BID DOCUMENTS
AND
TECHNICAL SPECIFICATIONS
FOR

RACE BROOK ELEMENTARY SCHOOL
BOILER AND UNIT VENTILATOR REPLACEMENT PROJECT
107 GRANNIS ROAD, ORANGE, CT

TOWN OF ORANGE
BOARD OF EDUCATION
637 ORANGE CENTER ROAD
ORANGE, CONNECTICUT

LYNN MCMULLIN
SUPERINTENDENT OF SCHOOLS

STATE PROJECT NUMBER TMP-107-QGCV
ISSUED FOR BID: NOVEMBER 1, 2013

ROSE-TISO & CO., LLC
ARCHITECTS, SURVEYORS, & ENGINEERS
35 BRENTWOOD AVENUE, FAIRFIELD, CT 06825
TEL. 203-610-6262, FAX 203-610-6404

MUSCO ENGINEERING ASSOCIATES
CONSULTING ENGINEERS
375 MORGAN LANE, UNIT 307
WEST HAVEN, CONNECTICUT 06516
TEL: (203) 932-1901 FAX: (203) 931-1550

Facility Support Services, LLC
Environmental & Safety Consulting Engineers

SET NO:_____

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INVITATION TO BID

RACE BROOK ELEMENTARY SCHOOL
BOILER REPLACEMENT PROJECT
ORANGE, CONNECTICUT

CONTRACTING AUTHORITY:	TOWN OF ORANGE 617 ORANGE CENTER ROAD ORANGE, CT 06477

Sealed Bids for the Race Brook Elementary School Boiler Replacement Project located in Orange, CT, will be received by the Town of Orange, Connecticut until 2:00 p.m. Prevailing Local Time on November 26, 2013. No bids will be accepted after said date and time. Bids shall be submitted to the First Selectman's Office, 617 Orange Center Road, Orange, Connecticut 06477. The First Selectman's Office and representative(s) of Orange Board of Education will open and record all of the bids on November 26, 2013 after 2:00 pm.

Base Bid Description

The intent of this project includes the removal and installation of all systems, items and devices as indicated on the contract drawings and will include the following work:

Base bid work shall include removal of existing boiler system including but not limited to; boilers, burners, hot water heater, louvers, piping, breach, unit ventilators and energy management controls. Removal and re-installation of pipe insulation. Removal and disposal of asbestos containing materials. Removal and disposal of PCB containing materials. Installation of new electrical and mechanical work as on the plans.

Contract Documents may be obtained by interested bidders, in electronic format, on or after Monday November 1, 2013 at the office State Contracting Portal www.das.ct.gov. Contract Documents can also be purchased from Joseph Merritt & Company, 60 Hamilton Street, New Haven, CT 06511, 203-562-9885. All bidders shall comply with DAS Construction Prequalification Program (C.G.S. 4a-100) before they can bid on work costing more than $500,000 and which whole or part is funded by State funds.

Project Schedule

Upon execution of the Contract between Owner and Contractor, Contractor shall begin shop drawings and submittal process. All materials and equipment approved through the shop drawing process shall be housed by the Contractor until such time that the materials and equipment can be delivered to the site. Certificates of insurance shall be provided for all materials and equipment stored off-site

Depending on weather related events, work may be able to begin as early as Monday, June 16th, but no later than Monday, June 23rd. Work shall be completed by Tuesday, August 26th in all classrooms and spaces occupied by students. The project shall be complete and heating system operational by Monday October 6, 2014.

Document Review & Site Visit

Contract Documents, including Drawings and Project Manuals may be examined at Musco Engineering Assoc., 375 Morgan Lane, Unit 307, West Haven, CT or at the Orange Board of Education Offices at 637 Orange Center Road, Orange, CT between the hours of 9:30 a.m. and 4:00 p.m. daily except Saturdays, Sundays and municipal holidays on and after November 1, 2013.

There will be a Mandatory Pre-Bid Walk Thru of the Project for Bidders scheduled for November 11, 2013 at 3:00pm at Race Brook School, 107 Grannis Road, Orange, CT. Bidders are encouraged to have their sub-contractors attend the walk thru.

All Requests for Clarification regarding the Bid must be in writing on the Request for Clarification Form in the Bid Documents and must be post marked, delivered, faxed or e-mailed prior to November 18, 2013 and should be addressed to: Patrick M. Rose, Rose-Tiso & Co., LLC, 35 Brentwood Avenue, Fairfield, CT 06825, Fax: 203-610-6404, e-mail: prose@rosetiso.com

A certified check or a duly executed bid bond made payable to the order of Town of Orange in the amount of not less than 5% of the bid must be deposited by the bidder. His or her bid shall guarantee that, in case the contract is awarded to him, he will execute such contract and furnish a satisfactory Labor, Performance and Payment Bond. Furnishing materials in connection with the Contract Acceptance of the bid will be contingent upon fulfillment of this requirement by the bidder and upon failure to do so; the bidder shall forfeit the deposit. Bidder shall agree that bids submitted shall be good and may not be withdrawn for a period of 90 calendar days from the bid opening date.

Prevailing Wages as included in this specification shall be used in the preparation of this bid and in the execution of the work of this Contract and shall be binding upon the successful low bidder.

Bidder shall submit Bids on the provided bid forms in triplicate copies each with original signatures.

The Town of Orange and Orange Board of Education reserves the right to reject any or all bids, to waive any informalities or irregularities in the bid received and to accept the bid, which in their judgment will be for the best interest for the Town of Orange and Orange Board of Education and to adjust the scope of contract work as stated on the bid form. Selection of Contractors will be based on bidder qualifications, including evidence of past performance in similar projects and bid price. The Town of Orange and the Orange Board of Education intends to award the contract to the qualified bidders deemed by the Town of Orange and Orange Board of Education to have the lowest responsible bid. After the award of the bid, the contractor shall obtain all proper permits through the Town of Orange.

The Orange Board of Education is an equal opportunity employer.
Minority/ Woman's business enterprises are encouraged to apply.

REQUEST FOR CLARIFICATION
(THIS FORM MAY BE REQUESTED ELECTRONICALLY)

SEND TO: **PATRICK M. ROSE, ROSE-TISO & CO., LLC**
35 BRENTWOOD AVENUE
FAIRFIELD, CT 06825
FAX: (203) 610-6404
EMAIL: prose@rosetiso.com

DATE:_____

FIRM:_____

ADDRESS:_____

NAME:_____

QUESTION, COMMENT, AMBIGUITY:_____

_____

_____

_____

_____

DOCUMENT REFERENCES:

DRAWING(S), DETAILS(S), SECTION(S), NOTE(S):_____

_____

_____

_____

_____

PROJECT MANUAL DOCUMENT(S), SPECIFICATIONS SECTION(S), PAGE(S):_____

_____

_____

_____

INFORMATION FOR BIDDERS

ARTICLE 1 - DEFINITIONS

All Definitions and conditions set forth in the Contract of Race Brook Elementary School Boiler Replacement are applicable to the Invitation to Bid, Information for Bidders, the Bid Form, all of which documents are hereinafter referred to as the Bidding Documents.

ARTICLE 2 - ISSUANCE OF CONTRACT BIDDING DOCUMENTS

A. Initial complete set of Documents shall consist of the following:

   1. One (1) copy of the Contract Documents including the Drawings.

ARTICLE 3 - BID FORMS

A. Bid Forms must be submitted in triplicate on the forms provided by the Engineer. They shall be addressed to the Town of Orange in a sealed envelope, marked with the name and address of the bidder, and the title of the Project.

B. A lump sum bid is required. All blank spaces on the Bid Form must be filled in and, except as otherwise expressly provided in the Bidding documents, no change is to be made in the phraseology of the Bid Form or in the items mentioned herein.

C. Bid Forms that are illegible or that contain omission, alterations, additions, or items not called for in the Bidding Documents may be rejected as informal. In the event any bidder modifies, limits, or restricts all or any part of his Bid Form in a manner other than that expressly provided for in the Bid Documents, its Bid Form may be rejected as informal.

D. Any Bid Form shall be considered informal which does not contain prices in words and figures in all of the spaces provided. In case any price shown in words and its equivalent shown in figures do not agree, the written words shall be binding upon the bidder. In case of discrepancy in the prices contained in the Bid Forms submitted in duplicate by the bidder, the Bid Form which contains the lower bid shall be deemed the bid of the bidder; provided, however, the Owner at its election may consider the Bid Form of such bidder informal.

E. If the Bid Form is submitted by a corporation the names and places of residence of the president, secretary, and treasurer shall be given. If by a partnership, the names and places of residence of the partners shall be given. If by a joint venture, the names and addressees of the members of the joint venture shall be given. If by an individual, his or her name and place of residence shall be given.

F. No Bid Form will be considered which has not been deposited with the Town of Orange prior to the time designated in the Invitation to Bid as may be extended by addendum.

G. Bids may be modified, withdrawn, or canceled only by written or telegraphic notice received by the Owner prior to the time of receipt of bids designated in the Bidding Documents. A written or telegraphic notice of modification, withdrawal, or cancellation shall be marked by the bidder with the name and address of the bidder, and the title of the Project.

ARTICLE 4 - EXAMINATION OF BIDDING AND CONTRACT DOCUMENTS AND SITE CONDITIONS

A. Bidders shall examine the Bidding and Contract Documents and existing site conditions carefully and, before bidding, shall make written request to the Engineer for an interpretation or correction of any ambiguity, inconsistency, or error therein which should be discovered by a reasonably prudent bidder. Such interpretation or correction as well as any additional Contract provisions the Owner shall decide to include will be issued in writing by the Engineer as an addendum, which will be sent by certified or registered mail or telefax or delivered to each person recorded as having received a copy of the Bidding Documents form the Engineer. Upon such mailing, telephoning, or delivery and making available for inspection, such addendum will become a part of the Documents and will be binding on all bidders whether or not the bidder receives or acknowledges the actual notice of it. The requirements contained in all Bidding and Contract Documents shall apply to all addenda.

ARTICLE 5 - COMPUTATION OF BID

A. In computing their bids, bidders shall exclude the sales and compensating use taxes of the State of Connecticut for any supplies or materials which are incorporated into the completed Project. The Owner is tax exempt.

B. In computing their bids, bidders shall use Prevailing Wages included as part of this specification in the preparation of the bid and the execution of the work.

ARTICLE 6 - AWARD OF CONTRACT

A. The Owner intends to award the Contract to the lowest responsible bidder. The judgment of the Town of Orange and the Orange Board of Education shall be final.

B. Subject to the rights hereinafter reserved, the Town of Orange and the Orange Board of Education intends to award Contract within thirty (30) calendar days after the opening of bids to the bidder whose Bid Form conforms to the requirements of the Bidding Documents and which seems to be to the Owner's best interest, as may be adjusted by subsequent negotiations.

C. The owner reserves the right to reject any Bid or all Bids, to waive any informality in any Bid received or to afford any bidder an opportunity to remedy any deficiency resulting from a minor informality or irregularity.

D. No bidder shall withdraw his Bid within a period of ninety (90) days of opening of Bid.

E. Contractor shall be responsible for all town building permit fees.

ARTICLE 7 - DOCUMENTS

A. The successful Contractor shall be furnished three (3) copies of all bidding and construction documents free of charge. Additional copies or reproducible of other quality shall be furnished as requested at printers costs to the Contractor. The documents are listed in the Table of Contents of the Project Manual.

ARTICLE 8 - CONTRACT

A. The successful Contractor shall execute a Town of Orange and Orange Board of Education Contract between the Owner and Contractor.

ARTICLE 9 – PROJECT SCHEDULE

A. Upon execution of the Contract between Owner and Contractor, Contractor shall begin shop drawings and submittal process. All materials and equipment approved through the shop drawing process shall be housed by the Contractor until such time that the material can be delivered to the site. Certificates of insurance shall be provided for all materials and equipment stored off-site.

B. Depending on weather related events, work may be able to begin as early as Monday, June 16th, but no later than Monday, June 23rd. Work shall be completed by Tuesday, August 26th in all classrooms and spacing occupied by students. The project shall be complete and heating system operational by Monday October 6, 2014.

