.
c. Or approved equivalent.

C. Telecommunications Ground Accessories:

1. One-hole ground terminal block holds two wires up to size #4.

a. Acceptable Manufacturers:

(1) Chatsworth; Model 08009-001.
(2) Or approved equivalent.

2. Two-hole ground terminal block, holds two wires up to size 2/0.

a. Acceptable Manufacturers:

(1) Chatsworth; Model 40167-001.
(2) Or approved equivalent.

3. Two-hole grounding lug.

a. Acceptable Manufacturers:

(1) Chatsworth
(2) Or approved equivalent.

4. Cable runway ground strap kit.

a. Acceptable Manufacturers:

(1) Chatsworth; Model 40164-001.
(2) Or approved equivalent.

2.09 LADDER RACK CABLE RUNWAY

A. Cable Runway: 12-inches wide, 10-foot lengths, steel construction.

1. Acceptable Manufacturers:

a. Chatsworth; Model 11275-712.
b. B-Line; Model SB17U12BFB.
c. Or approved equivalent.

B. Runway wall angle support.

1. Acceptable Manufacturers:

a. Chatsworth; Model 11421-712.
b. B-Line; Model SB211312 FB.
c. Or approved equivalent.

C. Runway to rack mounting bracket.

1. Acceptable Manufacturers:

a. Chatsworth; Model 10595-712.
b. B-Line; Model SB213312FB.
c. Or approved equivalent.

D. Cable runway junction-splice kit.

1. Acceptable Manufacturers:

a. Chatsworth; Model 16302-701.
b. B-Line; Model SB2101AFB.
c. Or approved equivalent.

E. Cable runway butt-splice kit.

1. Acceptable Manufacturers:

a. Chatsworth; Model 16301-701.
b. B-Line; Model SB2107FB.
c. Or approved equivalent.

F. Cable runway triangle support bracket.

1. Acceptable Manufacturers:

a. Chatsworth; Model 11312-712.
b. B-Line; Model SB213AL12KFB.
c. Or approved equivalent.

G. Cable runway radius drop.

1. Acceptable Manufacturers:

a. Chatsworth; Model 12100-712.
b. B-Line; Model SB21292FB.
c. Or approved equivalent.

H. Cable runway radius (stringer).

1. Acceptable Manufacturers:

a. Chatsworth; Model 12101-701.
b. B-Line; Model SB2129SD12FB.
c. Or approved equivalent.

I. Cable runway foot kit.

1. Acceptable Manufacturers:

a. Chatsworth; Model 11309-701.
b. B-Line; Model SB2106BFB.
c. Or approved equivalent.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Provide all components of the telecommunications system from a single manufacturer.

B. Make floor penetrations no more than 4-inches from wall. Install conduit stubs to extend 4-inches from floor base. Cap conduits for protection.

C. Seismic installations require additional bracing of cabinets and overhead cable runways to building structure, as advised by and certified by a licensed structural engineer.

D. Ladder Rack Cable Tray:

1. Provide cable tray as shown in drawing package. The locations shown may need to be adjusted slightly in the field to assure proper placement.
2. Field cut to length tray Sections with a minimum number of splice points. Make field cuts using the manufacturers recommended equipment.
3. Deburr and file rough edges on cable tray.
4. Provide seismic bracing for installed cable trays.

E. Labeling:

1. Label racks with the equipment room number and a unique identifier beginning with the telecom room number and the number one, i.e. TR1-1.
2. Label the telecommunications grounding busbar and bonding conductor with the equipment room number and a unique identifier, beginning with the number one, i.e., TGB-SVR1. The designation for the Telecommunications Main Ground Busbar begins with TMGB.
3. Submit labeling schemes to the Owner for approval prior to testing and labeling.

3.02 TELECOMMUNICATIONS BACKBOARDS

A. Mount plywood backboard vertically, 4-inches from floor, minimum of two walls covered within each telecommunications space.

B. Mount backboards with the smooth "A" surface facing away from the wall. Paint the backboard with two coats of fire-resistant paint prior to mounting.

C. Install boards plumb, level and secured to studs or solid concrete or masonry walls. Use a minimum of six appropriate fasteners for every 16 SF of backboard. Anchors for attaching equipment boards include:

1. Material/Substrate: Anchor type.
2. Concrete/Masonry: Expansion anchors; wedge type with washer located on the backside of the board.
3. Gypsum Wallboard: Togglebolts; use pan head type.

D. Powder drive anchors, molly bolts and tappets are not allowed.

3.03 EQUIPMENT RACKS

A. Fasten free-standing equipment racks to the telecom room floor using a minimum of four 1/2-inch concrete anchors. Secure racks mounted on raised floors to the concrete floor below.

B. Position equipment racks according to drawings with a minimum of 3-feet of clearance in front and back. Field verify the dimensions of the room prior to installation of racks and report any discrepancies to the Owner.

C. Provide proper seismic bracing and wire management from backboard to freestanding equipment rack, per IBC.

3.04 WALL MOUNT EQUIPMENT RACKS

A. Position equipment racks according to drawings with a minimum of 3-feet of clearance in front. Field verify the dimensions of the room prior to installation of racks and report any discrepancies to the Owner.

B. Bolt vertical wire managers for equipment racks to the side of the rack using manufacturer's recommended hardware.

3.05 WALL MOUNT CABINETS

A. Provide all components of the cabinet system (cabinet, mounting rails, cable managers, power strips and accessories) from a single manufacturer.

B. Attach cabinet to the wall so the front door can be opened fully without obstruction by other building, storage or architectural components. Follow the manufacturer's installation instructions when securing the cabinet to the wall and backboard. Do not attach the cabinet to sheetrock (gypsum wall board). Attach cabinet directly into studs through a 3/4-inch plywood backboard. Reference 2.02 for additional information. Cabinet may be attached to a masonry wall when the installer provides hardware. Use included hardware or the appropriate hardware as defined by local code or the AHJ.

C. Cables to enter/exit the cabinet through conduit knockouts in the sides and/or bottom of the cabinet through a rectangular cutout in the back of the cabinet.

D. Install and adjust to position all accessories, including cable managers, power strips, equipment-mounting rails, fan kits, etc. prior to installing equipment into the cabinet. Test fans and power strips/outlets prior to installing equipment.

E. Install per manufacturer's instructions and recommendations.

3.06 FREE STANDING CABINETS

A. Provide all components of the cabinet system (cabinet, mounting rails, shelves, cable managers, PDUs or power strips, environmental sensors and thermal management accessories) from a single manufacturer.

B. Install and adjust to position all accessories, including vertical cable managers, vertical PDUs or power strips, equipment-mounting rails and airflow baffles using the manufacturer's installation instructions prior to baying and/or placing the cabinet for attachment to the building. Install shelves, horizontal cable managers and panel fillers after the cabinet is placed.

C. Secure cabinets to the structural floor using manufacturer's installation instructions and appropriate hardware as defined by local code or the AHJ. Installers to provide installation hardware. When placed over a raised floor, secure cabinet to the structural floor through the raised floor panels using threaded rod.

D. When used in a multi-cabinet bay, attach cabinets side-by-side using included baying kits according to the manufacturer's instructions.

E. Attach overhead ladder rack or cable tray to the ceiling, independent of the cabinet. Maintain a 3-inch minimum clearance between the top of the cabinet and the bottom of the ladder rack/cable tray. Position ladder rack/cable so it does not interfere with hot air exhaust through the cabinet's top panel. Use radius drops where cable enters/exits the ladder rack/cable tray. Alternately, attach ladder rack/cable tray to the top of the cabinets using an elevation kit, so the ladder rack/cable tray is a minimum of 3-inches above the cabinet.

F. Securely bond cabinets to the Telecommunications Grounding Busbar (TGB). Attach a bonding conductor, sized in accordance with TIA 607-B. Attach the bonding conductor to the cabinet using included hardware, according to the manufacturer's installation instructions. Installer to provide the bonding conductor and other necessary hardware required to make the connections between the cabinet and the Telecommunications Grounding Busbar.

3.07 VERTICAL WIRE MANAGERS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Bolt vertical wire managers for free-standing and 4-post equipment racks to the side of the rack using manufacturer's recommended hardware.

3.08 HORIZONTAL WIRE MANAGERS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.09 TELECOMMUNICATIONS GROUNDING

A. Bond equipment racks and ladder racking to each equipment room TGB (one per equipment room minimum) with #6 AWG or larger, stranded copper conductor.

B. Connect each TGB to the TMGB and building steel using a 3/0 AWG or larger, stranded copper conductor.

C. Connect each TMGB and TGB to the main electrical main distribution panel and building steel using a 3/0 AWG or larger, stranded copper conductor. Coordinate exact routing and connection points with the electrical contractor.

D. Two-hole lugs are required on all ground cable connecting to the TMGB and TGB.

3.10 LADDER RACK CABLE RUNWAY

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

END OF SECTION

SECTION 27 13 00
COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Work included:

1. This work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically address in the Specification or not.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

B. References and Standards as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

C. Meet requirements of NFPA 780, Standards for Installation of Lightning Protection Systems.

1.03 SUBMITTALS

A. Submittals as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Shop Drawings that include, but are not limited to, the following: Telecommunication Room layout, Telecommunication Room wall elevations, equipment rack elevations, cable routing, cable connecting diagrams, termination pin outs, supporting hardware details, block diagrams, riser diagrams and cable pathways. Work may not begin until shop drawings are approved. Note: Intent of submitting shop drawings is for contractors to display a conceptual understanding of the issued Engineer drawings. Do not submit Engineer Drawings on your title block.
2. Procedures for cable labeling and identification, long term documentation methods and numbering scheme in accordance with ANSI/TIA/EIA- 606-A.
3. A copy of certified installer certificates and warranty certificates for products proposed.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. Manufacturers to have a recognized certified installer program in place for system components proposed. Cable will be approved with manufacturer system installed.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Labor, materials and documentation according to selected manufacturer requirements necessary to ensure that the Owner will be furnished with an Extended Product Warranty and Application Assurance of a minimum of 20 years in length. The Application Assurance Warranty will cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA-568-C.
2. Provide a warranty on the physical installation.
3. Furnish necessary documentation required by the manufacturer immediately following 100 percent testing of cables.
4. Administer the warranty process with the responsible manufacturer's representative. Provide warranty directly to the Owner from the manufacturer. Ensure that the manufacturer provides the Owner with the appropriate warranty certification within 90 calendar days of the final project completion.

1.06 SYSTEM DESCRIPTION

A. Provide a standards-based cable system to serve backbone communication systems requirements as specified in these specifications and shown on Drawings. Closely follow ANSI/TIA/EIA, IEEE and ISO standards which apply to backbone communication systems.

B. Install intrabuilding backbone cables from TRs through raceway systems as shown on Drawings.

C. Install interbuilding (OSP) backbone cables from existing through raceway systems as shown on Drawings.

PART 2 - PRODUCTS

A. Splice Cases:

1. Copper UTP

2.02 COPPER BACKBONE CABLE

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex

6. Panduit /General
7. Siemon
8. Or approved equivalent.

B. Intrabuilding: 100 ohm, CAT6, 24 AWG, ARMM multi-pair cable with an underlying overall metallic shield.

1. Riser rated, CMR rated jacket.
2. Plenum rated, CMP rated jacket.

C. Intrabuilding Distribution, Without Overall Shield: 100 ohm, CAT6, 24 AWG, multi-pair cable.

1. Riser rated, CMR rated jacket.
2. Plenum rated, CMP rated jacket.

D. Intrabuilding Category 6 UTP: 100 ohm, Category 6, 4-pair unshielded twisted pair.

1. Riser rated, CMR rated jacket color blue.
2. Plenum rated, CMP rated jacket color blue

E. Interbuilding: 100 ohm, CAT6, 24 AWG, OSP PE-39 or PE-89 unshielded twisted pair with an overall shield and a single sheath. Shielding must be Steel Aluminum Black Polyethylene (STALPETH).

F. Intrabuilding or Interbuilding Indoor/Outdoor, UL listed for use indoors. Unshielded twisted pair, 100 ohm, 4-pair:

1. Category 6, Mohawk P/N M58772.

G. Intrabuilding or Interbuilding Indoor/Outdoor, UL listed for use indoors. Category 6, 100 ohm, 25-pair unshielded twisted pair with an overall shield: Mohawk P/N M58783.

2.03 FIBER OPTIC BACKBONE CABLE

A. Acceptable Manufacturers;

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit /General
7. Siemon
8. Or approved equivalent.

B. Intrabuilding Multimode Riser: 6 Strand, 50/125 micron, laser optimized.

C. Intrabuilding Multimode Plenum: 6 Strand, 50/125 micron, laser optimized.

D. Intrabuilding Singlemode Riser: 24 Strand, 8.3 micron, high performance low water peak distribution cable.

E. Interbuilding Multimode: 6 Strand, 50/125 micron, laser optimized.

F. Interbuilding Singlemode: 24 Strand,, 8.3 micron, high performance low water peak loose tube cable.

2.04 COPPER TERMINATION HARDWARE

A. Acceptable Manufacturers:

a. Belden
b. CommScope
c. Corning - fiber optic only
d. Leviton/Berk-Tek
e. Ortronics/Superior Essex
f. Panduit /General
g. Siemon
h. Or approved equivalent.