END OF SECTION

BID FORM

RACE BROOK ELEMENTARY SCHOOL
BOILER REPLACEMENT PROJECT

Name and Address of Bidder:

_____

_____

Gentlemen:

The undersigned, having familiarized ( ) his/herself ( ) themselves with the local conditions affecting the cost of the work, and with the Project Manual (including the Bidding and Contract Documents and the Technical Specifications) the Drawings and Addenda, if any thereto, as prepared by Rose-Tiso & Co., LLC, and on file in the office of the Town of Orange, hereby propose to construct and complete the Project listed above for the Race brook Elementary School - Boiler Replacement Project, Orange, Connecticut, all in accordance therewith for the sum listed below.

BASE BID

ITEM #1 – BOILER REPLACEMENT:

_____

_____Dollars ($_____)

BREAKDOWN OF BASE BID

ACM Abatement & Disposal	$_____
PCB Abatement & Disposal	$_____
Demolition Boiler Room	$_____
Demolition Unit Ventilators	$_____
Masonry Supply & Install	$_____
Firestopping & joint Sealants Supply & Install	$_____
Louvers Supply & Install	$_____
Boilers Equipment Supply	$_____
Boiler Installation	$_____
Unit Ventilators Equipment Supply	$_____
Unit Ventilators Installation	$_____
Energy Management System Supply & Install	$_____

Electrical Boiler Room Supply & Install $_____

Electrical Unit Ventilators Supply & Install $_____

Total Base Bid $_____

UNIT PRICES:

The undersigned further proposes and agrees that, should the amount of work required be increased or decreased, the following Unit Prices will be the cost-in-place for computing extra cost or credits.

The amounts shown below are Gross changes to the Contract Sum for additional work and include the Contractor's and Subcontractor's amount for overhead and profit. All work is to be accomplished in accordance with applicable sections of the specifications, and each Unit Price shall include all equipment, tools, labor, permits fees, etc., incidental to the completion of the work involved.

The following Unit Prices and provisions are to be included in and become part of this Contract to be used in evaluating additions to or deductions from the work called for in the Specifications and/or Drawings. BIDDERES ARE REQUIRED TO SUBMIT WITH THEIR BIDS, AMOUNTS FOR THE UNIT PRICE DESCRIPTIONS AS LISTED BELOW:

DESCRIPTION	UNIT	COST
1. ACM Mudded Fittings & End Caps, Removal & Disposal	Each	$_____
2. PCB Removal of Substrate	S.F.	$_____
3. Disposal PCB Impacted Substrate	Ton	$_____
4. Substrate Replacement	S.F.	$_____

Notes:
1. Includes all labor and equipment
2. Includes loading, transport & disposal fees

If awarded this Contract, the Undersigned guarantees Completion of Contract.
Note: Contractor is required to give completion date _____

SECTION III - ADDENDUM RECEIPT

Receipt of the following Addenda to the Contract Documents is acknowledged:

Addendum Number: _____Dated:_____

Addendum Number: _____Dated:_____

Addendum Number: _____Dated:_____

SECTION IV - BID ACCEPTANCE

1. In submitting this bid, it is understood that the right is reserved by the Orange Board of Education to reject any and all bids. If written notice of the acceptance of this bid is mailed, faxed, or delivered to the undersigned within thirty (30) days after the opening thereof, the undersigned agrees to execute and deliver a contract in the prescribed form and furnish the required bonds within ten (10) days after the contract is presented to him for signature.

2. The contract award will be made to the lowest responsible bidder. The Town of Orange further reserves the right to reject any bid or all bids.

3. Certification of Non-segregated Facilities. By signing this bid, the bidder certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not permit his employees to perform their services at any location under his control, where segregated facilities are maintained.

4. The bidder agrees that a breach of this certification is a violation of the Equal Opportunity clause in the contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants, and other eating areas, time clocks, locker rooms, and other storage or dressing areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact, segregated on the basis of race, color, religion, national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certification from proposed subcontractors prior to the award of subcontracts exceeding $10,000.00 which are not exempt from the provision of the Equal Opportunity clause) that he will forward a notice to these proposed subcontractors as provided in the Instruction to Bidders.

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Date _____20 _____

OFFICIAL ADDRESS:

_____ By _____

_____ Title _____

_____ _____

NON-COLLUSIVE BIDDING CERTIFICATION

1. 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 knowledge and belief:

   a. 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;

   b. 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;

   c. 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.

2. A bid shall not be considered for award nor shall any award be made where 1 a, b and c above have not been complied with; provided however, that if in 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 1 a, b and c 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 made for the purpose of restricting competition.

   The fact that a bidder; (a) has published price lists, rates, or tariffs covering items being procured, (b) has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (c) has sold the same items to other customers at the same prices being bid, does not constitute, without more, a disclosure within the meaning of subparagraph 1 a.

State of Connecticut:

County of:

_____ being first duly sworn, deposes and says:

That he is a ( ) Partner; ( ) Officer; ( ) Owner of:

_____

Bidder: _____

Title: _____

Subscribed and sworn to before me

this _____ day of _____ 20 _____

_____

My commission expires: _____ 20 _____

STATEMENT OF BIDDER'S CONSTRUCTION EXPERIENCE

All questions 1 through 13 must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, add separate sheet for items marked (*).

1. Name of Bidder_____

2. Permanent main office address_____

3. When organized _____

4. When incorporated _____

5. How many years have you been engaged in the contracting business under your present firm name? _____

6. * Contracts on hand: (Schedule these showing the gross amount of each contract and the approximate anticipated dates of completion.)

   _____

   _____

   _____

7. *General character of work performed by your company_____

   _____

8. * Have you ever failed to complete any work awarded to you?_____

   If so, where and why? _____

   _____

9. * Have you ever defaulted on a contract?_____
   If yes, please attach details.

10. * List the more important projects recently completed by your company, starting approximate cost for each, and the month and year completed._____

    _____

    _____

11. * List your boiler manufacturer and unit ventilator manufacturer proposed for this contract._____

    _____

    _____

12. * Experience in work similar in scope to this project _____

_____

_____

13. Will you, upon request, fill out a detailed financial statement and furnish any other information that may be required by the Town of Orange?

_____

_____

The undersigned hereby authorizes and requests any person, firm, or corporation to furnish any information requested by the Town of Orange, in verification of the recitals comprising this Statement of Bidder's Construction Experience.

Date at _____ this _____ day of _____20 _____.

Name of Bidder

_____

By

_____

Title

_____

State of _____

County of _____

_____being duly sworn deposes and says that

he is _____of _____
(Name of Organization)

and that the answers to the foregoing questions and all statements therein contained are true and correct.

Sworn to before me this _____ day of _____20 _____

_____
(Notary Public)

My commission expires_____

DRAFT

AIA® Document A312™ – 2010

Performance Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Race Brook Boiler and ventilation Replacement Project»
« »

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: « » None « » See Section 16

CONTRACTOR AS PRINCIPAL
Company: *(Corporate Seal)*

Signature: _____
Name and Title: « »« »

SURETY
Company: *(Corporate Seal)*

Signature: _____
Name and Title: « »« »

(Any additional signatures appear on the last page of this Performance Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

« »
« »
« »
« »
« »
« »

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

§ 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Section 3.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after

.1 the Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Section 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

.2 the Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

.3 the Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

§ 4 Failure on the part of the Owner to comply with the notice requirement in Section 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

§ 5 When the Owner has satisfied the conditions of Section 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

§ 5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

§ 5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

§ 5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Section 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

§ 5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor and with reasonable promptness under the circumstances:

.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

§ 6 If the Surety does not proceed as provided in Section 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Section 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

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§ 7 If the Surety elects to act under Section 5.1, 5.2 or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication, for

.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

.2 additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Section 5; and

.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

§ 8 If the Surety elects to act under Section 5.1, 5.3 or 5.4, the Surety's liability is limited to the amount of this Bond.

§ 9 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors and assigns.

§ 10 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 11 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 12 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

§ 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 14 Definitions

§ 14.1 Balance of the Contract Price. The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

§ 14.2 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

§ 14.3 Contractor Default. Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

§ 14.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 14.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

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§ 15 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 16 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

DRAFT

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Payment Bond

CONTRACTOR:
(Name, legal status and address)

« »« »
« »

SURETY:
(Name, legal status and principal place of business)

« »« »
« »

OWNER:
(Name, legal status and address)

« »« »
« »

CONSTRUCTION CONTRACT
Date: « »
Amount: $ « »
Description:
(Name and location)

«Race Brook Boiler and ventilation Replacement Project»
« »

BOND
Date:
(Not earlier than Construction Contract Date)
« »
Amount: $ « »
Modifications to this Bond: « » None « » See Section 18

CONTRACTOR AS PRINCIPAL
Company: *(Corporate Seal)*

Signature: _____
Name and Title: « »« »

SURETY
Company: *(Corporate Seal)*

Signature: _____
Name and Title: « »« »

(Any additional signatures appear on the last page of this Payment Bond.)

(FOR INFORMATION ONLY — Name, address and telephone)

AGENT or BROKER:

« »
« »
« »

OWNER'S REPRESENTATIVE:
(Architect, Engineer or other party:)

« »
« »
« »
« »
« »
« »

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable.

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§ 1 The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors and assigns to the Owner to pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

§ 2 If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

§ 3 If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Section 13) of claims, demands, liens or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials or equipment furnished for use in the performance of the Construction Contract and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety.

§ 4 When the Owner has satisfied the conditions in Section 3, the Surety shall promptly and at the Surety's expense defend, indemnify and hold harmless the Owner against a duly tendered claim, demand, lien or suit.

§ 5 The Surety's obligations to a Claimant under this Bond shall arise after the following:

§ 5.1 Claimants, who do not have a direct contract with the Contractor,

.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

.2 have sent a Claim to the Surety (at the address described in Section 13).

§ 5.2 Claimants, who are employed by or have a direct contract with the Contractor, have sent a Claim to the Surety (at the address described in Section 13).

§ 6 If a notice of non-payment required by Section 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Section 5.1.1.

§ 7 When a Claimant has satisfied the conditions of Sections 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

§ 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

§ 7.2 Pay or arrange for payment of any undisputed amounts.

§ 7.3 The Surety's failure to discharge its obligations under Section 7.1 or Section 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Section 7.1 or Section 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

§ 8 The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Section 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

§ 9 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

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§ 10 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, or give notice on behalf of, Claimants or otherwise have any obligations to Claimants under this Bond.

§ 11 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.

§ 12 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Section 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

§ 13 Notice and Claims to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

§ 14 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

§ 15 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

§ 16 Definitions

§ 16.1 Claim. A written statement by the Claimant including at a minimum:

.1 the name of the Claimant;
.2 the name of the person for whom the labor was done, or materials or equipment furnished;
.3 a copy of the agreement or purchase order pursuant to which labor, materials or equipment was furnished for use in the performance of the Construction Contract;
.4 a brief description of the labor, materials or equipment furnished;
.5 the date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
.6 the total amount earned by the Claimant for labor, materials or equipment furnished as of the date of the Claim;
.7 the total amount of previous payments received by the Claimant; and
.8 the total amount due and unpaid to the Claimant for labor, materials or equipment furnished as of the date of the Claim.

§ 16.2 Claimant. An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms "labor, materials or equipment" that part of water, gas, power, light, heat, oil, gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.

§ 16.3 Construction Contract. The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

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§ 16.4 Owner Default. Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

§ 16.5 Contract Documents. All the documents that comprise the agreement between the Owner and Contractor.

§ 17 If this Bond is issued for an agreement between a Contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

§ 18 Modifications to this bond are as follows:

« »

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL		SURETY	
Company:	*(Corporate Seal)*	Company:	*(Corporate Seal)*
Signature:		Signature:	
Name and Title:	« »« »	Name and Title:	« »« »
Address:	« »	Address:	« »

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AIA® Document A107™ – 2007

Standard Form of Agreement Between Owner and Contractor for a Project of Limited Scope

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«Race Brook Boiler and ventilation Replacement Project»
« »
« »

The Architect:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

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TABLE OF ARTICLES

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16 PROTECTION OF PERSONS AND PROPERTY

17 INSURANCE & BONDS

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19 MISCELLANEOUS PROVISIONS

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ARTICLE 1 THE WORK OF THIS CONTRACT

The Contractor shall execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 2 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 2.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.
(Insert the date of commencement, if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

« »

§ 2.2 The Contract Time shall be measured from the date of commencement.

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User Notes: (1395996519)

§ 2.3 The Contractor shall achieve Substantial Completion of the entire Work not later than « » (« ») days from the date of commencement, or as follows:
(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

« »

Portion of Work	Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.
(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

« »

ARTICLE 3 CONTRACT SUM

§ 3.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be one of the following:
(Check the appropriate box.)

[« »] Stipulated Sum, in accordance with Section 3.2 below

[« »] Cost of the Work plus the Contractor's Fee, in accordance with Section 3.3 below

[« »] Cost of the Work plus the Contractor's Fee with a Guaranteed Maximum Price, in accordance with Section 3.4 below

(Based on the selection above, complete Section 3.2, 3.3 or 3.4 below.)

§ 3.2 The Stipulated Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 3.2.1 The Stipulated Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

« »

§ 3.2.2 Unit prices, if any:
(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit ($0.00)

§ 3.2.3 Allowances included in the stipulated sum, if any:
(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Allowance

§ 3.3 COST OF THE WORK PLUS CONTRACTOR'S FEE

§ 3.3.1 The Cost of the Work is as defined in Exhibit A, Determination of the Cost of the Work.

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§ 3.3.2 The Contractor's Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee and the method of adjustment to the Fee for changes in the Work.)

« »

§ 3.4 COST OF THE WORK PLUS CONTRACTOR'S FEE WITH A GUARANTEED MAXIMUM PRICE
§ 3.4.1 The Cost of the Work is as defined in Exhibit A, Determination of the Cost of the Work.

§ 3.4.2 The Contractor's Fee:
(State a lump sum, percentage of Cost of the Work or other provision for determining the Contractor's Fee and the method of adjustment to the Fee for changes in the Work.)

« »

§ 3.4.3 GUARANTEED MAXIMUM PRICE
§ 3.4.3.1 The sum of the Cost of the Work and the Contractor's Fee is guaranteed by the Contractor not to exceed « » ($ « »), subject to additions and deductions by changes in the Work as provided in the Contract Documents. Such maximum sum is referred to in the Contract Documents as the Guaranteed Maximum Price. Costs which would cause the Guaranteed Maximum Price to be exceeded shall be paid by the Contractor without reimbursement by the Owner.
(Insert specific provisions if the Contractor is to participate in any savings.)

« »

§ 3.4.3.2 The Guaranteed Maximum Price is based on the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:

« »

§ 3.4.3.3 Unit Prices, if any:
(Identify and state the unit price, and state the quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit ($0.00)

§ 3.4.3.4 Allowances included in the Guaranteed Maximum Price, if any:
(Identify and state the amounts of any allowances, and state whether they include labor, materials, or both.)

Item	Allowance

§ 3.4.3.5 Assumptions, if any, on which the Guaranteed Maximum Price is based:

« »

ARTICLE 4 PAYMENTS
§ 4.1 PROGRESS PAYMENTS
§ 4.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 4.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

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§ 4.1.3 Provided that an Application for Payment is received by the Architect not later than the « » day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the « » day of the « » month. If an Application for Payment is received by the Architect after the date fixed above, payment shall be made by the Owner not later than « » (« ») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 4.1.4 Retainage, if any, shall be withheld as follows:

« »

§ 4.1.5 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

« » % « »

§ 4.2 FINAL PAYMENT
§ 4.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 18.2, and to satisfy other requirements, if any, which extend beyond final payment;
.2 the contractor has submitted a final accounting for the Cost of the Work, where payment is on the basis of the Cost of the Work with or without a guaranteed maximum price; and
.3 a final Certificate for Payment has been issued by the Architect.

§ 4.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

« »

ARTICLE 5 DISPUTE RESOLUTION
§ 5.1 BINDING DISPUTE RESOLUTION
For any claim subject to, but not resolved by, mediation pursuant to Section 21.3, the method of binding dispute resolution shall be as follows:
(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, claims will be resolved in a court of competent jurisdiction.)

[« »] Arbitration pursuant to Section 21.4 of this Agreement

[« »] Litigation in a court of competent jurisdiction

[« »] Other *(Specify)*

« »

ARTICLE 6 ENUMERATION OF CONTRACT DOCUMENTS
§ 6.1 The Contract Documents are defined in Article 7 and, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 6.1.1 The Agreement is this executed AIA Document A107–2007, Standard Form of Agreement Between Owner and Contractor for a Project of Limited Scope.

§ 6.1.2 The Supplementary and other Conditions of the Contract:

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Document	Title	Date	Pages

§ 6.1.3 The Specifications:
(Either list the Specifications here or refer to an exhibit attached to this Agreement.)
« »

Section	Title	Date	Pages

§ 6.1.4 The Drawings:
(Either list the Drawings here or refer to an exhibit attached to this Agreement.)
« »

Number	Title	Date

§ 6.1.5 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are enumerated in this Article 6.

§ 6.1.6 Additional documents, if any, forming part of the Contract Documents:

.1 Exhibit A, Determination of the Cost of the Work, if applicable.

.2 AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed, or the following:

« »

.3 Other documents:
(List here any additional documents that are intended to form part of the Contract Documents.)

« »

ARTICLE 7 GENERAL PROVISIONS

§ 7.1 THE CONTRACT DOCUMENTS

The Contract Documents are enumerated in Article 6 and consist of this Agreement (including, if applicable, Supplementary and other Conditions of the Contract), Drawings, Specifications, Addenda issued prior to the execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive or (4) a written order for a minor change in the Work issued by the Architect. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Contractor shall be required to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

§ 7.2 THE CONTRACT

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind between any persons or entities other than the Owner and the Contractor.

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§ 7.3 THE WORK
The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

§ 7.4 INSTRUMENTS OF SERVICE
Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

§ 7.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS AND OTHER INSTRUMENTS OF SERVICE
§ 7.5.1 The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and will retain all common law, statutory and other reserved rights, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with this Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

§ 7.5.2 The Contractor, Subcontractors, Sub-subcontractors and material or equipment suppliers are authorized to use and reproduce the Instruments of Service provided to them solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and material or equipment suppliers may not use the Instruments of Service on other projects or for additions to this Project outside the scope of the Work without the specific written consent of the Owner, Architect and the Architect's consultants.

§ 7.6 TRANSMISSION OF DATA IN DIGITAL FORM
If the parties intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmission, unless otherwise provided in the Agreement or in the Contract Documents.

ARTICLE 8 OWNER
§ 8.1 INFORMATION AND SERVICES REQUIRED OF THE OWNER
§ 8.1.1 The Owner shall furnish all necessary surveys and a legal description of the site.

§ 8.1.2 The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 8.1.3 Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 9.6.1, the Owner shall secure and pay for other necessary approvals, easements, assessments and charges required for the construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

§ 8.2 OWNER'S RIGHT TO STOP THE WORK
If the Contractor fails to correct Work which is not in accordance with the requirements of the Contract Documents, or repeatedly fails to carry out the Work in accordance with the Contract Documents, the Owner may issue a written order to the Contractor to stop the Work, or any portion thereof, until the cause for such order is eliminated; however, the right of the Owner to stop the Work shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

§ 8.3 OWNER'S RIGHT TO CARRY OUT THE WORK
If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents, and fails within a ten-day period after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner, without prejudice to any other remedy the Owner may have, may correct such deficiencies and may deduct the reasonable cost thereof, including Owner's expenses and compensation for the Architect's services made necessary thereby, from the payment then or thereafter due the Contractor.

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ARTICLE 9 CONTRACTOR

§ 9.1 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

§ 9.1.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents.

§ 9.1.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 8.1.1, shall take field measurements of any existing conditions related to that portion of the Work and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies, or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

§ 9.1.3 The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

§ 9.2 SUPERVISION AND CONSTRUCTION PROCEDURES

§ 9.2.1 The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work under the Contract, unless the Contract Documents give other specific instructions concerning these matters.

§ 9.2.2 The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for or on behalf of the Contractor or any of its Subcontractors.

§ 9.3 LABOR AND MATERIALS

§ 9.3.1 Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

§ 9.3.2 The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

§ 9.3.3 The Contractor may make a substitution only with the consent of the Owner, after evaluation by the Architect and in accordance with a Modification.

§ 9.4 WARRANTY

The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation or normal wear and tear under normal usage.

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§ 9.5 TAXES
The Contractor shall pay sales, consumer, use and other similar taxes that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

§ 9.6 PERMITS, FEES, NOTICES, AND COMPLIANCE WITH LAWS
§ 9.6.1 Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as other permits, fees, licenses and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

§ 9.6.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work. If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

§ 9.7 ALLOWANCES
The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. The Owner shall select materials and equipment under allowances with reasonable promptness. Allowance amounts shall include the costs to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts. Allowance amounts shall not include the Contractor's costs for unloading and handling at the site, labor, installation, overhead, and profit.

§ 9.8 CONTRACTOR'S CONSTRUCTION SCHEDULES
§ 9.8.1 The Contractor, promptly after being awarded the Contract, shall prepare and submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall not exceed time limits current under the Contract Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project to the extent required by the Contract Documents, and shall provide for expeditious and practicable execution of the Work.

§ 9.8.2 The Contractor shall perform the Work in general accordance with the most recent schedule submitted to the Owner and Architect.

§ 9.9 SUBMITTALS
§ 9.9.1 The Contractor shall review for compliance with the Contract Documents and submit to the Architect Shop Drawings, Product Data, Samples and similar submittals required by the Contract Documents in coordination with the Contractor's construction schedule and in such sequence as to allow the Architect reasonable time for review. By submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them; (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so; and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents. The Work shall be in accordance with approved submittals.

§ 9.9.2 Shop Drawings, Product Data, Samples and similar submittals are not Contract Documents.

§ 9.10 USE OF SITE
The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

§ 9.11 CUTTING AND PATCHING
The Contractor shall be responsible for cutting, fitting or patching required to complete the Work or to make its parts fit together properly.

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§ 9.12 CLEANING UP
The Contractor shall keep the premises and surrounding area free from accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery and surplus material from and about the Project.

§ 9.13 ROYALTIES, PATENTS AND COPYRIGHTS
The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for such defense or loss when a particular design, process or product of a particular manufacturer or manufacturers is required by the Contract Documents or where the copyright violations are contained in Drawings, Specifications or other documents prepared by the Owner or Architect. However, if the Contractor has reason to believe that the required design, process or product is an infringement of a copyright or a patent, the Contractor shall be responsible for such loss unless such information is promptly furnished to the Architect.

§ 9.14 ACCESS TO WORK
The Contractor shall provide the Owner and Architect access to the Work in preparation and progress wherever located.

§ 9.15 INDEMNIFICATION
§ 9.15.1 To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this Section 9.15.1.

§ 9.15.2 In claims against any person or entity indemnified under this Section 9.15 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under Section 9.15.1 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or Subcontractor under workers' compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 10 ARCHITECT
§ 10.1 The Architect will provide administration of the Contract and will be an Owner's representative during construction, until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents, unless otherwise modified in writing in accordance with other provisions of the Contract.

§ 10.2 The Architect will visit the site at intervals appropriate to the stage of the construction to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general, if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for, the construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

§ 10.3 On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and report to the Owner (1) known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor, and (2) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or

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charge of and will not be responsible for acts or omissions of the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

§ 10.4 Based on the Architect's evaluations of the Work and of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 10.5 The Architect has authority to reject Work that does not conform to the Contract Documents and to require inspection or testing of the Work.