B. Category 6 Modular Patch Panels:

1. 24 port, 8-position modular jack panel, high density, 6 port modules, Category 6, IDC terminals, T568A/B wiring scheme.
2. 48 port, 8-position modular jack panel, high density, 6 port modules, Category 6, IDC terminals, T568A/B wiring scheme.
3. 24 port, 8-position modular jack panel, high density, 8 port modules, Category 6, IDC terminals, T568A/B wiring scheme.
4. 48 port, 8-position modular jack panel, high density, 8 port modules, Category 6, IDC terminals, T568A/B wiring scheme.

C. Wall-Mount Termination Fields:

1. Wall-mounted 110-style termination frames with legs.
2. Rack-mounted110-style termination frames without legs. Provide associated rack mounting hardware.

D. Communication Entrance Protection:

1. Acceptable Manufacturers:

a. Circa
b. Systimax
c. Porta System
d. Or approved equivalent.

2. Wall-mount 5-pin circuit protector blocks. Provide multi-pair tails or 110-style input/output terminations per application. Provide 5-pin, solid state surge arresters for each position on circuit protection panel.

2.05 FIBER OPTIC TERMINATION HARDWARE

A. Acceptable Manufacturers:

1. Belden
2. CommScope

3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit /General
7. Siemon
8. Or approved equivalent.

B. High Density Fiber Termination Shelf:

1. 7-inch high shelf designed for mounting in 19-inch equipment racks and capable of accepting 12 adapter panels. The shelf will contain built-in slack management and be accessible from the front or rear with locking doors.

    a. 19-inch rack mount, 13-inches deep.
    b. 19-inch rack mount, 19-inches deep.

2. 3.5-inch high shelf designed for mounting in 19-inch equipment racks and capable of accepting 6 adapter panels. The shelf will contain built-in slack management and be accessible from the front or rear with locking doors.

    a. 19-inch rack mount, 13-inches deep.
    b. 19-inch rack mount, 19-inches deep.

3. Fiber Adapter Panels:

    a. Adapter panel for high density termination shelf with 6 LC multimode phosphor-bronze alignment sleeves.
    b. Adapter panel for high density termination shelf with 6 duplex SC multimode phosphor-bronze alignment sleeves.

4. Preloaded Fiber Termination Shelf:

    a. 1.75-inch high shelf designed for mounting in 19-inch equipment racks with 12 LC multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.
    b. 1.75-inch high shelf designed for mounting in 19-inch equipment racks with 24 LC multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.
    c. 1.75-inch high shelf designed for mounting in 19-inch equipment racks with 6 duplex SC multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.
    d. 1.75-inch high shelf designed for mounting in 19-inch equipment racks with 12 duplex SC multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.
    e. 1.75-inch high shelf designed for mounting in 19-inch equipment racks with 12 MT-RJ multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.

f. 1.75-inch high shelf designed for mounting in 19-inch equipment racks with 24 MT-RJ multimode phosphor-bronze alignment sleeves. The shelf will contain built-in slack management and be accessible from the front or rear.

C. Multimode LC Connector:

1. Ceramic tip LC style capable of being terminated on 50/125 fiber with 900 micron buffer.
2. Ceramic tip SC style capable of being terminated on 50/125 fiber with 900 micron buffer.
3. Ceramic tip LC style capable of being terminated on 62.5/125 fiber with 900 micron buffer.
4. Ceramic tip SC style capable of being terminated on 62.5/125 fiber with 900 micron buffer.

D. Single mode LC Connector:

1. Ceramic tip LC style capable of being terminated on 8.3/125 fiber with 900 micron buffer.
2. Ceramic tip SC style capable of being terminated on 8.3/125 fiber with 900 micron buffer.

2.06 FIBER PATCH CORDS

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit /General
7. Siemon
8. Or approved equivalent.

B. Multimode Fiber Optic Jumpers:

1. Factory terminated double ended, two strand multimode cordage with LC connectors on each end, length as defined by the Owner.
2. Factory terminated double ended, two strand multimode cordage with SC connectors on each end, length as defined by the Owner.

C. Singlemode Fiber Optic Jumpers:

1. Factory terminated double ended, two strand singlemode cordage with LC connectors on each end, length as defined by the Owner.
2. Factory terminated double ended, two strand singlemode cordage with SC connectors on each end, length as defined by the Owner.

2.07 SPLICE CASES

A. Acceptable Manufacturers:

1. Preformed
2. Corning (Fiber Optic Only)
3. 3M
4. Or approved equivalent.

B. Copper UTP: Provide as close as practicable (within 50-feet) of where OSP cable enters building in a duct or conduit system. Size splice case(s) to accommodate pair count of the cable(s) entering building. Splice case must be capable of bonding to the Telecommunications Main Grounding Bus Bar (TMGB). Complete with end caps to properly seal cable from expanding water blocking gel. Use 25-pair 3M splice modules for splice connections.

C. Fiber Optic: Provide as close as practicable (within 50-feet) of where OSP cable enters building in a duct or conduit system. Size splice cases(s) to accommodate strand count of the cable(s) entering building. Splice case must be capable of bonding to the Telecommunications Main Grounding Bus Bar (TMGB). Complete with end caps to properly seal cable from expanding water blocking gel.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Miscellaneous Hardware: Provide supporting hardware, cable ties, labels, underground vault racking, bullet bonds, gel blocking kits, pull rope and other miscellaneous hardware for a complete and operable system.

B. Provide like items from one manufacturer, such as cable, patch panels, connectors, and equipment connection cords.

C. Communications Backbone Cabling includes cables, connectors, patch panels, connecting blocks and patch cords, as well as the necessary support systems, such as cable managers, tie wraps and D-rings.

D. Furnish and install materials necessary for a complete and working system.

E. Contractor must be a Certified Installer for selected manufacturer prior to, during and through completion of the system installation and must be able to provide the manufacturer's extended warranty.

F. Perform work in a neat and workmanlike manner.

G. Firestopping: Install all firestop systems in accordance with manufacturer's recommendations. Firestop systems to be completely installed and available for inspection by local inspection authorities prior to cable system acceptance.

H. Install cable after interior of building has been physically protected from the weather and mechanical work likely to damage cabling has been completed.

I. Before installing cabling, ensure cable pathways are completely and thoroughly cleaned:

1. Inspect conduit, wireway, cable trays and innerduct systems prior to installation.
2. Swab any additional enclosed raceway and innerduct systems.

J. Provide protection for exposed cables where subject to damage. Provide abrasion protection for any cable or wire bundles, which pass through holes or across edges of sheet metal.

K. Install cable ties and other cable management clamps via hand so they fit snugly. Do not over tighten or use mechanical tools which could compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.

L. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Use Velcro ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.

M. Limit cable raceway fill to less than the TIA/EIA-569-B maximum fill for the particular raceway type.

N. If a J-hook or trapeze system is used to support cable bundles, support cables at a maximum of 48 to 60-inch intervals. Cables are prohibited to rest on acoustic ceiling grids or panels.

O. Install cable above fire-sprinkler systems and ensure the cable does not attach to the system or any ancillary equipment or hardware. Install cable system and support hardware so it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

P. Do not attach cables to ceiling grid or lighting fixture wires. Where support for cable is required, install appropriate carriers to support the cabling.

Q. Any cable damaged or exceeding recommended installation parameters during installation will be replaced by the contractor prior to final acceptance at no cost to the Owner.

R. Unshielded Twisted Pair Cable Installation Practices:

1. Install cable in accordance with manufacturer's recommendations and best industry practices.
2. Do not exceed the cable's minimum bend radius and maximum pulling tension.
3. Install unshielded twisted pair cable so there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.

S. Provide the following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:

1. Open or Nonmetal Communications Pathways:

a. 12-inches from electric motors, fluorescent light fixtures and unshielded power lines carrying up to 3 kVA.
b. 36-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
c. 48-inches from large electrical motors or transformers.

2. Grounded Metal Conduit Communications Pathways:

    a. 2-1/2-inches from electrical equipment and unshielded power lines carrying up to 2 kVA.
    b. 6-inches from electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA.
    c. 12-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
    d. 3-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA.
    e. 6-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying more than 5 kVA.

T. Determine requirements for plenum rated cable and devices. When doubt exists, seek prior determination in writing by AHJ.

U. Seal conduits entering from outside the building and install listed firestop material in conduits and sleeves to satisfy NEC and local codes.

V. Unshielded Twisted Pair Termination:

1. Dress and terminate cables in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.1 document, manufacturer's recommendations and best industry practices.
2. Maintain the cable jacket within 1-inch of the termination point.
3. Do not exceed 0.5-inch of pair untwist at the termination point.
4. Do not exceed 4 times the outside diameter of the cable in the termination area for bend radiance compliance.
5. Neatly bundle and dress cables to their respective panels or blocks. Feed each panel or block by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

W. Testing Procedures:

1. Test cables and termination hardware for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C. Verify pairs of each installed cable prior to system acceptance. Repair or replace any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels and connector blocks in order to ensure 100 percent useable conductors in cables installed.
2. Test cables in accordance with this document, the ANSI/TIA/EIA standards, the manufacturer's procedures and best industry practice. If any of these are in conflict, bring any discrepancies to the attention of the project team for clarification and resolution.
3. Test Unshielded Twisted Pair cables as follows:

    a. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Test cabling using a Level IV test unit for Category 6 performance compliance as specified in ANSI/TIA/EIA-568-C.
    b. Continuity: Test each pair of each installed cable using a test unit that shows opens, shorts, polarity and pair-reversals, crossed

pairs and split pairs. Test shielded/screened cables with a device that verifies shield continuity in addition to the above stated tests. Record the test as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Correct or repair any faults in the wiring and re-test the cable prior to final acceptance.

c. Length: Test each installed cable link for installed length using a TDR type device. Test the cables from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length will conform to the maximum distances set forth in the ANSI/TIA/EIA-568-C standard. Record cable lengths, referencing the cable identification number and circuit or pair number. For multi-pair cables, record the shortest pair length as the length for the cable.

4. Follow the Standards requirements established in ANSI/TIA/EIA-568-C.
5. Perform testing with a Level IV tester. The basic tests required are:

   a. Wire Map
   b. Length
   c. Attenuation
   d. NEXT (Near end crosstalk)
   e. Return Loss
   f. ELFEXT Loss
   g. Propagation Delay
   h. Delay skew
   i. PSNEXT (Power sum near-end crosstalk loss)
   j. PSELFEXT (Power sum equal level far-end crosstalk loss)

6. Provide test results in electronic format, with the following minimum information per cable:

   a. Circuit ID
   b. Test result, “Pass” or “Fail”
   c. Date and Time of test
   d. Project Name

7. Fiber Test Documentation: Provide electronic CD disk and hard copy test reports from ANSI/TIA/EIA-526-14A Method B Standards. Calculate a “Loss Budget” for each cable length based on cable length and connectors. Provide as a minimum, OTDR test results in the form of a printed waveform and text table for both 850 nm and 1300 nm for multimode fiber and 1350 nm and 1510 nm for singlemode fiber. Test fibers and connector systems for end-to-end attenuation. Provide a power meter test on fiber optic strands at both wavelengths A to B, B to A and OSPL (OSPL is as defined as La + Lb). Include the results of unsatisfactory tests, with an explanation of how the problem was corrected. Clearly label connector and fiber loss on test waveforms.
8. Provide an electronic copy of the test results, in the native tester software format, to the Owner along with the printed test results.
9. Provide a fully functional version of the tester software for use by the Owner in reviewing the test results.

3.02 COPPER BACKBONE CABLE

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

C. Install backbone cables separately from horizontal distribution cables.

D. Install a pull cord (nylon; 1/8-inch minimum) with cable installed in conduit.

E. Where cables are installed in conduits, install the backbone and horizontal cables in separate conduits.

F. Where cables are installed in an air-return plenum, install riser-rated cable in metallic conduit.

G. Where backbone cables and distribution cables are installed in a cable tray, install backbone cables first, and bundle them separately from the horizontal distribution cables.

H. Securely fasten all backbone cables to the sidewall of the TR on each floor.

I. Securely attach backbone cables spanning more than three floors at the top of the cable run; use a wire mesh grip and attach cables on alternating floors, or as required by code.

J. Support vertical runs of cable to messenger strand, cable ladder or other method, to provide proper support to the weight of the cable.

K. Attach large bundles of cables using metal clamps and/or metal banding to support the cables.

L. Labeling:

1. Label cables using a machine printed label at each end of the cable at approximately 6-inches of the termination point. Do not use handwritten labels.
2. Labels to denote to and from with room names and numbers.
3. Provide the final cable ID matrix to the Owner for approval one week prior to cable installation.
4. Note labeling information on the As-Built Drawings.

3.03 FIBER OPTIC BACKBONE CABLE

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

C. Place fiber optic cable so as to maintain the minimum cable bend radius limits specified by the manufacturer or ten times the cable diameter, whichever is larger.

D. Place fiber optic cable runs in innerduct. Use care when handling fiber optic cable. Carefully monitor pulling tension so as not to exceed the limits specified by the manufacturer.

E. Terminate fiber optic cable in rack-mounted fiber optic termination units at each end using standard SC style bulkhead connectors.