§ 10.6 The Architect will review and approve or take other appropriate action upon the Contractor's submittals such as Shop Drawings, Product Data and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

§ 10.7 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect will make initial decisions on all claims, disputes and other matters in question between the Owner and Contractor but will not be liable for results of any interpretations or decisions rendered in good faith.

§ 10.8 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 10.9 Duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified or extended without written consent of the Owner, Contractor and Architect. Consent shall not be unreasonably withheld.

ARTICLE 11 SUBCONTRACTORS

§ 11.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site.

§ 11.2 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after award of the Contract, shall furnish in writing to the Owner through the Architect the names of the Subcontractors or suppliers for each of the principal portions of the Work. The Contractor shall not contract with any Subcontractor or supplier to whom the Owner or Architect has made reasonable written objection within ten days after receipt of the Contractor's list of Subcontractors and suppliers. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor's Work. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 11.3 Contracts between the Contractor and Subcontractors shall (1) require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by the terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by the Contract Documents, assumes toward the Owner and Architect, and (2) allow the Subcontractor the benefit of all rights, remedies and redress against the Contractor that the Contractor, by these Contract Documents, has against the Owner.

ARTICLE 12 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 12.1 The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and to award separate contracts in connection with other portions of the Project or other construction or operations on the site under conditions of the contract identical or substantially similar to these, including those portions related to insurance and waiver of subrogation. If the Contractor claims that delay or additional cost is involved because of such action by the Owner, the Contractor shall make such claim as provided in Article 21.

§ 12.2 The Contractor shall afford the Owner and separate contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's activities with theirs as required by the Contract Documents.

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§ 12.3 The Owner shall be reimbursed by the Contractor for costs incurred by the Owner which are payable to a separate contractor because of delays, improperly timed activities or defective construction of the Contractor. The Owner shall be responsible to the Contractor for costs incurred by the Contractor because of delays, improperly timed activities, damage to the Work or defective construction of a separate contractor.

ARTICLE 13 CHANGES IN THE WORK

§ 13.1 By appropriate Modification, changes in the Work may be accomplished after execution of the Contract. The Owner, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, with the Contract Sum and Contract Time being adjusted accordingly. Such changes in the Work shall be authorized by written Change Order signed by the Owner, Contractor and Architect, or by written Construction Change Directive signed by the Owner and Architect.

§ 13.2 Adjustments in the Contract Sum and Contract Time resulting from a change in the Work shall be determined by mutual agreement of the parties or, in the case of a Construction Change Directive signed only by the Owner and Architect, by the Contractor's cost of labor, material, equipment, and reasonable overhead and profit, unless the parties agree on another method for determining the cost or credit. Pending final determination of the total cost of a Construction Change Directive, the Contractor may request payment for Work completed pursuant to the Construction Change Directive. The Architect will make an interim determination of the amount of payment due for purposes of certifying the Contractor's monthly Application for Payment. When the Owner and Contractor agree on adjustments to the Contract Sum and Contract Time arising from a Construction Change Directive, the Architect will prepare a Change Order.

§ 13.3 The Architect will have authority to order minor changes in the Work not involving adjustment in the Contract Sum or extension of the Contract Time and not inconsistent with the intent of the Contract Documents. Such changes shall be effected by written order and shall be binding on the Owner and Contractor. The Contractor shall carry out such written orders promptly.

§ 13.4 If concealed or unknown physical conditions are encountered at the site that differ materially from those indicated in the Contract Documents or from those conditions ordinarily found to exist, the Contract Sum and Contract Time shall be equitably adjusted as mutually agreed between the Owner and Contractor; provided that the Contractor provides notice to the Owner and Architect promptly and before conditions are disturbed.

ARTICLE 14 TIME

§ 14.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 14.2 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 14.3 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

§ 14.4 The date of Substantial Completion is the date certified by the Architect in accordance with Section 15.4.3.

§ 14.5 If the Contractor is delayed at any time in the commencement or progress of the Work by changes ordered in the Work, by labor disputes, fire, unusual delay in deliveries, abnormal adverse weather conditions not reasonably anticipatable, unavoidable casualties or any causes beyond the Contractor's control, or by other causes which the Architect determines may justify delay, then the Contract Time shall be extended by Change Order for such reasonable time as the Architect may determine, subject to the provisions of Article 21.

ARTICLE 15 PAYMENTS AND COMPLETION

§ 15.1 APPLICATIONS FOR PAYMENT

§ 15.1.1 Where the Contract is based on a Stipulated Sum or the Cost of the Work with a Guaranteed Maximum Price, the Contractor shall submit to the Architect, before the first Application for Payment, a schedule of values, allocating the entire Contract Sum to the various portions of the Work, prepared in such form and supported by such

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data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used in reviewing the Contractor's Applications for Payment.

§ 15.1.2 With each Application for Payment where the Contract Sum is based upon the Cost of the Work, or the Cost of the Work with a Guaranteed Maximum Price, the Contractor shall submit payrolls, petty cash accounts, receipted invoices or invoices with check vouchers attached, and any other evidence required by the Owner to demonstrate that cash disbursements already made by the Contractor on account of the Cost of the Work equal or exceed (1) progress payments already received by the Contractor, less (2) that portion of those payments attributable to the Contractor's Fee; plus (3) payrolls for the period covered by the present Application for Payment.

§ 15.1.3 Payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment stored, and protected from damage, off the site at a location agreed upon in writing.

§ 15.1.4 The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information and belief, be free and clear of liens, claims, security interests or other encumbrances adverse to the Owner's interests.

§ 15.2 CERTIFICATES FOR PAYMENT

§ 15.2.1 The Architect will, within seven days after receipt of the Contractor's Application for Payment, either issue to the Owner a Certificate for Payment, with a copy to the Contractor, for such amount as the Architect determines is properly due, or notify the Contractor and Owner in writing of the Architect's reasons for withholding certification in whole or in part as provided in Section 15.2.3.

§ 15.2.2 The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluations of the Work and the data comprising the Application for Payment, that, to the best of the Architect's knowledge, information and belief, the Work has progressed to the point indicated and that the quality of the Work is in accordance with the Contract Documents. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion and to specific qualifications expressed by the Architect. The issuance of a Certificate for Payment will further constitute a representation that the Contractor is entitled to payment in the amount certified. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work, (2) reviewed construction means, methods, techniques, sequences or procedures, (3) reviewed copies of requisitions received from Subcontractors and material suppliers and other data requested by the Owner to substantiate the Contractor's right to payment, or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

§ 15.2.3 The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 15.2.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 15.2.1. If the Contractor and the Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 9.2.2, because of

.1 defective Work not remedied;
.2 third party claims filed or reasonable evidence indicating probable filing of such claims unless security acceptable to the Owner is provided by the Contractor;
.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment;
.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
.5 damage to the Owner or a separate contractor;

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.6 reasonable evidence that the Work will not be completed within the Contract Time and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

.7 repeated failure to carry out the Work in accordance with the Contract Documents.

§ 15.2.4 When the above reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 15.3 PROGRESS PAYMENTS

§ 15.3.1 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to sub-subcontractors in similar manner.

§ 15.3.2 Neither the Owner nor Architect shall have an obligation to pay or see to the payment of money to a Subcontractor except as may otherwise be required by law.

§ 15.3.3 A Certificate for Payment, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

§ 15.4 SUBSTANTIAL COMPLETION

§ 15.4.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

§ 15.4.2 When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

§ 15.4.3 Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. When the Architect determines that the Work or designated portion thereof is substantially complete, the Architect will issue a Certificate of Substantial Completion which shall establish the date of Substantial Completion, establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance, and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

§ 15.4.4 The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in such Certificate. Upon such acceptance and consent of surety, if any, the Owner shall make payment of retainage applying to such Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

§ 15.5 FINAL COMPLETION AND FINAL PAYMENT

§ 15.5.1 Upon receipt of the Contractor's written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions stated in Section 15.5.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

§ 15.5.2 Final payment shall not become due until the Contractor has delivered to the Owner a complete release of all liens arising out of this Contract or receipts in full covering all labor, materials and equipment for which a lien could

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be filed, or a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including costs and reasonable attorneys' fees.

§ 15.5.3 The making of final payment shall constitute a waiver of claims by the Owner except those arising from

.1 liens, claims, security interests or encumbrances arising out of the Contract and unsettled;
.2 failure of the Work to comply with the requirements of the Contract Documents; or
.3 terms of special warranties required by the Contract Documents.

§ 15.5.4 Acceptance of final payment by the Contractor, a Subcontractor or material supplier shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

ARTICLE 16 PROTECTION OF PERSONS AND PROPERTY

§ 16.1 SAFETY PRECAUTIONS AND PROGRAMS

The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the Contract. The Contractor shall take reasonable precautions for safety of, and shall provide reasonable protection to prevent damage, injury or loss to

.1 employees on the Work and other persons who may be affected thereby;
.2 the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody or control of the Contractor or the Contractor's Subcontractors or Sub-subcontractors; and
.3 other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures and utilities not designated for removal, relocation or replacement in the course of construction.

The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities bearing on safety of persons and property and their protection from damage, injury or loss. The Contractor shall promptly remedy damage and loss to property caused in whole or in part by the Contractor, a Subcontractor, a sub-subcontractor, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable and for which the Contractor is responsible under Sections 16.1.2 and 16.1.3, except for damage or loss attributable to acts or omissions of the Owner or Architect or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor's obligations under Section 9.15.

§ 16.2 HAZARDOUS MATERIALS

§ 16.2.1 The Contractor is responsible for compliance with the requirements of the Contract Documents regarding hazardous materials. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents, and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and report the condition to the Owner and Architect in writing. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased in the amount of the Contractor's reasonable additional costs of shutdown, delay and start-up.

§ 16.2.2 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants and agents and employees of any of them from and against claims, damages, losses and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area, if in fact, the material or substance presents the risk of bodily injury or death as described in Section 16.2.1 and has not been rendered harmless, provided that such claim, damage, loss or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss or expense is due to the fault or negligence of the party seeking indemnity.

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§ 16.2.3 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall indemnify the Contractor for all cost and expense thereby incurred.

ARTICLE 17 INSURANCE AND BONDS

§ 17.1 The Contractor shall purchase from, and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, insurance for protection from claims under workers' compensation acts and other employee benefit acts which are applicable, claims for damages because of bodily injury, including death, and claims for damages, other than to the Work itself, to property which may arise out of or result from the Contractor's operations and completed operations under the Contract, whether such operations be by the Contractor or by a Subcontractor or anyone directly or indirectly employed by any of them. This insurance shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever coverage is greater, and shall include contractual liability insurance applicable to the Contractor's obligations under Section 9.15. Certificates of Insurance acceptable to the Owner shall be filed with the Owner prior to commencement of the Work. Each policy shall contain a provision that the policy will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the Owner. The Contractor shall cause the commercial liability coverage required by the Contract Documents to include: (1) the Owner, the Architect and the Architect's Consultants as additional insureds for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's operations; and (2) the Owner as an additional insured for claims caused in whole or in part by the Contractor's negligent acts or omissions during the Contractor's completed operations.

§ 17.2 OWNER'S LIABILITY INSURANCE

The Owner shall be responsible for purchasing and maintaining the Owner's usual liability insurance.

§ 17.3 PROPERTY INSURANCE

§ 17.3.1 Unless otherwise provided, the Owner shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance on an "all-risk" or equivalent policy form, including builder's risk, in the amount of the initial Contract Sum, plus the value of subsequent modifications and cost of materials supplied and installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. Such property insurance shall be maintained, unless otherwise provided in the Contract Documents or otherwise agreed in writing by all persons and entities who are beneficiaries of such insurance, until final payment has been made as provided in Section 15.5 or until no person or entity other than the Owner has an insurable interest in the property required by this Section 17.3.1 to be covered, whichever is later. This insurance shall include interests of the Owner, the Contractor, Subcontractors and sub-subcontractors in the Project.

§ 17.3.2 The Owner shall file a copy of each policy with the Contractor before an exposure to loss may occur. Each policy shall contain a provision that the policy will not be canceled or allowed to expire, and that its limits will not be reduced, until at least 30 days' prior written notice has been given to the Contractor.

§ 17.3.3 The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 12, if any, and any of their subcontractors, sub-subcontractors, agents and employees for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to Section 17.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Owner as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 12, if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

§ 17.3.4 A loss insured under the Owner's property insurance shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause. The Contractor shall pay Subcontractors their just shares of insurance proceeds

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received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their sub-subcontractors in similar manner.

§ 17.4 PERFORMANCE BOND AND PAYMENT BOND

§ 17.4.1 The Owner shall have the right to require the Contractor to furnish bonds covering faithful performance of the Contract and payment of obligations arising thereunder as stipulated in bidding requirements or specifically required in the Contract Documents on the date of execution of the Contract.

§ 17.4.2 Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds or shall authorize a copy to be furnished.

ARTICLE 18 CORRECTION OF WORK

§ 18.1 The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, whether discovered before or after Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense, unless compensable under Section A.2.7.3 in Exhibit A, Determination of the Cost of the Work.

§ 18.2 In addition to the Contractor's obligations under Section 9.4, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 15.4.3, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty.

§ 18.3 If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct it in accordance with Section 8.3.

§ 18.4 The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

§ 18.5 The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Article 18.

ARTICLE 19 MISCELLANEOUS PROVISIONS

§ 19.1 ASSIGNMENT OF CONTRACT

Neither party to the Contract shall assign the Contract without written consent of the other, except that the Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate such assignment.

§ 19.2 GOVERNING LAW

The Contract shall be governed by the law of the place where the Project is located, except, that if the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 21.4.

§ 19.3 TESTS AND INSPECTIONS

Tests, inspections and approvals of portions of the Work required by the Contract Documents or by applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of public authorities shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public

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authority, and shall bear all related costs of tests, inspections and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of (1) tests, inspections or approvals that do not become requirements until after bids are received or negotiations concluded, and (2) tests, inspections or approvals where building codes or applicable laws or regulations prohibit the Owner from delegating the costs to the Contractor.

§ 19.4 COMMENCEMENT OF STATUTORY LIMITATION PERIOD

The Owner and Contractor shall commence all claims and causes of action, whether in contract, tort, breach of warranty or otherwise, against the other arising out of or related to the Contract in accordance with the requirements of the final dispute resolution method selected in the Agreement within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all claims and causes of action not commenced in accordance with this Section 19.4.

ARTICLE 20 TERMINATION OF THE CONTRACT

§ 20.1 TERMINATION BY THE CONTRACTOR

If the Architect fails to certify payment as provided in Section 15.2.1 for a period of 30 days through no fault of the Contractor, or if the Owner fails to make payment as provided in Section 4.1.3 for a period of 30 days, the Contractor may, upon seven additional days' written notice to the Owner and the Architect, terminate the Contract and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 20.2 TERMINATION BY THE OWNER FOR CAUSE

§ 20.2.1 The Owner may terminate the Contract if the Contractor

- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
- .2 fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;
- .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of a public authority; or
- .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 20.2.2 When any of the above reasons exists, the Owner, upon certification by the Architect that sufficient cause exists to justify such action, may, without prejudice to any other remedy the Owner may have and after giving the Contractor seven days' written notice, terminate the Contract and take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor and may finish the Work by whatever reasonable method the Owner may deem expedient. Upon request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 20.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 20.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 20.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Architect, upon application, and this obligation for payment shall survive termination of the Contract.

§ 20.3 TERMINATION BY THE OWNER FOR CONVENIENCE

The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause. The Contractor shall be entitled to receive payment for Work executed, and costs incurred by reason of such termination, along with reasonable overhead and profit on the Work not executed.

ARTICLE 21 CLAIMS AND DISPUTES

§ 21.1 Claims, disputes and other matters in question arising out of or relating to this Contract, including those alleging an error or omission by the Architect but excluding those arising under Section 16.2, shall be referred initially to the Architect for decision. Such matters, except those waived as provided for in Section 21.8 and Sections

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15.5.3 and 15.5.4, shall, after initial decision by the Architect or 30 days after submission of the matter to the Architect, be subject to mediation as a condition precedent to binding dispute resolution.

§ 21.2 If a claim, dispute or other matter in question relates to or is the subject of a mechanic's lien, the party asserting such matter may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.

§ 21.3 The parties shall endeavor to resolve their disputes by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with their Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to this Agreement, and filed with the person or entity administering the mediation. The request may be made concurrently with the binding dispute resolution but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 21.4 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any claim, subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association, in accordance with the Construction Industry Arbitration Rules in effect on the date of this Agreement. Demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 21.5 Either party, at its sole discretion, may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation; (2) the arbitrations to be consolidated substantially involve common questions of law or fact; and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

§ 21.6 Any party to an arbitration may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration provided that the party sought to be joined consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of a Claim not described in the written Consent.

§ 21.7 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

§ 21.8 CLAIMS FOR CONSEQUENTIAL DAMAGES

The Contractor and Owner waive claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

.1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and

.2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 20. Nothing contained in this Section 21.8 shall be deemed to preclude an award of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

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This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	CONTRACTOR *(Signature)*
« »« »	« »« »
(Printed name and title)	*(Printed name and title)*

DRAFT

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SECTION 00 01 08

SUPPLEMENTARY CONDITIONS

The following supplements *modify, change, delete* form *or add to* the General Conditions of the *Abbreviated Standard Form of* Agreement Between Owner *and Contractor* for a *Project of Limited Scope - AIA Document A 107-2007* (thereafter referred to as "The *Contract".* Where any Article *of* the General *Conditions is* modified or any paragraph, *subparagraph or* clause thereof is modified or *deleted by* these supplements, the unaltered *provisions of* that article, paragraph, *subparagraph or* clause shall remain in effect.

Numerical *designations herein have* the same, *or* are a sequential developmental of the same *designations as* the General Conditions.

ARTICLE 4 - PAYMENTS

Add the following sentence to 4.1.2:

The form of application for payment shall be AIA Document G702, "Application and Certification for Payment", supported by AIA Document G703, "Continuation Sheet." Three copies of the Application for payment shall be submitted and sworn before a notary public.

Add the following Subparagraphs:

4.1.3.1 Until Substantial Completion, the Owner will make monthly payments equal to Ninety-Five percent (95 %) of the value of labor and materials incorporated in the work and of materials suitably stored at the site, less Ten percent (10%) retainage. The remaining Five percent (5%) due will be paid when all work, including punch list items, has been completed and accepted by the Owner and Architect/Engineer. The amount of retainage may be reduced to 5 percent at the Owners sole discretion upon written request by the Contractor, and approval of the Engineer, at the time of Substantial Completion, providing that the quality of work is acceptable to the Owner and Engineer.

4.1.3.2 Full 10 percent retainage or reduced retainage as noted above will be payable to the Contractor no later than 30 calendar days after all work has been completed and accepted by Owner and Engineer and final 5 percent payment has been made.

4.1.3.3 The following information must be filed with requests for payment for materials and equipment stored off the project site:

1. Type of material must be specifically identified by the trade contractor.

2. Trade contractor must furnish an invoice from its supplier showing the total value of the material and/or equipment being stored off site.

4.1.3.4 The Contractor further agrees that the submission of any Application for Payment shall, upon receipt of such payment and to the fullest extent permitted by law, be conclusively deemed to waive all liens with respect to said work, materials and labor to which the Contractor then may be entitled; provided however that in no event shall such waiver of lien rights waive right to payment for said work, materials and labor.

4.1.3.5 Each Application for Payment must be accompanied by a certification that each subcontractor has been paid all amounts due him on the basis of the previous periodic payment to the Contractor, or else stating that the amount not so paid and the reason for the discrepancy. In the event of any such discrepancy the Contractor shall be required to furnish his own written explanation.

ARTICLE 7 - GENERAL PROVISIONS

7.1 THE CONTRACT DOCUMENTS

Add the following Subparagraph 7.1.1:

1. Where discrepancies or conflicts occur:

   (a) Addenda shall take precedence over Drawings or Specifications

   (b) Specifications shall take precedence over Drawings.

   (c) Supplementary Conditions shall take precedence over AIA General Conditions.

   (d) Stated dimensions shall take precedence over dimensions obtained by scaling,

   (e) Large scale detail drawings shall take precedence over small scale drawings.

Add the following Subparagraph to 7.1:

7.1.1.2.1 The Contractor will be furnished free of charge three (3) copies of Drawings and Project Manual. Additional sets will be furnished at the cost of reproduction, postage and handling.

Add the following Subparagraphs to 7.3

7.3.1 Wherever the term “M/E” is used, it is defined to mean mechanical and electrical trades. “Mechanical is defined to include plumbing, fire protection, and heating and ventilating trades.

7.3.2 The term “Installer” shall be taken to mean the installing contractor or subcontractor.

7.3.3 In the event of conflicts or discrepancies among the Contract documents, interpretations will be based on the following priorities:

1. Addenda, with those of later date having precedence over those of earlier date.
2. The Owner-Contractor Agreement and its General Conditions as modified by the Supplementary Conditions.
3. Drawings and Specifications (Divisions 1 through 16, as applicable)

7.3.4 In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided in accordance with the engineer’s interpretation.

7.3.5 Should any contradiction, ambiguity, error, or inconsistency appear in or between any of the Contract Documents, the Contractor shall, before proceeding with the work in question, notify the Engineer and request an interpretation. In no case shall he proceed with the affected work until advised by the Engineer.

7.3.6 If the Contractor fails to make a request for interpretation of errors, discrepancies, or conflicts in the Drawings or Specifications, no excuse will be accepted for failure to carry out the work in a

satisfactory manner, as interpreted by the Engineer. In all cases, the Contractor will be deemed to have estimated on the highest quality materials and most expensive way of doing work unless he has asked for and obtained written decision as to which methods or materials will be required.

7.3.7 The Drawings accompanying the specifications are intended to indicate the general arrangement of the work, and, except where specific details and dimensions are shown, the Contractor shall make all reasonable and approved modifications in arrangement without additional cost to the Owner as required for the proper execution of the work.

7.3.8 The Contractor is specifically cautioned that in all Specification sections, the "Description of Work" paragraph, including its subparagraph entitled "Related Work Specified Elsewhere," is general, and in now way limits or qualifies the requirements of the Contract.

7.3.9 The Contractor, before proceeding with its work, shall check carefully all lines and levels given on Drawings with the existing lines and levels, and shall advise the Engineer in writing of any discrepancies found.

ARTICLE 9 - CONTRACTOR

9.2 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following Subparagraphs to 9.2.1:

9.2.1.1 The Contractor shall verify all measurements at the Project and shall be responsible for their accuracy. No increase in the Contract Sum will be allowed for additional work required due to differences between field dimensions and Drawing Documents or stated approximate quantities.

9.2.1.2 The Contractor shall consult with representatives of all subcontractors to avoid interference. The contractor shall rearrange any work which may cause interference with work of other trades, without increase in contract Sum.

Add the following Subparagraph to 9.2.2:

9.2.2.1 Once assigned, the Project Superintendent may not be changed without the approval of the Owner and Engineer.

9.2.2.2 The Project Superintendent must attend all Project Meetings.

9.3 LABOR AND MATERIALS

Add the following Subparagraph to 9.3

9.3.1.1 No later than twenty (20) days from the Contract Date, the contractor shall provide a list showing the name of the product and the manufacturer proposed to be used for each of the products identified in the Specification and, where applicable, the name of the installing Subcontractor. The list shall be arranged by and be complete for each Specification Section.

9.4 WARRANTY

Add the following to 9.4:

9.4.1 The Contractor shall provide the following Guarantee/Warranty on letterhead at project completion.

CONTRACTOR'S LETTERHEAD)

NAME AND **ADDRESS OF** OWNER

Date:

Re:

(Name of Project)

Gentlemen:

The undersigned guarantees the Owner that he will be responsible for faulty materials, equipment and workmanship and that he will remedy all defects due thereto and pay for all damages to other work resulting therefrom which shall appear within a period of two (2) years from the date at which Substantial Completion of the work is certified by the Engineer.