F. Splicing of fiber optic cable is prohibited.

G. Labeling:

1. Label cables using a machine printed label at each end of the cable at approximately 6-inches of the termination point. Do not use handwritten labels.
2. Labels to denote to and from with room names and numbers.
3. Provide the final cable ID matrix to the Owner one week prior to cable installation.
4. Note labeling information on the As-Built Drawings.

3.04 COPPER TERMINATION HARDWARE

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

C. Dress and terminate cables in accordance with the recommendations made in the ANSI/TIA/EIA-568-B standard, manufacturer's recommendations and best industry practices.

D. Pair untwist at the termination is not to exceed 0.125-inch.

E. Bend radius of the cable in the termination area is not to exceed four times the outside diameter of the cable.

F. Dress cables to their respective panels or blocks. Feed each panel or block by an individual bundle, separated and dressed back to the point of cable entrance into the rack or frame.

G. Maintain the cable jacket to the termination point.

3.05 FIBER OPTIC TERMINATION HARDWARE

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

C. Neatly coil fiber slack within the fiber space tray or enclosure.

D. Individually attach each cable to its respective fiber enclosure by mechanical means. Securely attach the cable strength member to the cable strain-relief bracket in the enclosure.

E. Strip each fiber bundle upon entering the splice tray and the individual fibers routed in the splice tray.

F. Splice no more than 12 strands of fiber in each tray.

G. Install all spare strands into spare splice trays.

H. Clearly label each cable at the entrance to the enclosure. Cables labeled within the bundle will not be accepted.

3.06 FIBER PATCH CORDS

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

C. Provide sufficient duplex fiber optic patch cords at each fiber termination point to cross-connect one-half the number and type of fibers terminated there, Assume a minimum of two duplex fiber optic jumpers per termination point for a 6-strand optical fiber. Provide lengths for a neat appearance not to exceed 15-feet. Coordinate connector requirements with Owner or Owner's Authorized Representative.

D. Field terminated patch cords are not allowed.

3.07 SPLICE CASES

A. Install per manufacturer's instructions and recommendations.

B. Reference 3.01, General Installation Requirements.

END OF SECTION

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 SUMMARY

A. Work included:

1. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

B. Use this Section in conjunction with other Division 27, Communications specifications and related Contract Documents to establish the total general requirements for the project communications systems and equipment.

C. References and Standards as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

D. Meet requirements of NFPA 780, Standard for the Installation of Lightning Protection Systems.

1.03 SUBMITTALS

A. Submittals as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Shop Drawings that include, but are not limited to, the following: Telecommunication Room layout, Telecommunication Room wall elevations, equipment rack elevations, cable routing, cable connecting diagrams, termination pin outs, supporting hardware details, block diagrams, riser diagrams, cable pathways. Work may not begin until shop drawings are approved. Note: Intent of submitting shop drawings is for contractors to display a conceptual understanding of the issued Engineer drawings. Do not submit engineer's drawing on your title block.
2. Procedures for cable labeling and identification, long term documentation methods and numbering scheme in accordance with ANSI/TIA/EIA-606A.
3. A copy of certified installer certificates and warranty certificates for products proposed.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. Manufacturers to have a recognized certified installer program in place for system components proposed. Cable will be approved with manufacturer system installed.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Labor, materials and documentation according to selected manufacturer requirements necessary to ensure that the Owner will be furnished with an Extended Product Warranty and Application Assurance of a minimum of 20 years in length. The Application Assurance Warranty will cover the failure of the wiring system to support current or future applications that are designed for the link/channel specifications of ANSI/TIA/EIA-568-C.1. These applications include, but are not limited to, 10BASE-T, 100BASE-T, 1000BASE-T, 10GBASE-T and 155 Mb/s ATM.
2. A warranty on the physical installation.
3. Necessary documentation required by the manufacturer immediately following 100 percent testing of cables.

C. Administer the warranty process with the responsible manufacturer's representative. Provide warranty directly to the Owner from the manufacturer. Ensure that the manufacturer provides the Owner with the appropriate warranty certification within 90 calendar days of the final project completion.

1.06 SYSTEM DESCRIPTION

A. Provide a standards-based cable system to serve horizontal communication systems requirements as specified and as shown on Drawings. Closely follow ANSI/TIA/EIA, IEEE and ISO standards.

B. The horizontal distribution subsystem refers to intrabuilding twisted-pair communications cabling connecting telecommunications rooms (TRs) to telecommunications outlets (TOs) located at individual work areas and consists of the following:

1. Category 6 100 ohm, 4-pair, unshielded twisted pair cables from the telecom rooms to the outlets.
2. The horizontal system includes cables, jacks, patch panels and patch cords, as well as the necessary support systems, such as cable managers and faceplates.
3. Cables are routed through conduit, spaces below raised floors, open ceiling areas, non-ventilated spaces above ceiling tile and through plenum air-handling spaces above ceiling tile.
4. Furnish and install materials necessary for a complete and working system.

PART 2 - PRODUCTS

2.01 STATION CABLING

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit
7. Siemon
8. Or approved equivalent.

B. Category 6 Unshielded Twisted Pair:

1. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, CMP rated jacket color blue.
2. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, CMR rated jacket color blue.
3. 100 ohm, Category 6, 23 AWG, 4-pair unshielded twisted pair, Indoor/Outdoor rated, color black.

2.02 MODULAR JACKS

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit
7. Siemon
8. Or approved equivalent.

B. Category 6 Modular Jacks:

1. Eight-position modular jack, Category 6, IDC terminals, T568A/B wiring scheme
2. Each jack must be stamped or have icons to identify it as CAT 6.
3. Coordinate color with building finishes.

2.03 WORK AREA OUTLETS

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit

7. Siemon
8. Or approved equivalent.

B. Flush Mounted Faceplate:

1. One-port faceplate with mounting lugs for wall phone, constructed from high impact thermo-plastic, mounts within a single-gang wall box.
2. Two-port faceplate, constructed from high impact thermo-plastic, with recessed label fields; mounts within a single-gang wall box as indicated on the drawings.
3. Eight-port faceplate, constructed from high impact thermo-plastic, with recessed label fields; mounts within a double-gang wall box as indicated on the drawings.
4. Coordinate faceplate color with building finishes. Submit to Architect for approval prior to installation.

C. Flush Mounted Stainless-Steel Faceplates:

1. Two-port stainless steel faceplate, with recessed label fields; mounts within a single gang wall box as indicated on the drawings.
2. Eight-port stainless steel faceplate, with recessed label fields; mounts within a double gang wall box as indicated on the drawings.

D. Modular Furniture Faceplates:

1. 0.125-inch deep modular furniture bezel fits 1.375-inch x 2.71-inch furniture knockout.
2. 0.625-inch deep modular furniture bezel fits 1.375-inch x 2.71-inch furniture knockout, with recessed label field.
3. 1-inch deep modular furniture bezel fits 1.375-inch x 2.71-inch furniture knockout, with recessed label field.
4. Three-port modular furniture adapter plate
5. Adjustable Four-port modular furniture faceplate fits 2.67-inch to 2.75-inch x 1.34-inch to 1.41-inch furniture knockout.
6. Four-port modular furniture faceplate fits Herman Miller Beltline furniture openings 2.35-inch x 3.41-inch.
7. Six-port modular furniture faceplate fits Herman Miller Beltline furniture openings 2.35-inch x 3.41-inch.
8. Six-port modular furniture faceplate fits Herman Miller Baseline furniture openings 1.89-inch x 2.99-inch.
9. Coordinate furniture plate colors with building finishes. Submit to Architect for approval prior to installation.

E. Modular Mounting Frames/Covers:

1. Two-port 106-Type duplex frame; mounts within a single gang wall box.
2. Four-port Stylistics rectangular (GFCI) footprint frame; mounts within a single gang wall box.
3. Single-gang 106-Type Plastic Cover Plate.
4. Single-gang Stylistics Plastic Cover Plate.
5. Coordinate mounting frame colors with building finishes. Submit to Architect for approval prior to installation.

F. Multimedia Outlets:

1. Multimedia outlet with up to 6 ports of copper exiting from the front and up to 12 strands of fiber exiting from the bottom. Constructed from high impact thermo-plastic, with recessed label fields.
2. Bottom adapter plate for up to six LC or SC simplex adapter modules.
3. Bottom adapter plate for up to three SC duplex adapter modules.
4. Bottom adapter plate for up to four TracJack adapter modules.
5. Protective bottom shrouds.

G. Dust Covers: Single port dust cover for modular openings, color to match faceplate.

2.04 TERMINATION BLOCKS

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit
7. Siemon
8. Or approved equivalent.

B. Category 6 110-style Blocks:

1. Category 6, 288 pair, 110-style, with mounting legs, wall-mount.
2. Category 6, 96 pair, 110-style, with mounting legs, wall-mount.
3. Category 6, 288 pair, 110-style, without mounting legs, rack-mount.
4. Category 6, 96 pair, 110-style, without mounting legs, rack-mount.

C. Connecting Blocks:

1. 3 pair 110-style connecting blocks.
2. 4 pair 110-style connecting blocks.
3. 5 pair 110-style connecting blocks.

D. Wiring Troughs:

1. Horizontal trough for routing of patch cords and cross-connect wire, with mounting legs.
2. Horizontal trough for routing of patch cords and cross-connect wire, without mounting legs.

E. 110 Block Labels:

1. Clear plastic holder for 110 blocks with paper inserts, for blocks with legs
2. Clear plastic holder for 110 blocks with paper inserts, for blocks without legs

F. Mounting Brackets: 19-inch rack-mount brackets for 200 pair 110 termination blocks and wiring troughs.

2.05 PATCH PANELS

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit
7. Siemon
8. Or approved equivalent.

B. Category 6 Modular Patch Panels:

1. 24 port, eight-position modular jack panel, high density, 6 port modules, Category 6, IDC terminals, T568A/B wiring scheme.
2. 48 port, eight-position modular jack panel, high density, 6 port modules, Category 6, IDC terminals, T568A/B wiring scheme.
3. 24 port, eight-position modular jack panel, high density, 8 port modules, Category 6, IDC terminals, T568A/B wiring scheme.
4. 48 port, eight-position modular jack panel, high density, 8 port modules, Category 6, IDC terminals, T568A/B wiring scheme.

C. Universal Patch Panels:

1. 19-inch rack-mounted panel capable of accepting up to 24 modular jacks.
2. 19-inch rack-mounted panel capable of accepting up to 48 modular jacks.

2.06 PATCH CORDS

A. Acceptable Manufacturers:

1. Belden
2. CommScope
3. Corning - fiber optic only
4. Leviton/Berk-Tek
5. Ortronics/Superior Essex
6. Panduit
7. Siemon
8. Or approved equivalent.

B. Category 6 Modular Patch Cords: Factory terminated double ended, eight-position to eight-position, modular, stranded conductors, 4 pair color, blue.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Miscellaneous Hardware: Provide supporting hardware, cable ties, labels, pull rope and other miscellaneous hardware for a complete and operable system.

B. Provide like items from one manufacturer, such as jacks, patch panels, equipment connection cords and wall plates.

C. Horizontal cabling includes cables, jacks, patch panels, connecting blocks and patch cords, as well as the necessary support systems, such as cable managers and faceplates.

D. Furnish and install materials necessary for a complete and working system.

E. Contractor must be a Certified Installer for selected manufacturer prior to, during and through completion of the system installation and must be able to provide the manufacturer's extended warranty.

F. Perform work in a neat and workmanlike manner.

G. Install cable after interior of building has been physically protected from the weather and mechanical work likely to damage cabling has been completed.

H. Before installing cabling, ensure cable pathways are completely and thoroughly cleaned.

1. Inspect conduit, wireway, cable trays and innerduct systems prior to installation.
2. Swab any additional enclosed raceway and innerduct systems.

I. Provide protection for exposed cables where subject to damage. Provide abrasion protection for any cable or wire bundles, which pass through holes or across edges of sheet metal.

J. Install cable ties and other cable management clamps via hand so it fits snugly. Do not over tighten or use mechanical tools which could compress, crimp, or otherwise change the physical characteristics of the cable jacket or distort the placement of twisted-pair components. Replace any cable exhibiting stresses due to over tightening of cable management devices.

K. Where possible, route cables in overhead cable trays and inside wire management systems attached to the equipment cabinets and racks. Use Velcro ties or ducts to restrain cabling installed outside of wire management systems on racks or in cabinets.

L. Co-install a pull cord (nylon; 1/8-inch minimum) with cable installed in conduit.

M. Limit cable raceway fill to less than the TIA/EIA-569-B maximum fill for the particular raceway type.

N. If a J-hook or trapeze system is used to support cable bundles, support horizontal cables at a maximum of 48- to 60-inch intervals. Cables are prohibited to rest on acoustic ceiling grids or panels.

O. Bundle horizontal distribution cables in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.

P. Install cable above fire-sprinkler systems and ensure that the cable does not attach to the system or any ancillary equipment or hardware. Install cable system and support hardware such that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

Q. Do not attach cables to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support the cabling.

R. Any cable damaged or exceeding recommended installation parameters during installation will be replaced by the contractor prior to final acceptance at no cost to the Owner.

S. Determine requirements for plenum rated cable and devices. When in doubt, seek determination in writing by Authority Having Jurisdiction (AHJ) prior to ordering. Without written confirmation from the AHJ, Contractor to assume that a plenum rating is required.

T. Unshielded Twisted Pair Cable Installation Practices:

1. Install cable in accordance with manufacturer's recommendations and best industry practices.
2. Install cables in continuous lengths from origin to destination (no splices).
3. Do not exceed the cable's minimum bend radius and maximum pulling tension.
4. Install unshielded twisted pair cable so that there are no bends smaller than four times the cable outside diameter at any point in the run and at the termination field.
5. Do not exceed 25-lbf pulling tension on 4-pair UTP cable.

U. Provide the following minimum separation distances between pathways for copper communications cables and power wiring of 480 volts or less:

1. Open or Nonmetal Communications Pathways:

a. 12-inches from electric motors, fluorescent light fixtures and unshielded power lines carrying up to 3 kVA.
b. 36-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
c. 48-inches from large electrical motors or transformers.

2. Grounded Metal Conduit Communications Pathways:

a. 2-1/2-inches from electrical equipment and unshielded power lines carrying up to 2 kVA.
b. 6-inches from electrical equipment and unshielded power lines carrying from 2 kVA to 5 kVA.
c. 12-inches from electrical equipment and unshielded power lines carrying more than 5 kVA.
d. 3-inches from power lines

enclosed in a grounded metal conduit (or equivalent shielding) carrying from 2 kVA to 5 kVA.

e. 6-inches from power lines enclosed in a grounded metal conduit (or equivalent shielding) carrying more than 5 kVA.

V. Unshielded Twisted Pair Termination:

1. Coil cables in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. Do not store more than 12-inches of UTP in an in-wall box, modular furniture raceway, or insulated walls. Loosely coil and store excess slack in accessible ceiling space above each drop location when there is not enough space present in the outlet box to store slack cable.
2. Dress and terminate cables in accordance with the recommendations made in the ANSI/TIA/EIA-568-C.1 document.
3. Terminate four pair cables on the jack and patch panels using ***<<T568B; or T568A>>*** wiring scheme.
4. Maintain the cable jacket within 1-inch of the termination point.
5. Do not exceed 0.5-inch of pair untwist at the termination point.
6. Do not exceed four times the outside diameter of the cable in the termination area for bend radiance compliance.
7. Neatly bundle and dress cables to their respective panels or blocks. Feed each panel or block by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.

W. Testing Procedures:

1. Test cables and termination hardware for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C. Verify pairs of each installed cable prior to system acceptance. Repair or replace any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels and connector blocks in order to ensure 100 percent useable conductors in cables installed.
2. Test cables in accordance with this document, the ANSI/TIA/EIA standards, the manufacturer's procedures and best industry practice. If any of these are in conflict, bring any discrepancies to the attention of the project team for clarification and resolution.
3. Test Unshielded Twisted Pair Cables as Follows:

a. Test twisted-pair copper cable links for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category performance. Test horizontal cabling using a Level IV test unit for Category ***<<5e; or 6>>*** performance compliance as specified in ANSI/TIA/EIA-568 C.

b. Continuity: Test each pair of each installed cable using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. Test shielded/screened cables with a device that verifies shield continuity in addition to the above stated tests. Record the test

as pass/fail as indicated by the test unit in accordance with the manufacturers' recommended procedures and referenced to the appropriate cable identification number and circuit or pair number. Correct or repair any faults in the wiring and retest the cable prior to final acceptance.

c. Length: Test each installed cable link for installed length using a TDR type device. Test the cables from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length will conform to the maximum distances set forth in the ANSI/TIA/EIA-568-C Standard. Record cable lengths, referencing the cable identification number and circuit or pair number. For multipair cables, record the shortest pair length as the length for the cable.

4. Follow the Standards requirements established in ANSI/TIA/EIA-568-C.
5. Perform testing with a Level IV tester. The basic tests required are:

a. Wire Map
b. Length
c. Attenuation
d. NEXT (Near-end Crosstalk)
e. Return Loss
f. ELFEXT Loss
g. Propagation Delay
h. Delay Skew
i. PSNEXT (Power Sum Near-end Crosstalk Loss)
j. PSELFEXT (Power Sum Equal Level Far-end Crosstalk Loss)

6. Provide test results in electronic format, with the following minimum information per cable:

a. Circuit ID
b. Test Result, “Pass” or “Fail”
c. Date and Time of Test
d. Project Name

7. Provide an electronic copy of the test results, in the native tester software format, to the Owner along with the printed test results.
8. Provide a fully functional version of the tester software for use by the Owner in reviewing the test results.

X. Labeling:

1. Label horizontal cables using a machine printed label at each end of the cable at approximately 6-inches of the termination point. Do not use handwritten labels.
2. Label patch panel ports and TO ports with the cable identifier.
3. Labels to be Telecom Room number, patch panel number and patch panel port number. Provide the final cable ID matrix to the Owner for approval one week prior to cable installation.
4. Note labeling information at each outlet on the record drawings.

Y. Coordination of Conditions: Structured cabling for wireless access points of a given description may be used in more than one type of ceiling or wall structure. Coordinate ceiling construction, wall types, recessing depth and other construction details prior to ordering special components indicated in the details for shipment. Where materials supplied do not match ceiling construction replace them at no cost to Owner.

3.02 STATION CABLING

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.03 MODULAR JACKS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.04 WORK AREA OUTLETS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.05 TERMINATION BLOCK

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.06 PATCH PANELS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.07 PATCH CORDS

A. Field terminated patch cords and jumpers are not allowed. At a minimum, provide equipment connection cords for one-half the total number of cables installed at each termination point. For example: A telecommunications outlet with four Category 6 cables installed would require two Category 6 equipment connection cords at the work area outlet and two Category 6 equipment connection cords in the telecommunications equipment room for a total of four Category 6 equipment connection cords.

END OF SECTION

SECTION 27 41 16
INTEGRATED AUDIO-VIDEO SYSTEMS AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work included:

1. The work included under this specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. The contractor will provide and install all of the required material whether specifically addressed in the Specification or not.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications and Division 01, General Requirements apply to this Section.

B. References and Standards as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

C. In addition, meet the following:

1. BICSI/INFOCOMM AV Design Reference Manual.
2. ANSI/INFOCOMM 2M-2010 Standard Guide for Audiovisual Systems Design and Coordination Processes.

D. In addition, reference Section 11 52 13, Projection Screens.

1.03 SUBMITTALS

A. Submittals as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Screen shots for touch panel user-interface.
2. Shop drawings showing installation instructions, block wiring diagrams, component interconnections, custom faceplate layouts with labeling, device locations and literal descriptions.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. A minimum of five years' experience in the design, installation, testing and maintenance of commercial audio-video systems.
2. Employ at least one full-time InfoCOMM Certified Technology Specialist

(CTS) who is involved in reviewing work performed by Contractor on this project.

3. Maintain a local service facility which stocks spare devices and/or components for servicing systems.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Section 27 00 01, Communications Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 EQUIPMENT MOUNTING HARDWARE

A. Equipment Racks:

1. Acceptable Manufacturers:

   a. Middle Atlantic
   b. Lowell Manufacturing
   c. Or approved equivalent.

2. Type: 19-inch stand-alone equipment cabinet with vented side panels, vented locking rear door
3. Removable, key-locked side panels.
4. Black powder-coat finish.
5. UL listed.

B. Equipment Cabinet Accessories:

1. Acceptable Manufacturers:

   a. Middle Atlantic
   b. Lowell Manufacturing
   c. Or approved equivalent.

2. Blank rack-panels.
3. Vent panels.

C. In-Wall Equipment Racks:

1. Acceptable Manufacturers:

   a. Middle Atlantic
   b. Or approved equivalent.

2. Type: 19-inch wide, 19-inch deep, 45-inch high EIA/TIA compliant equipment rack.
3. Designed to be installed flush in wall cavity or void with sliding rail and 90-degree pivot rotation for maintenance purposes.
4. Black powder-coat finish.

2.02 VIDEO DISPLAY MOUNTING HARDWARE

A. Flat-Panel Display Mounting:

1. Acceptable Manufacturers:

a. Chief Manufacturing; LSM Series.
b. Or approved equivalent.

2. 17-1/2-inch lateral shift.
3. Plus or minus 1/2-inch height adjustment.
4. Mounts on 16-inch, 20-inch, or 24-inch stud spacing.
5. Less than 2-inch depth from wall.
6. 200-lb weight capacity.

B. Mounting Accessories:

1. Acceptable Manufacturers:

a. Adjustable Extension Column:

(1) Chief Manufacturing; CMS Series.
(2) Or approved equivalent.

b. Fixed Extension Column:

(1) Chief Manufacturing; CMA-012
(2) Or approved equivalent.

c. C-Clamp:

(1) Chief Manufacturing; CMA-362.
(2) Or approved equivalent.

2. Devices consist of plates, columns, clamps, brackets and adapters.
3. All devices of steel construction using National Pipe Thread (NPT) and American National Standards Institute (ANSI) standards.
4. Examples of Components Required:

a. 8-inch Ceiling plate with attached adjustable 1-1/2-inch NPT (column).
b. Angled ceiling adapter.
c. Adjustable extension column.
d. Fixed extension column, 1-foot length.
e. C-Clamp.

2.03 POWER DISTRIBUTION

A. Acceptable Manufacturers:

1. Lowell Manufacturing
2. Middle Atlantic
3. Or approved equivalent.

B. Rack-Mounted Power Distribution:

1. One front and eight rear NEMA 5-15R electrical outlets.
2. One 15-amp circuit.
3. Surge and spike protection.
4. 9-foot extension cable.
5. Black powder coat finish.
6. UL listed.

2.04 AUDIO SOURCE EQUIPMENT

A. CD Player:

1. Acceptable Manufacturers:

   a. Tascam
   b. Or approved equivalent.

2. Plays audio CDs, MP3 CDs and WAV file CDs.
3. RCA unbalanced line output.
4. Coaxial and optical S/PDIF digital output.
5. 1/4-inch stereo headphone output.
6. Wireless remote control.

B. Wireless Microphone Receivers:

1. Acceptable Manufacturers:

   a. Shure
   b. Sennheiser
   c. Audio-Technica
   d. Or approved equivalent.

2. UHF band operation.
3. 960 operating frequencies across 24 MHz of bandwidth.
4. Auto frequency selection.
5. Detachable 1/4-wave antennas.
6. 1/4-inch and XLR audio outputs.
7. Multifunction LCD display.
8. Provide with combination pack which includes a hand-held dynamic microphone and a bodypack with lavalier microphone.

C. Hand-Held Wired Microphones:

1. Acceptable Manufacturers:

   a. Shure
   b. Sennheiser
   c. Audio-Technica
   d. Or approved equivalent.

2. Dynamic (moving coil) type microphone.
3. 50-Hz to 16-kHz frequency response.
4. Super-cardioid polar pattern, rotationally symmetrical about microphone

axis, uniform with frequency.

5. Die-cast metal casing with spherical steel mesh grille.

D. Boundary Wireless Microphones:

1. Acceptable Manufacturers:

a. Shure
b. Sennheiser
c. Audio-Technica
d. Or approved equivalent.

2. Condenser (electret bias) type microphone.
3. Cardioid polar pattern (at 1-kHz).
4. Up to 100-foot operating range.
5. Powered by two AA batteries, 8-hour battery life.

E. Gooseneck Desktop Microphones:

1. Acceptable Manufacturers:

a. Shure
b. Sennheiser
c. Audio-Technica
d. Or approved equivalent.

2. Microphone Base:

a. Logic enabled for LED and mute control.
b. Programmable mute switch (push-to-mute, push-to-talk, logic, local).
c. Low-cut filter.
d. 20-foot, attached microphone cable with 5-pin male XLR termination.

3. Microphones:

a. Gooseneck construction, 10-inch length.
b. Condenser (electret bias) type microphone.
c. 50-Hz to 17-kHz frequency response.
d. Cardioid polar pattern.
e. Bi-color status indicator.

2.05 AUDIO DISTRIBUTION EQUIPMENT

A. DSP Audio Matrix Mixer:

1. Acceptable Manufacturers:

a. Biamp Systems; AudiaFLEX.
b. Biamp Systems; AudiaSOLO.
c. Or approved equivalent.

2. Up to 24-input/output modular design.

3. Software programmable features include:

    a. Standard, automatic and matrix mixers.
    b. Graphic and parametric equalization.
    c. Dynamic Processing: Compression, limiting and ducking.
    d. Digital delay up to 2000-ms.

4. Bi-directional RS-232 control port for control via third-party control systems.
5. Ethernet-ready network port for network control and monitoring.

B. DSP Audio Matrix Mixer Accessories:

1. Two-channel balanced microphone/line-level input module: Software controllable mute, level, signal-invert and full-scale output reference.

    a. Acceptable Manufacturers:

        (1) Biamp Systems; IP2.
        (2) Or approved equivalent.

2. Two-channel balanced microphone/line-level output module: Software controllable gain/peak indication, plus 48V phantom power, mute, level and signal invert.

    a. Acceptable Manufacturers:

        (1) Biamp Systems; OP2e
        (2) Or approved equivalent.

3. Two-channel wide-band acoustic echo cancellation input card: Onboard DSP, suppression of steady-state background noise, assignable reference point for each AEC input.

    a. Acceptable Manufacturers:

        (1) Biamp Systems; AEC-2HD.
        (2) Or approved equivalent.