During this period, upon written notice, the undersigned will proceed with due diligence at the undersigned's expense to replace properly all defective materials and equipment and perform all labor necessary to correct all defects in the work.

In case the undersigned fails upon reasonable notice to remedy such defects, the Owner may, in addition to and without limitation of any other rights or remedies the Owner may have, furnish such materials or labor as are necessary to do so, and the undersigned agrees to reimburse the Owner fully and promptly upon demand.

Guarantees from Contractor shall be supported by individual guarantees from each trade or subcontractor and manufacturer or supplier covering work performed and material and equipment.

All materials, fixtures, appliances, equipment and other items requiring excessive servicing during the guarantee period, in the opinion of the Engineer, will be considered defective, and shall be made good, replaced and/or corrected, to the satisfaction of the Engineer and Owner, under the terms of this paragraph.

The furnishing of the above guarantee, and all other special guarantees required by the Contract Documents, shall be a condition precedent to final payment.

(Name of Contractor)_____

(Signature of Contractor)_____Date_____

(Name of Notary)_____

(Signature of Notary)_____Date_____

9.6 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

Add the following Subparagraphs to 9.6.1:

9.6.1.1 The Contractor and each Subcontractor shall secure and pay for certificates of inspection and of occupancy that may be required by authorities having jurisdiction over the Work, including Labor Department and the Underwriter's Laboratory Certificates. The Contractor shall deliver original certificates to the Owner upon completion of the Work.

9.6.1.2 The requirements of subparagraphs preceding do not waive the Contractor's responsibility of complying with the requirements of the contract documents when such regulations and requirements exceed those of any laws, ordinances, rules, regulations and orders of any public bearing on the work.

9.15 INDEMNIFICATION

Add the following Subparagraphs to 9.15.1

9.15.1.2 Unless otherwise stated in the Agreement, each respective Contractor, shall, before commencing work, secure and pay for such insurance as may be required to comply with the indemnification and hold harmless provisions outlined under 9.15.1.

9.15.1.3 Such insurance shall be with such companies as may be satisfactory to the Owner. Insurance shall be so written as to prevent cancellation without at least thirty (30) days written notice to the Owner, Engineer and Contractor.

ARTICLE 13- CHANGES IN THE WORK

Add the following Paragraph

13.5

1. The allowance for overhead and profit combined, included in the total to the Owner, shall be based on the following schedule:
2. For the Contractor, for any work performed by the Contractor's own forces 15 % of the total cost.
3. For the Contractor, for work performed by Contractor’s Subcontractor, 10 % of the amount due the subcontractor.
4. For each subcontractor involved, for any work performed by that subcontractor’s own forces, 10% of the cost.
5. For each subcontractor, for work performed by the subcontractor’s sub-contractor, 5% of the amount due the subcontractor.
6. The Maximum allowance for overhead and profit combined shall not exceed 15% of the cost of the work.
7. In order to facilitate checking of quotations for extras or credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials, and subcontracts. Labor and materials shall be itemized in thee manner prescribed above. Where major cost items are subcontracts, they shall be itemized also. In no case will a change involving over $500.00 be approved without such itemization.

ARTICLE 15 – PAYMENTS AND COMPLETION

Add the following subparagraphs to 15.1.2:

15.1.2.1 Until Final Completion, the Owner shall pay Ninety-five percent (95% of the amount due the Contractor on the accounting of progress payments.

15.1.2.2 Application for payments shall not be made more often than once a month on or before the date to be agreed upon between the Owner and Contractor.

15.1.2.3 Application for payments shall be made in the form of AIA Document No. G702 and G702A, or in a similar and equal form as approved by the Engineer.

15.1.2.4 Each application for payment shall be accompanied by the Contractor's Affidavit of Payment of Debts and Claims through the date of preceding payment, in the form of AIA Document No. G706. Affidavit of Payment from each subcontractor through date of preceding payment shall include lien release for amounts previously paid if required by Owner or Engineer.

15.1.2.5 Unless otherwise set forth in the Contract, monthly progress payments shall equal Ninety-five percent (95%) of the value of labor and materials incorporated in the work and of materials suitably stored at the site, as estimated by the Engineer, less the aggregate of previous payments.

Add the following subparagraph to 15.1.3:

15.1.3.1 In determining the value of materials delivered and suitably stored on site that are to be reflected in any progress payment, only material shall be included that is necessary and pertinent to the stage of construction then in progress, or to be incorporated within the period of thirty (30) days following the date of application for payment. Contractor is solely responsible for theft, loss, and damage of all materials delivered to site and shall replace such materials with equal materials at no extra cost to the Owner.

Add the following Clauses to subparagraph 15.4.2.

15.4.2.1 Guarantees (Warranties) required by the various Sections of the Specifications shall be executed on forms satisfactory to the Architect/Engineer and Owner. Guarantee Period shall start with date of Substantial Completion unless otherwise specified.

15.4.2.2 Upon Substantial Completion of the work, the Contractor shall forward to the Engineer the originals and one (1) copy of the guarantees (warranties) required under the various Sections of the Specifications with assignments thereof to the Owner.

Add the following Clause to Subparagraph 15.5.1

15.5.1.1 When final certificate of occupancy has been obtained and all punch list work completed, the final payment of the remaining five percent (5%) shall be due forty-five (45) days after the date of Final Completion as distinct from Substantial Completion, providing all punch list items have been satisfactorily completed and so certified by Architect/Engineer.

Add the following Clause to Subparagraph 15.5.2

15.5.2.1 Prior to final payment, Contractor's Affidavit of Payment of Debts and Claims and Affidavit of Release of Liens shall be submitted in the form of AIA Documents G706 and G706A. Contractor shall provide a bond to cover normal one-year guarantee of all work from date of Substantial Completion if final payment is made prior to end of guarantee period.

ARTICLE 17 – INSURANCE AND BONDS

Add the following Subparagraphs to 17.1:

17.1.1 Liability Insurance shall include all major divisions of coverage and be on a comprehensive basis including:

1. Premises Operation (including X, C and U coverage as applicable).

2. Independent Contractor's Protective.

3. Products and Completed Operations.

4. Personal Injury Liability with Employment Exclusion deleted.

5. Contractual, including specified provision for Contractors.

6. Owned, Non-owned and Hired Motor Vehicles.

7. Broad Form Property Damage including Completed Operations.

17.1.2: If the General Liability coverage is provided by a Commercial General Liability Policy on a "claims-made" basis, the policy date shall predate the Contract termination date of the policy or applicable extended reporting period shall be no earlier that the termination date of coverage required to be maintained after final payment certified in accordance with Subparagraph 17.4.1

17.1.3 The insurance required by Subparagraph 16.1 shall be written for not less than the following, or greater if required by law:

1. Worker's Compensation:
   a. State: Statutory
   b. Applicable Federal: Statutory
   c. Employer's Liability: $100,000.00 (Per Accident)

2. Comprehensive General Liability (including Premises-Operations; Protective; Products and Completed Operations; Broad Form Property Damage):
   (a) Bodily Injury:

   $1,000,000.00 Each Occurrence
   $1,000,000.00 Annual Aggregate

   (b) Property Damage:

   $1,000,000.00 Each Occurrence
   $1,000,000.00 Annual Aggregate

   (c) Additionally named insured:

   1. Orange Board of Education
      637 Orange Center Rd.
      Orange, Connecticut 06477
      Including its employees, consultants and agents

   2. Musco Engineering Associates
      375 Morgan Lane, Unit #307
      West Haven, Connecticut
      Including its employees, consultants and agents

   3. Town of Orange
      617 Orange Center Rd.
      Orange, CT 06477

3. Contractual Liability:
   (a) Bodily Injury:

   $1,000,000.00 Each Occurrence
   $1,000,000.00 Annual Aggregate

   (b) Property Damage

   $1,000,000.00 Each Occurrence
   $1,000,000.00 Annual Aggregate

4. Personal Injury, with Employment Exclusion deleted:
   (a) $1,000,000.00 Each Person
   (b) $1,000,000.00 Aggregate

5. Comprehensive Automobile Liability: (including owned, non-owned and hired vehicles)
   (a) Bodily Injury:

   $1,000,000.00 Each Person
   $1,000,000.00 Annual Aggregate

   (b) Property Damage:

   $1,000,000.00 Each Occurrence

6. Excess Umbrella Liability:

   $3,000,000.00 Over primary insurance
   $3,000,000.00 Retention for self-insured hazards (each occurrence).

17.1.4 Contractor's liability insurance must be maintained until final certificate of payment is issued pursuant to paragraph 14.5.1 and Completed Operators Insurance is in effect.

17.1.5 Certificates of insurance must be submitted on AIA Document G715 Certificate of Insurance, or such other form as acceptable to the Owner and Engineer

ARTICLE 19 - MISCELLANEOUS PROVISIONS

Add the following to Paragraph l9.2:

19.2.1 The Contractor and his Subcontractors shall abide by Sections 46a-51, 46a-60, 61 and 62 of the Connecticut General Statues "Discriminatory Practices".

19.2.2 The Contractor and all Subcontractors shall comply with all applicable requirements of paragraph 814c "Human Rights and Opportunities" of the Connecticut General Statues.

19.2.3 The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, age or national origin, and he agrees to comply with all laws and ordinances relating thereto and all orders, rules and regulations issued pursuant thereto including, without imitation, Executive Order 11246 (as amended by Order 11375). Should any of the aforementioned laws, ordinances, rules, regulations, or orders require any particular provision, representation or agreement to be set forth in the Contract, same is incorporated herein by reference to the same as if fully written out herein.

19.2.4 Particular attention is directed to the provisions of the Fair Labor Standard Act (Federal Wage and Hour Law) and its requirements for minimum age of 18 for any employees used in the Work and that at least time and a half be paid more than 40 hours of work in any one week. Except for emergencies brought about by weather or accident, the normal working day will be eight (8) hours and work should be planned accordingly. No work will be performed on Saturday, Sundays, or holidays unless prior approval is obtained from the Owner.

Add the following additional Article:

ARTICLE 22 - PROHIBITED INTERESTS

22.1 No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept, or approve of or take part in negotiating, making, accepting, or approving any architectural engineering, inspection, construction or material supply contract, or any sub-contraction connection with the construction of the Project shall become directly or indirectly interested personally in the Contract or in any part thereof.

22.2 No officer, employee, architect, attorney, engineer or inspector of the Owner who is authorized in such capacity and on behalf of the Owner to exercise any legislative, executive, supervisory, or other similar functions in connection with the construction of the Project shall become directly or indirectly interested personally in this Contract or in any part thereof, any material supply contract, subcontract, insurance contract, or any other contract pertaining to this Contract.

END OF SECTION

DRAFT

AIA® Document G706™ – 1994

Contractor's Affidavit of Payment of Debts and Claims

PROJECT: *(Name and address)*
Race Brook Boiler and ventilation Replacement Project

TO OWNER: *(Name and address)*

ARCHITECT'S PROJECT NUMBER:

CONTRACT FOR: General Construction
CONTRACT DATED:

OWNER: ☐
ARCHITECT: ☐
CONTRACTOR: ☐
SURETY: ☐
OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that, except as listed below, payment has been made in full and all obligations have otherwise been satisfied for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or Owner's property might in any way be held responsible or encumbered.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Consent of Surety to Final Payment. Whenever Surety is involved, Consent of Surety is required. AIA Document G707, Consent of Surety, may be used for this purpose

Indicate Attachment ☐ Yes ☒ No

The following supporting documents should be attached hereto if required by the Owner:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

3. Contractor's Affidavit of Release of Liens (AIA Document G706A).

CONTRACTOR: *(Name and address)*

BY: _____
(Signature of authorized representative)

_____
(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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AIA® Document G706A™ – 1994

Contractor's Affidavit of Release of Liens

PROJECT: *(Name and address)* Race Brook Boiler and ventilation Replacement Project	ARCHITECT'S **PROJECT NUMBER:**	OWNER: ☐ ARCHITECT: ☐ CONTRACTOR: ☐
	CONTRACT FOR: General Construction	SURETY: ☐
TO OWNER: *(Name and address)*	CONTRACT DATED:	OTHER: ☐

STATE OF:
COUNTY OF:

The undersigned hereby certifies that to the best of the undersigned's knowledge, information and belief, except as listed below, the Releases or Waivers of Lien attached hereto include the Contractor, all Subcontractors, all suppliers of materials and equipment, and all performers of Work, labor or services who have or may have liens or encumbrances or the right to assert liens or encumbrances against any property of the Owner arising in any manner out of the performance of the Contract referenced above.