C. DSP Audio Matrix Mixer:

1. Acceptable Manufacturers:

    a. Biamp Systems
    b. Or approved equivalent.

2. 8-input/8-output design.
3. Software programmable features include:

    a. Standard, automatic and matrix mixers.
    b. Graphic and parametric equalization.
    c. Dynamic Processing: Compression, limiting and ducking.
    d. Digital delay up to 2000-ms.

4. Bi-directional RS-232 control port for control via third-party control systems.
5. Ethernet-ready network port for network control and monitoring.

2.06 AUDIO AMPLIFICATION

A. Acceptable Manufacturers:

1. QSC Audio; CX302V.
2. Or approved equivalent.

B. Audio Power Amplifier:

1. Two-channel, 250-W per channel (70-volt, 1-kHZ, 0.05-percent total harmonic distortion).
2. 20-Hz to 20-kHz frequency response, plus or minus 2-dB.
3. 3-pin XLR and 3-pin detachable terminal block input connectors.
4. Short circuit, open circuit, thermal, ultrasonic and RF protection.
5. On/off muting, DC-fault power supply shutdown.
6. 70-volt isolation transformer.

2.07 LOUDSPEAKERS

A. Flush Ceiling-Mount Passive Loudspeaker:

1. Acceptable Manufacturers:

a. JBL, Inc.; Control 26CT.
b. Or approved equivalent.

2. 6.5-inch coaxial woofer and 3/4-inch tweeter.
3. 89-dB SPL nominal sensitivity (1-W at 1 meter).
4. 150-W continuous program power capacity.
5. 70-Volt Multi-Tap Transformer: 60-W, 30-W, 15-W and 7.5-W taps.
6. 110-degree nominal dispersion, conical coverage.
7. Formed steel, UL-listed back can.
8. Include mounting hardware and paintable grille.

B. Flush Wall-Mount Passive Loudspeaker:

1. Acceptable Manufacturers;

a. Loudspeaker:

(1) JBL, Inc.; Control 126WT.
(2) Or approved equivalent.

b. Rough-In Frame:

(1) JBL, Inc.; MTC-126RIF.
(2) Or approved equivalent.

2. 6.5-inch woofer and 1-inch tweeter.

3. 88-dB SPL nominal sensitivity (1-W at 1 meter).
4. 100-W continuous program power capacity.
5. 70-Volt Multi-Tap Transformer: 30-W, 15-W, 7.5-W and 3.7-W taps.

6. Supply with rough-in frames

C. Surface-Mount Passive Loudspeaker:

1. Acceptable Manufacturers:

a. Loudspeaker:

(1) JBL, Inc.; Control 28T-60-WH.
(2) Or approved equivalent.

b. Mounting Hardware:

(1) Vertical Column Orientation:

- JBL, Inc; MTC-28V
- Or approved equivalent.

(2) Horizontal Splay Orientation:

- JBL, Inc; MTC-28V
- Or approved equivalent.

(3) Ceiling Mounted Adapter:

- JBL, Inc.; MTC-28/25CM
- Or approved equivalent.

2. 8-inch woofer and 1-inch tweeter.
3. 70-Volt Multi-Tap Transformer: 60-W, 30-W, 15-W and 7.5-W taps.
4. 102-dB SPL nominal sensitivity (15-W tap at 1 meter).
5. 175-W continuous program power capacity.
6. 90-degree horizontal and 90-degree vertical nominal coverage angle.
7. Weather-resistant enclosure and transducers.
8. Surface mounting assembly and hardware.

9. Include additional mounting hardware where applicable:

2.08 VIDEO SOURCE EQUIPMENT

A. DVD Player:

1. Acceptable Manufacturers:

a. Denon
b. Sony
c. Panasonic
d. Or approved equivalent.

2. DVD, DVD+R/RW, CD, CD-R/RW, VCD playback capability.
3. HDMI, component, S-video and composite video output.
4. Stereo analog audio output, coaxial and optical digital audio outputs.
5. IR and RS-232 control.

B. Document Camera:

1. Acceptable Manufacturers:

   a. Wolfvision
   b. Or approved equivalent.

2. Camera:

   a. 1/3-inch CMOS sensor.
   b. Effective Pixel Capture: 1,280 horizontal, 1,024 vertical.
   c. Frame Rate: 30 frames per second.

3. Optics:

   a. Powered, 16x optical zoom lens.
   b. Shooting Area: Up to 16-inch horizontal, 12-inch vertical.
   c. Full-auto, one-shot and manual focus options.

4. Additional Features: White balance and 8x digital zoom.
5. Interface:

   a. Analog RGB input and output on D-sub HD15 connectors.
   b. Digital output on DVI-D connector.
   c. Composite video output on RCA connector.
   d. SD memory card port.

2.09 VIDEO DISTRIBUTION EQUIPMENT

A. Acceptable Manufacturers:

1. Cisco
2. Or approved equivalent.

B. Digital Audio-Video Matrix Switcher:

1. 8-input/8-output modular design. Input modules must accept HDMI, DVI, RGBHV, standard analog video formats.
2. Capable of receiving and distributing uncompressed digital video and audio over shielded twisted-pair cabling.
3. Support video resolutions up to WUXGA (1920x1200) and HD 1080p60.
4. HDCP content protection support.
5. Software and front-panel setup and diagnostic tools.
6. Ethernet-ready network port.
7. Provides power to remote devices from internal power supply, 110W (4.6A, 24V DC).

C. Digital Audio-Video Matrix Switcher Accessories:

1. HDMI Input Module:

    a. HDMI input, capable of accepting DVI and DisplayPort Multimode signals when used with an appropriate cable adapter.
    b. HDCP content protection support.
    c. Local HDMI and stereo audio outputs.
    d. Compatible with Digital Audio-Video Matrix Switcher.

2. Twisted-Pair/HDBASE-T Input Module:

    a. Accepts input from remote audio-video input devices via shielded twisted-pair cabling.
    b. Twisted-pair input receive audio, video and control signals from remote devices.
    c. HDCP content protection support.
    d. Local HDMI, stereo audio, control signal and remote device power outputs.
    e. Compatible with Digital Audio-Video Matrix Switcher.

3. DVI/RGB Input Module:

    a. Video input accepts DVI digital video input or analog RGB/component video signals.
    b. Local balanced stereo audio input and HDMI output.
    c. HDCP content protection support.
    d. Device must include an RGB to DVI-I adapter.
    e. Compatible with Digital Audio-Video Matrix Switcher.

4. Twisted-Pair/HDBASE-T Output Module:

    a. Transmits audio-video signals over shielded twisted-pair cabling.
    b. Compatible with Digital Audio-Video Matrix Switcher.

D. All-In-One Presentation Switcher:

1. 6-input/3-output design.
2. Includes video input capable of component, composite, S-video and RGB-type video signals.
3. Includes HDMI and twisted-pair/HDBASE-T inputs/outputs.
4. Includes control system with RS-232, IR and relay ports.
5. Includes audio amplifier with 70V transformer isolated output.

2.10 VIDEO DISPLAY EQUIPMENT

A. Acceptable Manufacturers:

1. Mitsubishi
2. Samsung
3. Panasonic
4. Or approved equivalent.

2.11 CONTROL SYSTEM EQUIPMENT

A. Acceptable Manufacturers:

1. Cisco
2. Or approved equivalent.

B. Control System Processor:

1. Real-time, event driven, multi-tasking, multi-threaded operating system with dual-bus architecture.
2. Six bi-directional RS-232/422/485 ports, supporting baud rates up to 115.2-k baud.
3. Eight infrared/serial outputs. IR output up to 1.2 MHz, serial up to 115.2-k baud.
4. Eight digital input/output ports, which can also be used as analog input ports.
5. Eight relay outputs rated 1A, 30V AC/DC.
6. Expansion slots for expansion modules.

2.12 CONTROL SYSTEM USER-INTERFACE

A. Acceptable Manufacturers:

1. Cisco
2. Or approved equivalent.

B. Control System Interface:

1. Touch-panel with 4.9-inch diagonal TFT active matrix color LCD, 16:9 aspect ratio, 800x480-pixel resolution, 1000:1 contrast ratio and projected capacitive, multi-touch screen.
2. 512-MB SDRAM, 4-GB flash memory.
3. Ethernet-ready network port.
4. Flush wall-mount with back-box

2.13 WIRE AND CABLE

A. Acceptable Manufacturers:

1. Crestron
2. Belden
3. Liberty Wire & Cable
4. West Penn Wire
5. Or approved equivalent.

B. Cable and Adapter Types:

1. Microphone-level and line-level audio cable 22 AWG, stranded conductors, shielded. Plenum-rated.
2. Loudspeaker-level cable, 18 AWG, stranded, two conductors. Plenum-rated.
3. High resolution RGBHV cable, 25 AWG, five coaxial conductors. Plenum-rated.
4. Combination audio/RGBHV cable, pre-terminated with 3.5 mm audio and HD15 male to HD15 female connectors, 6-foot length. Plenum-rated.
5. Control cable for RS-232 communications applications with quantity of conductors as required by manufacturer's specifications for each

controlled device. Plenum-rated.

6. Control cable for electric projection screen. Comply with screen and control system manufacturer's specifications. Plenum-rated.
7. High-performance HDMI cable, 22 AWG minimum, supports data rates up to 4.95 Gbps; HDMI 1.3 Category 2 compliant, pre-terminated with male connectors. Plenum-rated.
8. High-performance HDMI-to-DisplayPort crossover cable. Plenum-rated.
9. Pre-terminated VGA cable, 6-foot length. Plenum-rated.
10. Shielded Cat6A for HDBASE-T applications. To be installed by Division 27, Section 27 15 00, Communications Horizontal Cabling, provider.
11. Quiktron RapidRun Digital Runner cable. Length as required per distance between termination points.
12. Quiktron RapidRun Digital HDMI flying lead. Provide active flying lead for runs greater than 50-feet.
13. Quiktron RapidRun Digital DVI and 3.5 mm audio flying lead. Provide active flying lead for runs greater than 50-feet.
14. Quiktron RapidRun PC Runner cable. Length as required per distance between termination points.
15. Quiktron RapidRun HD15 and 3.5 mm audio flying lead.

2.14 ASSISTIVE LISTENING EQUIPMENT

A. Acceptable Manufacturers:

1. Listen Technologies; LS-03
2. Or approved equivalent.

B. RF Wireless Assistive Listening System:

1. Two-channel FM transmitter,
2. Remote antenna.
3. Three wireless three-channel FM receivers
4. Assistive listening signage kit.

2.15 ARCHITECTURAL CONNECTIVITY

A. Acceptable Manufacturers:

a. Neutrik
b. Switchcraft
c. Liberty Wire & Cable
d. Or approved equivalent.

B. Custom A-V Outlet Plates:

1. Flush-mounted, stainless-steel faceplates.
2. Jack/connector configuration as shown on Drawings.
3. Size as shown on Drawings, to fit in industry standard back box unless specifically noted otherwise.
4. Label jacks and connectors as indicated on Drawings, with 1/4-inch Arial-type font.

C. Quiktron RapidRun Outlet Plates:

1. HD15 and 3.5 mm stereo audio jacks on decora plate with RapidRun PC Runner pigtail. Color: White
2. HDMI jack on decora plate with RapidRun Digital Runner pigtail. Color: White.
3. DVI and 3.5 mm stereo audio jacks on decora plate with RapidRun Digital Runner pigtail. Color: White

D. Twisted-Pair/HDBASE-T:

1. Acceptable Manufacturers:

a. Transmitter:

(1) Crestron
(2) Intelex
(3) Or approved equivalent.

b. Receiver:

(1) Crestron
(2) Or approved equivalent.

2. Transmitter:

a. Two auto-switched inputs (HDMI and VGA with 3.5 mm stereo audio).
b. Transmits audio-video signals over Crestron Digital Media cable.
c. USB port which supports USB HID class devices.
d. Fits in standard double-gang box with double-gang decora type faceplate.
e. Compatible with switcher.

3. Receiver:

a. HDBASE-T input, digital video output.
b. RS-232 or other method for two-way communications between control system and display.
c. HDCP content protection support.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Examination: Examine areas and conditions under which audio-video equipment will be installed. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not begin installation until unacceptable conditions are corrected.

B. Install complete system in strict accordance with manufacturer's recommendations. Complete electrical connections to all system components.

C. Install wiring in raceways where routed through inaccessible areas. Use J-hooks for cable installed in areas with accessible ceilings.

D. Install equipment so it is held firmly in place. This includes racks, rack equipment, loudspeakers, control equipment, conduit, etc.

E. Label switches, jacks, outlets, etc. in a logical and readable manner. Labels are to correspond with connection designations on shop drawings.

F. Do not install electronic equipment in any space until other work within the space has been completed, to prevent dust, dirt, debris, etc. from damaging equipment.

G. Mount modules for modular equipment in strict accordance with manufacturer's specifications.

H. Store loose devices and cables in rack-mounted drawers, cabinets, or Owner-approved location. Notify Owner of location of loose devices and cables during training.

I. Wiring:

1. Provide system wiring in accordance with good engineering practices as established by Telecommunications Industry Association (TIA), Electronic Industries Alliance (EIA) and NEC. Meet established state and local electrical codes.
2. Isolate cabling within rack by signal type. Maintain at least 4-inch separation from electrical power cables.
3. Dress cables in rack in a neat and workmanlike manner with velcro ties, cables bundled by signal type.

J. System Programming:

1. Programming of the control systems and user interfaces is the responsibility of the A-V Contractor. Program the user interface using manufacturer supplied configuration software and templates.
2. Program the control system and user-interface to provide novice-level functionality with features including, but not limited to, the following:

    a. Display power on/off.
    b. Source selection of audio and video devices.
    c. Volume control of all audio sources.
    d. Power on/off and source selection of video displays.
    e. Display system and device status.
    f. Control of dimmable lighting zones.
    g. Control of projection screens and motorized shades.

K. Performance Requirements:

1. Coordinate with Division 26, Electrical for installation of electrical service, raceways, conduit, back boxes and the like, necessary to support the systems specified.
2. Conceal wiring in walls and ceiling spaces during construction.
3. Determine requirements for plenum-rated cable. When doubt exists, seek determination in writing by AHJ prior to ordering.

L. Inspection and Testing Upon Completion:

1. Verify that projectors are adjusted such that the projected image fills the projection screen at the center of its zoom range.
2. Warranty materials and installation to be free of defects in material and workmanship after final acceptance of installation and test per Division 01, General Requirements.
3. Upon completion of the installation, furnish copies of complete operational instructions, complete with record drawings. Include part numbers and names, addresses and telephone numbers of parts source. One hard copy and two digital copies on CD required for materials.
4. Nothing contained in this specification to be construed to relieve the Contractor from furnishing a complete and acceptable system in all its categories. The Architect will reject any materials or labor that are or may become detrimental to the accomplishment of the intents of these Specifications.

M. Training:

1. Provide Owner with manufacturer's operating instructions.
2. Provide representatives to instruct the Owner's personnel in the operation of each system, its components and equipment.
3. Demonstrate to the Owner all system features and operations.
4. Provide comprehensive training for the Owner's Authorized Representative for the operation, maintenance and troubleshooting of the systems. Provide two copies of configuration data file for control systems and touch-panel user interfaces on CD.

N. Clean-Up:

1. Remove unused materials and debris from the work and storage areas. Leave areas in an undamaged and acceptable condition.
2. Save the shipping boxes for the Owner in case of need to return product for service.

3.02 EQUIPMENT MOUNTING HARDWARE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Fasten free-standing equipment racks to the floor using a minimum of four 3/8-inch concrete anchors. In raised floor areas, secure equipment racks to the concrete floor below.

D. Position free-standing equipment racks according to the Drawings with a minimum of 3 feet clearance in front. Report any discrepancies to the Architect.

E. Mount equipment within rack as shown in rack elevations on Drawings.

F. Fill unused rack space with blank rack panels.

3.03 VIDEO DISPLAY MOUNTING HARDWARE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Position projector mounting hardware according to the Drawings, fastened to structure.

D. Size extension columns so the projector lens aligns to the top of the projection screen.

E. Coordinate backing requirements for flat-panel display mounting hardware with Architect prior to rough-in.

3.04 POWER DISTRIBUTION

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Mount power distribution in rack as shown in rack elevations on Drawings.

D. Connect equipment cords from rack-mounted equipment to the power distribution unit.

3.05 AUDIO SOURCE EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.06 AUDIO DISTRIBUTION EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.07 AUDIO AMPLIFICATION

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide and install amplifiers that will supply sufficient power to speakers without exceeding 70% of the amplifier's maximum rated output power

D. Audio Signal Routing: Provide and install required signal routing mixers, equalizers, or processors such that the user can produce and route an audio signal to any location or equipment within the system.

E. Speakers: Provide and install flush or surface mounted ceiling or wall speakers of professional commercial grade. Locate speakers as noted on drawings.

3.08 LOUDSPEAKERS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.09 VIDEO SOURCE EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.10 VIDEO DISTRIBUTION EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.11 VIDEO DISPLAY EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.12 CONTROL SYSTEM EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.13 CONTROL SYSTEM USER-INTERFACE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.14 WIRE AND CABLE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide system wiring in accordance with good engineering practices as established by Telecommunications Industry Association (TIA), Electronic Industries Alliance (EIA) and NEC. Meet established state and local electrical codes.

D. Isolate cabling within rack by signal type. Maintain at least 4-inch separation from electrical power cables.

E. Dress cables in rack in a neat and workmanlike manner with velcro ties, cables bundled by signal type.

F. Label cables using a machine printed label, at each end of the cable within 12-inches of the termination point. Handwritten labels are not permitted. Labels to correspond with cable designations on shop drawings.

3.15 ASSISTIVE LISTENING EQUIPMENT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provide and install an assistive listening system located as indicated on the drawings.

D. Ensure User signal is clearly receivable at any point within the room where the transmitter is located.

E. Provide the minimum number of assistive listening user headsets or neck loops required by Code

3.16 ARCHITECTURAL CONNECTIVITY

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Input Plates:

1. Provide and install user equipment input plates in the locations indicated and per the details shown on the drawings.
2. Provide and install active input plates where cabling exceeds the maximum distance limitations for signal transmission.
3. Input plates are to have, at a minimum, an HDMI input into the A/V system.

END OF SECTION

SECTION 28 10 00S
ACCESS CONTROL AND INTRUSION DETECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Work included:

1. The work included in this specification consists of furnishing all labor, equipment, materials, supplies, and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed in this Specification or not.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications Basic Requirements and Division 01, General Requirements apply to this Section.

B. References and Standards as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

C. In addition, meet the following:

1. Federal Information Processing Standard Publication 201-1, Personal Identity Verification (PIV) of Federal Employees and Contractors. (FIPS 201-1)
2. Homeland Security Presidential Standard Directive 12: Policy for a Common Identification Standard for Federal Employees and Contractors. (HSPD-12)

1.03 SUBMITTALS

A. Submittals as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Division 27 Communications Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 SECURITY MANAGEMENT SYSTEM (SMS)

A. Acceptable Manufacturers:

1. Honeywell
2. AMAG
3. S2 Security
4. Or approved equivalent.

B. Provide and install the following:

1. An SMS that is capable of controlling and monitoring the access control system and the intrusion alarm system and that has an interconnection with the video surveillance system. See Section 28 23 00, Video Surveillance if the Video Management System is going to fulfill these functions.
2. An SMS that is designed to control and/or interface with industry standard OEM equipment.
3. An SMS that uses modular architecture to allow easy integration of the following capabilities/equipment:

    a. Access Control
    b. Intrusion detection
    c. Elevator control.
    d. Time and attendance.
    e. CCTV system integration.
    f. Alarm receiver interface.
    g. Badging capabilities.
    h. Employee and visitor database.

4. Provide one server license and four client licenses.
5. All SMS software to reside within the controller and be through a standard web browser.
6. Up to 25 users to able to operate, monitor and control the entire system with a user ID and password.
7. Software will have the following:

    a. User rights setup and password assignment.
    b. Centralized access control and alarm transactions monitoring.
    c. Remote control functions for access control, arming/disarming of alarm points and on/off controls.
    d. Card database administration.
    e. Report generation of transactions.

2.02 ACCESS CONTROL SYSTEM MAIN CONTROL PANEL

A. Acceptable Manufacturers:

1. Software House
2. Or approved equivalent.

B. Provide and install the following:

1. A main access control system control panel that has the overall system intelligence, any required additional input/output boards and the communications controllers required for remote monitoring and control.
2. An access control system main panel that is modular and can have optional systems and functionality added per project requirements.

3. Control Panel Requirements:

   a. 32-bits CPU.
   b. Minimum speed of 500MHZ.
   c. Must support standard RS 232, Ethernet and remote dial in via modem.
   d. Minimum 512Mb of flash memory.
   e. Minimum 512Mb of RAM.
   f. Supports up to 64 channels for alarm monitoring and 64 channels of voltage free relays for alarm signaling.
   g. The TO consist of at least one CPU board, two card readers, controller board, one eight channel input and output board, AC line filter, regulated power supply unit with online battery charger.
   h. Control panel board to support four industry standard wiegand compatible reader interface ports, provide digital input interfaces to door status sensors and form-C relay output interfaces to door strikes.

2.03 ACCESS CONTROL SYSTEM DOOR CONTROL PANEL

A. Acceptable Manufacturers:

   1. Honeywell
   2. AMAG
   3. S2 Security
   4. Or approved equivalent.

B. The local door controller to consist of a scalable architecture, allowing the monitoring and control of single or multiple doors per controller.

C. Door controller to utilize on-board microprocessors and database storage to allow for off-network door control capabilities.

D. Door controller to be connected and managed through Ethernet, RS-232, RS-485 or wireless communications.

E. Door controller is to match the brand manufacturer of the main access control panel and operate in conjunction with that system.

2.04 CARD READER

A. Acceptable Manufacturers:

   1. HID
   2. Or approved equivalent.

B. Provide and install card readers at locations indicated on the Drawings. Mounting height to be 48-inches unless noted otherwise on the Drawings.

C. Provide and install a single gang size, wall mount proximity card reader or mullion mount card reader on store front applications.

D. Card Readers to be suitable for indoor or outdoor use.

E. Card Readers to be ADA compliant.

2.05 ACCESS CONTROL CARDS

A. Acceptable Manufacturers:

1. HID
2. Or approved equivalent.

B. 13.56 MHz Proximity Cards.

2.06 BIOMETRIC READER

A. Acceptable Manufacturers:

1. HID
2. Or approved equivalent.

B. Provide and install biometric readers based on the physiological characteristics of the building occupants.

C. Install at locations indicated on drawings.

D. Biometric readers to be ADA compliant.

2.07 DOOR POSITION SWITCH/CONTACT

A. Acceptable Manufacturers:

1. Sentrol
2. Or approved equivalent.

B. Provide and install recessed door position switches designed to be compatible with and operate with the access control and intrusion system, in the locations indicated on the Drawings.

C. In situations where a recessed switch cannot be used, utilize a surface mount switch (roll-up door).

D. Coordinate switch type and installation with architectural door hardware schedule and requirements.

2.08 REQUEST TO EXIT DEVICE (REX)

A. Acceptable Manufacturers:

1. Bosch
2. Or approved equivalent.

B. Provide and install a REX at each door indicated on the Drawings.

C. Coordinate with the door hardware schedule for type of device required.

D. If the REX is not built into the door hardware, install a surface mount passive infrared sensor (PIR) type device per architect's direction.

2.09 ELECTRIC LATCH OR STRIKE

A. Provided by others; see Architectural door hardware schedule.

2.10 MAGNETIC LOCK

A. Provided by others; see Architectural door hardware schedule.

2.11 POWER SUPPLY

A. Acceptable Manufacturers:

1. Altronix
2. Or approved equivalent.

B. Provide and install power supplies for the access control panels, intrusions panels and other system devices that has an integral battery for backup.

C. Power supply converts 115VAC/60Hz input into eight independently controlled 12VDC or 24VDC fail safe and/or fail secure outputs with a total of 6-amp continuous supply current. Power supply has built in charger for backup batteries.

D. Back up battery is 12V, 0.7 amp rechargeable, sealed and maintenance free with a two-hour run time.

E. Size power supply(s) so there is 20 percent spare capacity for future devices.

F. Install in a UL listed enclosure.

2.12 INTRUSION MAIN CONTROL PANEL

A. Acceptable Manufacturers:

1. Honeywell
2. Bosch
3. Or approved equivalent.

B. Provide and install an intrusion main control panel concurrent with the access control installation, locate with the other security system components.

C. The Main Panel Includes:

1. Up to 255 events.
2. 50 user passcodes.
3. 43 programmable outputs.
4. 48 points.
5. On board Ethernet port for alarm communication and remote programming.
6. On board USB for on-site programming.

7. Email and text messaging notification for Android and iOS mobile devices.
8. Programmable keypad shortcuts.
9. Supports four keypads.

D. Provide and install Ethernet, telephone, or other submitted communications equipment for reporting and monitoring purposes.

2.13 MOTION DETECTOR

A. Acceptable Manufacturers:

1. Honeywell
2. Bosch
3. Or approved equivalent.

B. Provide and install motion detectors in the locations indicated on the Drawings.

C. Provide and install a ceiling mounted, 360 degree, dual-technology detector that is compatible with the intrusion alarm system.

D. Motion Detector to be dual-technology, (microwave and PIR) with a 360-degree, 60-foot diameter coverage pattern, three sensitivity settings and visible LED lights to indicate a trouble condition.

E. Motion Detector enclosure to be constructed of high impact ABS plastic.

2.14 KEYPAD

A. Acceptable Manufacturers:

1. Honeywell
2. Bosch
3. Or approved equivalent.

B. Vacuum fluorescent display.

C. Ten numeric keys and five function keys

D. Audible tones for warning with adjustable volume. Tones include intrusion signal, entrance warning, exit warning, invalid key, trouble and keypad encoding.