EXCEPTIONS:

SUPPORTING DOCUMENTS ATTACHED HERETO:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.

2. Separate Releases or Waivers of Liens from Subcontractors and material and equipment suppliers, to the extent required by the Owner, accompanied by a list thereof.

CONTRACTOR: *(Name and address)*

BY:

(Signature of authorized representative)

(Printed name and title)

Subscribed and sworn to before me on this date:

Notary Public:
My Commission Expires:

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AIA® Document G702™ – 1992

Application and Certificate for Payment

TO OWNER:		**PROJECT:**	Race Brook Boiler and ventilation Replacement	**APPLICATION NO:**	001
				PERIOD TO:	
				CONTRACT FOR:	General Construction
FROM CONTRACTOR:		**VIA ARCHITECT:**		**CONTRACT DATE:**	
				PROJECT NOS:	/ /

Distribution t
OWNER:
ARCHITECT:
CONTRACTOR:
FIELD:
:

CONTRACTOR'S APPLICATION FOR PAYMENT

Application is made for payment, as shown below, in connection with the Contract.
Continuation Sheet, AIA Document G703, is attached.

1. ORIGINAL CONTRACT SUM $0.00
2. NET CHANGE BY CHANGE ORDERS $0.00
3. CONTRACT SUM TO DATE (Line 1 ± 2) $0.00
4. TOTAL COMPLETED & STORED TO DATE (Column G on G703) $0.00
5. RETAINAGE:

a. 0 % of Completed Work
(Column D + E on G703: $0.00)= $0.00

b. 0 % of Stored Material
(Column F on G703: $0.00)= $0.00

Total Retainage (Lines 5a + 5b or Total in Column I of G703) $0.00

6. TOTAL EARNED LESS RETAINAGE $0.00
(Line 4 Less Line 5 Total)
7. LESS PREVIOUS CERTIFICATES FOR PAYMENT $0.00
(Line 6 from prior Certificate)
8. CURRENT PAYMENT DUE $0.00
9. BALANCE TO FINISH, INCLUDING RETAINAGE
(Line 3 less Line 6) $0.00

CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS
Total changes approved in previous months by Owner	$0.00	$0.00
Total approved this Month	$0.00	$0.00
TOTALS	$0.00	$0.00
NET CHANGES by Change Order		$0.00

The undersigned Contractor certifies that to the best of the Contractor's knowledge, information and belief the Work covered by this Application for Payment has been completed in accordance with the Contract Documents, that all amounts have been paid by the Contractor for Work for which previou Certificates for Payment were issued and payments received from the Owner, and that current payment shown herein is now due.

CONTRACTOR:

By: _____ Date: _____

State of:
County of:
Subscribed and sworn to before
me this day of
Notary Public:
My Commission expires:

ARCHITECT'S CERTIFICATE FOR PAYMENT

In accordance with the Contract Documents, based on on-site observations and the data comprising this application, the Architect certifies to the Owner that to the best of the Architect's knowledge, information and belief the Work has progressed as indicated, the quality of the Work is in accordan with the Contract Documents, and the Contractor is entitled to payment of the AMOUNT CERTIFIED.

AMOUNT CERTIFIED ..... $0.

(Attach explanation if amount certified differs from the amount applied. Initial all figures on this Application and on the Continuation Sheet that are changed to conform with the amount certified.)

ARCHITECT:

By: _____ Date: _____

This Certificate is not negotiable. The AMOUNT CERTIFIED is payable only to the Contractor named herein. Issuance, payment and acceptance of payment are without prejudice to any rights of t Owner or Contractor under this Contract.

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AIA® Document G703™ – 1992

Continuation Sheet

AIA Document, G702™–1992, Application and Certification for Payment, or G736™–2009, Project Application and Project Certificate for Payment, Construction Manager as Adviser Edition, containing Contractor's signed certification is attached.
In tabulations below, amounts are in US dollars.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NO:	001
APPLICATION DATE:	
PERIOD TO:	
ARCHITECT'S PROJECT NO:	

A	B	C	D	E	F	G		H	I
			WORK COMPLETED						
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD	MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D + E + F)	% (G ÷ C)	BALANCE TO FINISH (C - G)	RETAINAGE (IF VARIABLE RATE)
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00%	0.00	0.00
	GRAND TOTAL	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00%**	**0.00**	**0.00**

DRAFT

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SECTION 01 00 10

SUMMARY OF WORK

1.1 WORK TO BE DONE

A. Work to be done under the Contract and in accordance with Contract Documents consists of performing, installing, furnishing, and supplying of all materials, services, equipment, labor and incidentals necessary or convenient for the as indicated on Drawings, including carrying out of all duties and obligations imposed upon Contractor by the Contract Documents.

B. The contractor shall be responsible for the following as part of this contract.

1. 4 sets of all shop drawing submittals as indicated.

2. Demolition and removal of all work indicated on the drawings and as described in Specifications.

3. Provide and install equipment and devices as indicated on the drawings as described in Specifications.

4. Additional work as stated in project manual.

5. Coordination with the owner for any additional electrical requirements.

1.2 CONTRACT ADMINISTRATION

A. The Contractor shall determine the scope of work, trade sections, and responsibilities to be included in each subcontractor's work.

B. Scope of sub's work may include more than one technical specification section and/or parts of one or more sections as the Contractor determines to be in the project's best interest.

C. Contract for the entire work shall be between the Contractor and the Owner.

D. The Contractor shall be the Contract Administrator and the Coordinator. He shall expedite, schedule, phase, supervise, direct and coordinate, the work of the subcontractors he assigns to perform the work.

E. The Contractor and each subcontractor shall examine all Drawings and Specifications for the entire work and become familiar with the entire project and all interrelated work.

1.3 DRAWINGS

The Contract Drawings as listed in this Project Manual and forms are part of the Contract Documents.

1.4 SCHEDULING

Work shall begin not more than 10 days from the Notice to Proceed and expedited so as to complete all work by November 1, 2013. Shop Drawings and material orders shall be scheduled to ensure this date is met.

1.5 TIME OF COMPLETION

A. It is expressly agreed by Owner and Contractor that date of completion of Project (November 1, 2013) as stated in the Contract is reasonable.

B. Contractor shall schedule work so that all work is substantially completed by date in Contract.

1.6 LAYOUT AND COORDINATION

A. Contractor shall examine the Contract Documents thoroughly and promptly report any errors or discrepancies to Engineer before commencing any unclear work.

B. Work shall be laid out in accordance with the Contract Documents.

C. Coordination of all interrelated work is Contractor's responsibility.

D. Locations and elevations shown are approximate only, based on best information furnished Engineer. Before ordering materials and starting work, Contractor shall confirm exact dimensions, plumbness, lines, and elevations in the field.

E. Contractor shall take all measurements of the work and assume responsibility for all measurements, lines, and levels.

1.7 OWNER'S USE OF SITE

The operation of Owner's facilities shall be uninterrupted during construction operation throughout the entire project.

1.8 WORK BY OTHER CONTRACTORS

Contractor shall cooperate with other Contractor(s) that Owner may have performing work under other contract(s) on or adjacent to this project site.

END OF SECTION

SECTION 01 00 30

SPECIAL PROJECT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract and Division 1, General Requirements, apply to the work of all Sections in the Project Manual.

1.2 CONTRACTOR'S QUALIFICATIONS

A. Contractor and subcontractors shall be recognized Contractors skilled and experienced in the specific work required, and equipped to perform workmanship in accordance with the accepted standards or quality required or noted in each specific trade section.

B. Minimum Experience of not less than ten (10) years experience with projects of magnitude equivalent to the required work.

C. Maintenance Proximity of not more than two (2) hours normal travel time from Contractor's office to project site, except if a special waiver has been granted by Engineer for a specific trade.

D. Contractor shall submit list of a minimum of three projects of comparable size, complexity, and materials with names and telephone numbers of persons to contact for references if requested by Engineer and owner.

1.3 CONSTRUCTION SUPERINTENDENT

A. The contractor shall provide a full time Construction Superintendent on the project. The Construction Superintendent shall be assigned solely to this project and shall be on-site while any and all work is being performed including that of any Subcontractor. The Construction Superintendent shall have full authority to act on behalf of the Contractor, and his decisions or actions shall not require prior or subsequent approval by the Contractor's home office or his immediate supervisors. The requirements for a full time on-site Contractor's superintendent shall be non-negotiable, and the failure to comply with these requirements, shall be in direct conflict with the contract obligations.

B. The Construction Superintendent shall be fully qualified in experience and skills. He shall have a minimum of ten (10) years experience in the field on all types of construction activities required under this project along with at least three years experience as a past project superintendent.

C. The Contractor shall submit to the Owner, if requested, a resume of the individual he proposes to use as the project superintendent. Orange Public Schools shall have the right to reject the proposed superintendent prior to start of work or at any time during execution of the project and to require Contractor to re-assign a more qualified Construction Superintendent to the project. The Contractor shall immediately fulfill such

request by the association for replacement of the Construction Superintendent at no additional costs to the contract.

D. The accepted Construction Superintendent may not be removed from assignment to the project until the project and all punch-list items are 100% completed and accepted by the Engineer. The Construction Superintendent shall at all times have in his possession an adequately charged portable cellular telephone in working order. The purpose of this telephone is to function as a readily available communication device between Superintendent and his office, and the Engineer.

E. Superintendent shall allow use of this telephone device only to the above specifically mentioned parties for incoming and outgoing calls for job related purposes. All costs shall be borne by the Contractor.

1.4 RESPONSIBILITY AND INTENT

A. Contractor shall provide all labor, materials, equipment, appliances, and services necessary to execute and complete all work as required by Contract Documents.

B. The work of the Contract shall, in general, include each and every trade or branch of work covered by the various Sections of the Project Manual, and may also include the work of other trades not specifically mentioned if and as needed to properly carry out the work to completion.

C. It is the intent, that the work included under each Section of the Project Manual shall cover the manufacturer, fabrication, delivery, uncrating, hoisting, installation, erection, testing, and with all incidentals thereto, unless otherwise noted or specified.

D. Any apparatus, equipment, or material not shown on the Drawings, but which is mentioned in the Project Manual, or vice versa, or any incidental equipment or material or service which may be necessary to make the work complete in all respects and ready for operation, even if not particularly specified, shall be furnished, delivered and installed by Contractor without any additional expenses to the Owner, the same as though specifically shown on Drawings or mentioned in Project Manual.

E. Small details not usually shown or specified, but necessary for proper installation and operation shall be included in the work and in Contractor's bid, the same as if herein specified or shown on the Drawings.

F. All materials and apparatus required for the work shall be new, of first-class quality. Where no specific kind or quality of material is specified, a first-class standard article as approved by Engineer shall be furnished.

G. Contractor shall visit the site, make his own detailed examinations as to existing determine any difficulties attending the execution of the work. Failure to determine existing conditions or interrelation of new construction with existing conditions will not be considered basis for granting additional compensation.

H. Contractor shall coordinate operations of all trades and subcontractors in the common use of temporary equipment and facilities in so far as possible.

I. All work of temporary nature required for Contract operations shall be removed upon completion of Contract, when no longer needed or when directed by Engineer.