2.15 GLASS BREAK DETECTOR

A. Acceptable Manufacturers:

1. Honeywell
2. Bosch
3. Or approved equivalent.

B. Provide and install glass break detectors in the locations indicated on the Drawings.

C. Install a glass break detector that is compatible with the intrusion alarm system.

2.16 SEISMIC SENSOR/SHOCK DETECTOR

A. Acceptable Manufacturers:

1. Honeywell
2. Bosch
3. Or approved equivalent.

B. Provide and install seismic sensor/shock detectors in the locations indicated on the Drawings.

C. Provide and install a seismic sensor/shock detector that is compatible with the intrusion alarm system.

2.17 CABLE AND WIRE

A. Acceptable Manufacturers:

1. West Penn Wire
2. Or approved equivalent.

B. Copper:

1. Power: 18 AWG, 2 pair, unshielded twisted pair.
2. RS-232: 18 AWG, 4-conductor, shielded.
3. Category 6 cabling to match that installed by the telecom contractor in Division 27, Communications.
4. Indicate all other wire required by manufacturer installation instructions on submittal Drawings and diagrams.
5. All cabling to be plenum rated where required.

C. Connectors:

1. Modular connector.
2. 24 V Power: Screw-down on spade lug.

2.18 LOCKDOWN/PANIC BUTTON

A. Acceptable Manufacturers:

1. STI
2. Or approved equivalent.

B. Push button with turn to reset.

C. Custom labeling for LOCKDOWN.

D. Clear cover to prevent accidental activation.

2.19 DOOR ENTRY VIDEO INTERCOM SYSTEM

A. Provide a complete system which integrates with the SMS, with all components sourced from a single manufacturer.

B. Video Door Entry Station:

1. Acceptable Manufacturers:

   a. Aiphone, Model AX-DVF, AX-DV.
   b. Axis A8004-VE (use with A9801 Security Relay).
   c. Or approved equivalent.

2. Vandal-resistant, flush-mount, stainless steel faceplate.
3. Integral intercom call-button, microphone and speaker.
4. Integral color video camera with protective lens cover.
5. Power and communication signal over single Cat6 cable connection to Central Exchange Unit.

C. Master Station:

1. Acceptable Manufacturers:

   a. Aiphone, Model AX-8MV.
   b. Or approved equivalent.

2. Door station selector buttons with LED indicator for up to eight doors.
3. Selective door release, scan monitor, line transfer and intercom call buttons with LED indicators.
4. Intercom microphone, speaker and volume controls.
5. 3-1/2-inch color LCD screen.
6. Communication signal over single Cat6 cable connection to Central Exchange Unit.
7. Provide with desktop mount.

D. Central Exchange Unit (CEU):

1. Acceptable Manufacturers:

   a. Aiphone, Model AX-084C.
   b. Or approved equivalent.

2. Capable of connecting to up to four master stations and eight door stations over Cat6 cable. Standard RJ45 type jacks.
3. Local NTSC video outputs.
4. Relay outputs for connection to SMS for door release.
5. Power supplies to provide 24V power to remote door entry stations.
6. RS-232C log/setting port.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. This specification is to be used in conjunction with the Drawings. There may be circumstances where a device listed here is not present or required on the project Drawings.

B. Contractor to coordinate conduit installation with the electrical contractor.

C. Preparation:

1. Order required parts and equipment upon notification of award of the work.
2. Bench test equipment prior to delivery to the job site.
3. Verify the availability of power where required. If a new source of power is required, a licensed electrician is required to install it.
4. Arrange to obtain programming information including access times, free access times, door groups, operator levels, etc.

D. Carefully follow the instructions in the manufacturer's Installation Manual to ensure steps have been taken to provide a reliable, easy to operate system.

E. Perform work as indicated in the Drawings and Specifications.

F. Install 3/4-inch conduit to designated card readers, door contacts, request-to-exit devices and electric lock at each door.

G. Ensure minimum separation requirements are met between communications cables and power circuits.

H. Integrate card readers with power assisted doors so that the door will not function without a valid card read while in secure mode.

I. Double doors that are electronically controlled will unlock one leaf upon valid card read and unlock both leaves during programmed time to be unlocked.

J. Execute adequate testing of the system to ensure proper operation.

K. Training Requirements:

1. Provide adequate training of the system users to ensure adequate understanding to prevent operating errors.
2. Provide eight hours of training of operational instruction and two hours of maintenance instruction. Training seminars are to be hands-on instruction held at Owner's facility.
3. Provide Owner with manufacturer's operating instructions.
4. Provide factory trained representatives to instruct Owner's personnel in the operation of system equipment.
5. Provide Owner's Authorized Representative with training plan and training checklist two weeks before planned training according to manufacturer's instructions.

6. Provide comprehensive training for Owner's Authorized Representative for operation, maintenance and troubleshooting of system. Attend training session and video tape by Commissioning Authority.
7. Security contractor will fully explain and demonstrate operation, function and override of system including, but not limited to: Software operation, remote access, programming, priority levels and monitoring station.

L. Workmanship:

1. Comply with highest industry standards, except when specified requirements indicate more rigid standards or more precise workmanship.
2. Perform work with persons experienced and qualified to produce workmanship specified.
3. Maintain quality control over suppliers and Subcontractors.

M. Equipment Pretest: Bench test prior to delivery to job site and prior to installation. Bench test per manufacturer's installation instructions.

N. Fire-Rated Doors and Frames: Do nothing to modify a UL rated door or frame that would void the UL label or fire rating.

O. Grounding: Provide earth-grounding of equipment as required by equipment manufacturer. Earth ground to be connected to ground rod or approved cold water pipe. Do not use electrical or telephone ground connections as earth grounds. Do not use connections to mounting posts or building structural steel as earth grounds.

P. Cutting and Patching: Responsible for cutting, fitting or patching that may be required to complete the work.

3.02 SECURITY MANAGEMENT SYSTEM (SMS)

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Program per Owner's requirements.

3.03 ACCESS CONTROL SYSTEM MAIN CONTROL PANEL

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.04 ACCESS CONTROL SYSTEM DOOR CONTROL PANEL

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.05 CARD READER

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.06 ACCESS CONTROL CARDS

A. Reference 3.01, General Installation Requirements.

B. Provide enough access control cards to match the Owner’s requirements. All cards are to be programmed per Owner requirements.

3.07 BIOMETRIC READER

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.08 DOOR POSITION SWITCH/CONTACT

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.09 REQUEST TO EXIT DEVICE (REX)

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.10 ELECTRIC LATCH OR STRIKE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Provided by others; see Architectural door hardware schedule.

3.11 MAGNETIC LOCK

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.12 POWER SUPPLY

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Power to Security Equipment:

1. Power equipment from 120 VAC circuit dedicated for security use, except as noted. Mark panel circuit breakers with labels worded "Security Equipment - Do Not Operate," or equivalent.
2. Locate plug-in transformers at the security control panels. Secure low-voltage plug-in transformers to outlet with screw or strap. Clearly label transformers to identify purpose and use.

D. Install power supplies for electric locks in central locations where they will not interfere with other operations.

3.13 INTRUSION MAIN CONTROL PANEL

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.14 MOTION DETECTOR

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.15 KEYPAD

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.16 GLASS BREAK DETECTOR

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.17 SEISMIC SENSOR/SHOCK DETECTOR

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.18 CABLE AND WIRE

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Design, layout, size and plan new wire and cable runs as required.

D. Wire and cable from the processors to devices at each door “home-run” unless otherwise specified.

E. Wire and cable installed in conduit or surface metal raceway, except as follows: Wire or cable, in lengths of less than 10-feet, that is “fished” within walls, ceilings and door frames.

F. Wire and cable passing through metalwork to be sleeved by an approved grommet or bushing.

G. Avoid splicing conductors. Make splices in junction boxes (except at equipment). Make splices with an approved crimp connection. Do not use wire nuts on any low-voltage wiring.

H. Identify wire and cable at terminations and at every junction box. Make identification with an approved permanent label, Brady or equal.

I. Cable and Wire Terminations:

1. Identify inputs and outputs on terminal strips with permanent marking labels.
2. Neatly dress and tie all wiring. The length of conductors within enclosures to be sufficient to neatly train the conductor to the terminal point with no excess. Run wire and cable parallel or normal to walls, floors and ground.
3. Install connectors as required by equipment manufacturers.
4. Make terminations so that there is no bare conductor at the terminal. Conductor insulation to bear against the terminal or connector shoulder.
5. Do not obstruct equipment controls or indicators with wire or cable. Route wire and cable away from heat producing components such as resistors and regulators.

J. Install the appropriate cable from the CPU to card readers, door contacts, request-to-exit devices and electric locks at each door.

3.19 LOCKDOWN/PANIC BUTTON

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Lockdown button to lock all exterior doors upon activation.

D. Provide custom, non-removable label “LOCKDOWN”.

3.20 DOOR ENTRY VIDEO INTERCOM SYSTEM

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

END OF SECTION

SECTION 28 23 00
VIDEO SURVEILLANCE

PART 1 - GENERAL

1.01 SUMMARY

A. Work included:

a. The work included in this specification consists of furnishing all labor, equipment, materials, supplies, and performing all operations necessary to complete the installation. The Contractor will provide and install all of the required material whether specifically addressed int his Specification or not.

1.02 GENERAL REQUIREMENTS

A. Contents of Division 27, Communications Basic Requirements and Division 01, General Requirements apply to this Section.

B. References and Standards as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

1.03 SUBMITTALS

A. Submittals as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

B. In addition, submit questionnaire for Owner programming requirements.

1.04 QUALITY ASSURANCE

A. Quality assurance as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

1.05 WARRANTY

A. Warranty of materials and workmanship as required by Division 27, Communications Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 VIDEO MANAGEMENT SYSTEM (VMS)

A. Manufacturers:

a. Salient
b. Genetec
c. ONSSI
d. Or approved equivalent.

B. VMS not required if the Security Management System (SMS) indicated in Section 28 10 00, Access Control and Intrusion Detection, is capable of all of the VMS required functions listed below.

C. Provide a video management system with the following:

a. Complete video surveillance solution that is scalable from one to any number of cameras required in the project, any of which can be added on a unit-by-unit basis.
b. Accepts all video streams supplied from Internet Protocol (IP) cameras that are digitally encoded in MPEG-4, MPEG-2, MJPEG, H.264, Wavelet or JPEG2000 compression formats and recorded simultaneously in real time.
c. Interface with analog-to-digital video encoders and IP cameras from multiple manufacturers.
d. Ability to set each camera's bit rate, frame rate and resolution independently from other cameras in the system, the altering of which will not affect the recording and display settings of other cameras.
e. Requires no proprietary recording hardware, hardware multiplexer, or time-division technology for video or audio recording and monitoring.
f. Based on a true open architecture that allows for use of non-proprietary PC storage hardware that does not limit the storage capacity and allows for gradual upgrades of recording capacity.
g. Able to use multiple CCTV keyboards to operate the entire set of cameras throughout the system, including cameras of various manufacturers' brands, including their pan, tilt, zoom (PTZ) functionalities.
h. Has the ability to attach a CCTV keyboard directly to an encoder/decoder via its serial port and is able to control a Live Viewer application with the use of a PC.
i. Allows users to activate live viewing controls and standard camera switching and automation functions of a CCTV keyboard using a standard PC keyboard.
j. Have long-term storage capabilities on any supported tape backup.
k. Digitally sign recorded video using 248-bit RSA public/private key cryptography and the user has the capability of changing the encryption key.
l. Encrypted control channel using SSL.
m. Allows for the configuration of a time zone for each camera connected to an encoder.
n. For playback review, users have the ability to search for video based on the following options:

(1) Local time of camera.
(2) Local time of user's workstation.
(3) GMT Time.

(4) Other time zone.

o. Consist of server software modules (SSM) and client software applications (CSA).
p. Possible to install both the SSM and CSA on a single workstation or on separate workstations.

2.02 VIDEO RECORDING SYSTEM

A. Manufacturers:

a. Salient
b. Genetec
c. ONSSI
d. Or approved equivalent.

B. Network Video Recorder (NVR):

a. System to support an integrated IP capable Digital Video Management recording solution (software) that provides following features and capabilities:

b. Seamless integration with entire security system.
c. Use of IP based camera hardware for live (surveillance only) viewing through network. System to be used to configure, view and administer each camera individually.
d. Modular architecture that is able to support an unlimited number of cameras.
e. Simultaneously record and display live video and recorded video.
f. Supports both event based and continuous recording.
g. Video events to be linked to system events in system database and only one database to be acceptable for this interface.
h. Independent camera setup for:

(1) Compression rate.
(2) Brightness.
(3) Contrast.
(4) Additional factory requirements.

i. Network interface to allow remote access of NVR from anywhere on end user's LAN/WAN.
j. Ability to play back stored video over the LAN/WAN for remote access of video clips and to not allocate more than 2 Mbps of network bandwidth per digital video server.
k. Any alarm/event in system to have ability to be associated with digital video clip in real time.
l. Supports user defined pre and post roll.
m. Support CCTV PTZ control via system video interface if PTZ cameras are present on system.
n. Supports an advanced matrix view of on-line cameras. Up to 16 channels to be able to be simultaneously displayed in video matrix. 16 channels to be any combination of live or recorded video.
o. Storage server to be sized and programmed per the following:

(1) 12 hour/day event video.
(2) 30-day storage.
(3) H.264 compression rate.
(4) Capacity for 50 cameras.
(5) 2-megapixel cameras.

C. Digital Video Recorder (DVR):

a. Install DVR either in rack or mounted to wall per manufacturer's recommendations. DVR will have following minimum capabilities:

b. Record video to hard drive-based digital storage medium in either NTSC or MPEG format.
c. Record at minimum rate of 30 images per second (IPS).
d. Have minimum of eight to 16 looping inputs.
e. Have minimum of eight to 16 alarm inputs and two relay outputs.
f. Provides instantaneous playback of recorded images.
g. IP addressable, if part of CCTV network.
h. Built-in digital motion detection with masking and sensitivity adjustments.
i. Easy playback and forward/reverse search capabilities.
j. Complete audit trail database, with minimum of six-month history that tracks events related to alarm.
k. DVR management capability providing automatic video routing to back-up spare recorder in case of failure.
l. Accessible locally and remotely via Internet, Intranet, or handheld device.
m. Records alarm events in real time, ensuring 60 seconds before and after event are included in recording.
n. Utilize RS-232, IP or fiber optic connections for integration with SMS computer station via remote port on network hub.
o. Allow for independently adjustable frame rate settings.

2.03 CAMERAS AND LENSES

A. Acceptable Manufacturers:

a. ILLUSTRA FLEX 4K MINI DRONE
b. Or approved equivalent.

B. Analog Cameras will have following minimum capabilities and functions: Charge coupled device (CCD) cameras and conform to National Television System Committee (NTSC) formatting:

a. Fixed cameras to be color and primary choice for monitoring.
b. Pan, tilt, zoom (PTZ) cameras (if required - see drawings for reference) to be color.
c. Powered by either 12 volts direct current (VDC) or 24 VAC. Power supplies to be Class 2 and UL compliant and have back-up power source to ensure cameras are still operational in event of loss of primary power to CCTV System.
d. Rated for continuous operation under following environmental conditions:

(1) Ambient temperatures of minus 10 degrees C (14 degrees F) to 55 degrees C (131 degrees F) utilizing equipment that will provide automatic heating and cooling.
(2) Humidity, wind gusts, ice loading and seismic conditions specified or encountered for locations where CCTV cameras will be utilized.

e. Home run to monitoring and recording device.
f. Built-in video motion detection that automatically monitors and processes information from camera.
g. Motion-detection settings to include adjustable object size and velocity.
h. Appropriate signage to be posted that provides notification that an area is under surveillance.
i. Fake cameras will not be utilized at any time.
j. Capable of changing from color to black and white in low light conditions.
k. Fit with auto-iris lenses to ensure image is maintained in low light.
l. Lightning protection to be IEEE C62.41 compliant and provided for cameras. Either surge protectors or lightning grid may be utilized. Ensure lightning protection equipment is compliant with Article 780 of the NEC. Use of fuses and circuit breakers as means of lightning protection not allowed.
m. Cameras used as part of CCTV network require video encoder to convert the signal from NTSC to Moving Picture Experts Group (MPEG) format.
o. If analog cameras are being used in conjunction with an IP network or Network Video Recorder (NVR), a video server will be required to convert the signal stream to IP.

C. Lenses: Install in manner that provides maximum coverage of area being monitored by camera.

a. Lens Components:
b. 1/3-inch to fit CCD fixed camera.
c. All glass with coated optics.
d. Mounts that are compatible with camera selected.
e. Packaged and supplied with camera.
f. Maximum f-stop of f/1.3 for fixed lenses and maximum f-stop of f/1.6 for variable focus lenses.
g. Equip with an auto-iris mechanism.

h. Sufficient circle of illumination to cover image sensor evenly.
i. Do not use on camera with an image format larger than lens is designed to cover.
j. Provide with preset capability.

k. Types of lenses for both interior and exterior fixed cameras:

(1) Manual Variable Focus:

(a) Utilized in large areas that are being monitored by camera.
(b) Allow for setting virtually any angle of field, which maximizes surveillance effects.

(2) Auto-iris fixed.

D. IP cameras will have following capabilities and functions:

a. Camera to be IEEE 802.3af compliant. IP cameras are only to be utilized as part of CCTV Network and should not be integrated with standard analog or digital CCTV System equipment.
b. Utilized for interior or exterior purposes.
c. Category 6 cable will be primary source for carrying signals up to 300-feet from network switch or server. If any camera is installed greater than 300-feet from controlling device then the following will be required:

(1) Local or remote 12 VDC or 24 VAC power source will be required from Class 2, UL compliant power supply.
(2) Signal converter will be required to convert from Category cable to fiber optic cable. Signal will then be converted back to a Category cable at converter at controlling device.

d. Have both an IP output and monitor output which produces picture equivalent to an analog camera and allows simultaneous output of both.
e. Have programmable IP address that allows for installation of multiple units in same Local Area Network (LAN) environment.
f. Incorporate minimum of Transmission Control Protocol (TCP)/IP, User Datagram Protocol (UDP), Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Internet Control Message Protocol (ICMP0, Address Resolution Protocol (ARP), Real-Time Transport Protocol (RTP), Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP), Simple Mail Transfer

Protocol (SMTP), Internet Group Management Protocol (IGMP) and Differentiated Service Code Point (DSCP) protocols for various network applications.

E. Cameras to have appropriate lens installed for the environment where they will be located. If information cannot be obtained from drawings and specifications regarding site conditions, a site visit will be required.

F. Cameras to be either dome style or installed in dome enclosure unless drawings indicate differently.

2.04 CAMERA ENCLOSURES AND MOUNTS

A. Acceptable Manufacturers:

a. ILLUSTRA
b. Or approved equivalent.

B. This Section pertains to interior and exterior enclosures, domes and applicable wall, ceiling, corner, pole and rooftop mounts associated with camera. Enclosures and mounts to match type of cameras used and be provided by same manufacturer as camera.

C. Cameras and lenses are to be housed in tamper resistant enclosures. Any additional mounting hardware required to install camera at its specified location to be provided with enclosure.

D. Install camera enclosures that are appropriate for environment where they are being installed.

E. Install exterior enclosures with following capabilities, components and functions:

a. Designed in manner that provides condensation free environment.
b. Will operate in 100 percent condensing humidity atmosphere.
c. Visible humidity indicator.
d. Contain camera mounts or supports as needed to allow for correct positioning of camera and lens.
e. Enclosure and sunshield are to match architectural requirements as to finish.

F. Indoor Enclosures and Mounts:

a. Ceiling Mounted Cameras and Enclosures:

(1) Install in finished or suspended ceiling. Any installation in situations where there is no finished ceiling and camera is installed attached to structure will require prior coordination with architect for acceptable mounting technique and conduit routing.
(2) Install cameras and enclosures in suspended ceilings with a tile bridge or other factory manufactured device that does not rely on tile grid for support. Secure all enclosures to structure.

b. Interior dome camera installations to be installed with lowest profile option available.

c. Interior Wall-Mounted Cameras and Enclosures:

(1) Install enclosure in manner that matches existing architectural finishes.
(2) Install at height that maintains greatest possible coverage but is not accessible to public.

d. Interior Dome Cameras and Enclosures:

(1) Interior dome camera can be pendant mounted, ceiling mounted, surface mounted, or corner mounted equipment. Coordinate with architect when determining which mount to use.
(2) Install dome enclosures that have smoked or tinted acrylic covers with light attenuation factor of no more than 1 f-stop.

e. Pan, Tilt, Zoom Capable Dome Camera:

(1) Install dome with integral electronic pan/tilt capabilities complete with wiring, wiring harness, connectors, receiver/driver, pan/tilt control system, pre-position cards, or any other hardware and equipment as needed to fully provide fully functional pan/tilt dome.

f. Install PTZ domes with following characteristics:

(1) Constructed of heavy-duty bearings and hardened steel gears.
(2) Permanently lubricated to ensure smooth and consistent movement of all parts throughout life of product.
(3) Equipped with motors that are thermally or impedance protected against overload damage.
(4) 360 degrees pan and minimum plus or minus 90 degrees tilt.
(5) Pan speed minimum of 10 degrees per second.

G. Exterior Dome Camera and Enclosures.

a. Install exterior dome cameras and enclosures that meet, as minimum, requirements listed out for interior dome cameras above.
b. Install enclosures that are constructed to be dust and watertight and fully operational in 100 percent condensing humidity.
c. Exterior Wall-Mounted Camera:

(1) Install mount with an adjustable head for mounting camera.
(2) Install mount constructed of aluminum, stainless steel, or steel with corrosion-resistant finish.

d. PTZ minimum requirements:

(1) Plus or minus 90 degrees of pan.
(2) Plus or minus 45 degrees of tilt.
(3) Installed at height that allows for maximum coverage of area being monitored.

H. Explosion-Proof Enclosure:

a. Install an enclosure that meets or exceeds requirements of NEMA 4 standards for hazardous locations.
b. Install enclosure that is supplied with mounting brackets for specified camera and lens.

2.05 CABLE, WIRE AND ACCESSORIES

A. Acceptable Manufacturers:

a. West Penn Wire
b. Or approved equivalent.

B. Install electrical and signal cables required for correct operations in conduit from controller or network switch to camera.

C. Copper Cabling:

a. RG59 coax cable for analog camera installations.
b. 4 pair Category 6 shielded twisted pair for IP/POE camera installations. Match brand manufacturer of telecom cable installed under Division 27, Communications.
c. 24V Power: 16 AWG twisted pair construction, or as otherwise noted by camera manufacturer.
d. PTZ Dome Data: Dual twisted, individually shielded pairs. Belden 9406 or approved equivalent.
e. Cabling to be plenum rated where required.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Provide new cameras per drawings.

B. Position cameras according to drawings. Once project begins, confirm each camera location and field of view with signature from Owner's Authorized Representative before camera mount is secured in place.

C. Headend video surveillance equipment: Rack mounted with equipment positioned according to drawings. Once project begins, confirm equipment location(s) with signature from Owner's Authorized Representative before being mounted in place. Position equipment and racks to allow for most secure and convenient access for operation and service.

D. Provide service loops at headend and camera equipment locations for each cable run. Neatly dress and tie wrap cabling. Label cables with laser, inkjet or machine printed labels. Do not use handwritten labels.

E. Testing Requirements: Perform electrical and mechanical tests recommended by equipment manufacturer and required in this specification. Bench settings are not acceptable. Hold final tests and acceptance in presence of Owner and manufacturer's representative. Supply personnel and required auxiliary equipment for this test without additional cost to owner. Allow 5-day "burn-in" time prior to preliminary testing

F. Training Requirements:

a. Provide eight hours of training of operational instruction and two hours of maintenance instruction. Training seminars are to be hands-on instruction held at Owner's facility.
b. Provide Owner with manufacturer's operating instructions.
c. Provide factory trained representatives to instruct Owner's personnel in the operation of system equipment.
d. Provide Owner's Authorized Representative with training plan and training checklist two weeks before planned training according to manufacturer's instructions.
e. Provide comprehensive training for Owner's Authorized Representative for operation, maintenance and troubleshooting of surveillance system. Attend training session and video tape by Commissioning Authority.
f. Security contractor will fully explain and demonstrate operation, function and override of surveillance system including, but not limited to: Camera sequencing, software operation, remote access, programming, priority levels and monitoring station.

G. Cutting and Patching: Responsible for cutting, fitting or patching that may be required to complete work.

3.02 VIDEO MANAGEMENT SYSTEM (VMS)

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.03 VIDEO RECORDING SYSTEM

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.04 CAMERAS AND LENSES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.05 CAMERA ENCLOSURES AND MOUNTS

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

3.06 CABLE, WIRE AND ACCESSORIES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

END OF SECTION

SECTION 32 31 36 - SECURITY GATES AND BARRIERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Security gates and barriers.

1.2 REFERENCE STANDARDS

A. ASTM F2656/F2656M - Standard Test Method for Crash Testing of Vehicle Security Barriers; 2023.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate installation of units with size, location and installation of service utilities.

1.4 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Provide detailed drawings showing:
   1. Layout and overall dimensions of each major element of the barrier equipment, including the hydraulic power unit and operator control panels, if applicable.
   2. Foundation and anchoring requirements of the barrier equipment.

C. Operation and Maintenance Data.

D. Specimen Warranty.

E. Project Record Documents: After completion of field tests, provide updated drawings, showing exactly where equipment and controls are installed.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.6 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Security Barriers:
   1. TrafficGuard, Inc., P.O. Box 201, Geneva, IL 60134, Tel 877-727- 7347, Fax 800-814-7194, Website: http://www.trafficguard.net
   2.
   3. Ameristar Perimeter Security, USA; _____: www.ameristarperimeter.com/#sle.

2.2 SECURITY GATES AND BARRIERS

A. Security Gates and Barriers: Factory-fabricated, -assembled, and -tested devices, including components for satisfactory operation; capable of resisting specified impact when installed in foundations indicated on drawings.

B. Material: Hot-dipped galvanized steel with painted finish.

C. Color: As selected from manufacturer's standard.

2.3 NON-AUTOMATED BARRIERS

A. Fixed Bollards: Permanently installed tubular steel bollards.
1. Crash Test Rating: M30, based on ASTM F2656/F2656M.
2. Post Design: Round, diameter 10-3/4 inches (0.27 m).
3. Mounting: Surface mounted through the flange.
4. Height: 30 inches (0.76 m).
5. Finish: Standard black powder coat finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. See Section 01 40 00 - Quality Requirements, for additional requirements.

3.4 PROTECTION

END OF SECTION 32 31 36