J. Contractor shall provide all materials necessary and use proper procedures and methods to protect existing work to remain. Guard against damage at all areas of existing work to remain. The Contractor shall investigate sizes and dimensions of all products, materials, equipment, etc. to be used in the Project and shall arrange for all such products to be adequately and accurately sized or broken down so as to fit into the work area. Contractor shall provide all necessary personnel to direct, handle, and protect the passage or transfer of products into and/or out of the work area.

K. Accidental damage occurring through construction procedures shall be the Contractor's responsibility. Contractor shall rebuild and restore conditions back to the original state at whatever costs are involved and at no additional cost to the Owner. Particular attention shall be given to the extent that no underground utility lines are disturbed or damaged during construction.

L. Contractor shall require good conduct of all workmen and other construction personnel while on the job site. Personnel under the Contractor's control who violate the above, or exhibit vulgarity in their behavior or language, shall be permanently restricted from working on the Project and shall be immediately replaced with competent personnel by the Contractor.

M. Contractor shall coordinate the work of all trades and be held responsible for assuring that all trades perform work to the highest quality and in compliance with the Contract Documents, manufacturer's instructions, applicable codes and Project completion schedule.

N. All subcontractors shall inform Contractor daily, of all work procedures, operations, delivery schedules, changes and/or conditions affecting their work. The subcontractors shall also inform Contractor of manpower participation and progress of their work in accordance with the progress schedule.

1.5 CODES, RULES, PERMITS, FEES, CERTIFICATES

A. All materials furnished and work performed shall comply with all Federal, State and, local codes, laws, rules, regulations and recommendations of National Board of Fire Underwriters, all requirements of local utility companies, Fire and Health Departments including all current Federal O.S.H.A. and Water Pollution Control Acts, the Department of Environmental Protection, and all Equal Employment Opportunity regulations.

B. Include in the work, without extra cost to the Owner, additional incidental labor, materials, services, and apparatus required, but not shown on the Drawings or specified, to meet these laws and regulations.

C. Contractor shall give all necessary notices, obtain all permits and certificates, perform all tests, pay all fees, pay all royalties and other costs in connection with this work, file all necessary plans and obtain all necessary approvals of all Agencies or Departments having jurisdiction over this work, and obtain all required Certificates of Inspection for this work; deliver three (3) copies of above to the Engineer.

1.6 CONTRACTOR'S ACCESS, STAGING AREA, CONTRACT WORK AREA

A. Contractor access and staging areas shall be located so as to minimize traffic congestion and disruption of work. Route of ingress and egress, storage areas, and other use of Owner's property, shall at all times be subject to approval by Owner.

B. Contractor shall be required to position adequately sized dumpsters for construction debris; exact location of dumpsters shall be approved by Owner and Architect/Engineer as construction activities require but always so as to maintain unobstructed to emergency and delivery vehicle access.

C. Contractor shall restrict all persons employed on project to those actual areas necessary to progress work and elsewhere only with Owner’s specific approval.

1.7 EXISTING SITE CONDITIONS

A. Contractor shall maintain existing building and site conditions, parking areas, and roads clean and free of excessive construction debris from his operations. Contractor shall protect all structures and site improvements from damage during the work and repair same to Owner’s satisfaction.

1.8 PHASING AND SCEDULING OF WORK

A. Contractor shall schedule and phase work so as to expeditiously execute completion of project within time period agreed to in the Contract.

B. Construction Progress Schedule and Time Schedule for Shop Drawings shall be submitted by Contractor within Fifteen (15) days of award and shall be updated bi-weekly and as requested by Architect/Engineer.

C. No extra costs will be allowed to the Contractor due to his being required to adjust phasing or scheduling to conform to job conditions, or the Owner’s needs.

1.9 RECORD DRAWINGS, AS-BUILTS

A. Keep a complete set of Plans and Specifications of all trades at the site, with all latest amendments, revisions, and addenda.

B. At completion of work, Contractor shall furnish to Architect/Engineer complete marked-up prints showing all as-built conditions including all deviations from original Contract Drawings. Refer to Supplementary Conditions for additional requirements.

C. CAD drawings showing all work. Architect/Engineer to provide background in PDF format.

1.10 SAFEGUARDS

A. Contractor shall provide the necessary safeguards to prevent accidents, to avoid all unnecessary hazards and to protect the public, work, and property at all times, including Saturdays, Sundays and holidays, and at other times when no work is being done. Occupational Safety and Health Act of 1970 shall be followed by Contractor as it applies to this work. Contractor shall provide hard hats for Engineers use during his field visits. Contractor shall provide all required temporary sheathing, bracing, shoring and re-shorings if applicable.

1.11 MANUFACTURER'S SPECIFICATIONS REFERENCE STANDARDS

A. Mention of a product by specific name, or alternate products offered and approved, shall imply application of the manufacturer's published specifications, modified as necessary to comply with the Contract Documents. A copy of the applicable manufacturer's specifications, Trade Association Specifications or Standards, shall be made available by the Contractor for reference.

B. All references to Standard Specifications and Tests of Technical Societies, Public Agencies and similar organizations, shall be taken to mean the latest editions adopted and published and all revisions and amendments at date of Contract Documents, unless otherwise specified or particularly noted.

1.12 WORK DONE AFTER NORMAL WORKING HOURS

A. Any portion of the work required to be performed at times of day or week, other than normal work hours, shall be performed at no extra cost to Owner. Contractor shall pay extra charges for work performed at overtime rates.

1.13 HAZARDOUS MATERIALS

A. Should any hazardous materials be encountered during any work under this Contract, Contractor shall stop work immediately and notify Owner, and shall proceed only when and as directed by Owner.

1.14 CLEAN-UP

A. Contractor shall be responsible for general cleaning and maintenance of premises and job site and for coordination and direction of clean-up work of all trades and contracts. Contractor shall require that each trade and subcontractor clean and maintain his portion of work as required and directed by Contractor. If premises and job site are not maintained properly, Owner may have any accumulations of waste materials or trash removed and cost charged to Contractor.

B. Under no circumstances shall any rubbish or waste be dropped or thrown from one level to another.

C. Care shall be taken by all workmen not to mark, soil, or otherwise deface any finished surfaces. In the event that any finished surface becomes defaced in any way by mechanics or workmen, Contractor shall clean and restore such surfaces to their original

condition.

D. Each subcontractor engaged in work shall bear his full responsibility in cleaning up in accordance with all provisions under this heading and he shall cooperate with Contractor to that effect, this shall in no way be construed to relieve Contractor of his responsibility for leaving all work in a clean and proper condition, satisfactory to Owner and the Engineer.

E. Periodic Cleaning: Contractor shall at all times, during the progress of work, keep site free from accumulation of waste matter or rubbish and shall confine his apparatus, materials, and operations of his workmen to limits prescribed herein, except as may be extended with the approval of Owner and Engineer. All waste material shall be removed daily from construction site to designated dumpster location. Dumpsters shall be emptied as necessary and at least weekly.

END OF SECTION

SECTION 01 31 13

COORDINATION

1.1 GENERAL SCOPE:

A. The General Conditions, Special Conditions, Instructions to Bidders, and all other parts set forth in Part 1 of the Specifications are hereby made a part hereof unless specifically accepted.

1.2 COORDINATION:

A. Coordinate scheduling, submittals and work of the various Specification sections to assure efficient and orderly sequence of installation of interdependent construction elements with provisions for accommodating items installed later.

B. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various specification sections having interdependent responsibilities installing, connecting, and placing such equipment and utilities in service.

C. Coordinate completion and clean up of work of separate sections of Specifications in preparation for completion of all portions of work.

1.3 CUTTING AND PATCHING:

A. Employ skilled and experienced installers to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements which affect the following:

1. Structural integrity of element.
2. Integrity of weather-exposed or moisture-resistant elements.
3. Performance, efficiency, maintenance and safety of element.
4. Visual qualities of exposed-to-view elements.
5. Work of Owner and separate contractors.

C. Execute cutting, fitting, and patching to complete Work, and to:

1. Fit the several parts together and to integrate with other work.
2. Uncover Work to install or correct ill-timed Work.
3. Remove and replace defective and non-conforming work.
4. Remove samples of installed work for testing.
5. Provide openings in elements of work for penetrations of mechanical and electrical work.

D. Execute work by methods which will avoid damage to other work, and provide proper surfaces to receive patching and finishing.

1. Provide required protection and support for existing surfaces and components.
2. Cut rigid materials using masonry saw or core drill.

E. Restore work with new products in accordance with requirements of Contract Documents.

1. Fit new and existing work tight to pipes, sleeves ducts, conduits, and other penetrations through surfaces.
2. All finish or new/disturbed grades shall be made to blend smoothly and evenly into existing work on the property.
3. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection. For an assembly, refinish entire unit.

F. In the event hazardous substances or conditions are exposed during the work, identify such hazards to the Architect for decision or remedy.

END OF SECTION

SECTION 01 31 19

PROJECT MEETINGS

1.1 GENERAL SCOPE:

A. The General Conditions, Special Conditions, Instructions to Bidders, and all other parts set forth in Part 1 of the Specifications are hereby made a part hereof unless specifically excepted.

1.2 PRECONSTRUCTION CONFERENCE

A. Owner will schedule a conference after Notice of Award.

B. Attendance Required: Owner's Representative, and Contractor.

C. Agenda:

1. Execution of Owner-Contractor Agreement.
2. Submission of insurance certificates.
3. Submission of list of products, Schedule of Values, and progress schedule.
4. Designation of personnel representing the parties in Contract, and the Owner.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders and Contract closeout procedures.
6. Scheduling.
7. Use of premises by Owner and Contractor.
8. Access to project site.

1.3 PROJECT MEETING REQUIREMENTS:

A. Schedule regular job Site meetings at intervals of approximately one (1) week.

B. Arrange for special meetings as may be required due to progress of the work.

C. Meetings shall be held at the Project Site.

D. Attendance shall be by: Owner's Representative, Architect, Contractor, Sub-Contractors, Suppliers, and such other Persons or Companies appropriate to the project construction work. All persons attending the meetings shall be qualified, familiar with the Project, and authorized to conclude matters relating to the Project.

1.4 SUGGESTED AGENDA:

A. Project job Site meeting shall in general contain the following agenda:

1. Review of progress report and construction schedule.
2. Review of off-site fabrication, delivery schedules.
3. Review submittal schedules.
4. Review of follow-up list of problems and incompletions.
5. Field observations, problems, conflicts.
6. Maintenance of quality standards.
7. Review proposed changes for effect on construction schedule, completion date and other contracts.
8. Other business pertinent to the work of the Project.

END OF SECTION

SECTION 01 33 00

SUBMITTALS

1.1 GENERAL SCOPE:

The General Conditions, Special Conditions, Instructions to Bidders, and all other parts set forth in Part 1 of the Specifications are hereby made a part hereof unless specifically excepted.

1.2 SUBMITTAL PROCEDURES:

A. Coordination of submittals:

1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
2. Verify that each item and the submittal for it conform in all respects with the specified requirements.
3. By affixing the Contractor's signature or approval stamp to each submittal, he/she certifies that this coordination has been performed.

B. Substitutions:

1. The Contract is based on the standards of quality established in the Contract Documents. To give all bidders equal opportunity, use of any materials or methods other than those specified will require the proper submittal information and must be pre-approved in written addenda 7 days prior to bid due date.
2. The following products do not require further approval except for interface within the Work:
   A. Minor products specified by reference to standard specification such as ASTM and similar standards.
   B. Products specified by manufacturer's name and catalog model number.
3. Building owner reserves right to final authority on acceptance or rejection of any substitute.
4. Request for substitutions will be accepted from prime bidders only. Requests for substitutions from parties not bidding on the project as a primary contractor will not be considered.

C. "Or equal":

1. The specified materials are named to denote the kind and quality required, whether or not the words "or approved equal" are used. These materials and associated physical properties shall serve as standards and all proposals shall be based upon the same.
2. Proposals shall be accompanied by a copy of the manufacturer's standard specification Section. That specification Section shall be signed and sealed by a professional engineer licensed in the state in which the installation is to take place. Substitution requests containing specifications without licensed engineer certification shall be rejected for non-conformance.
3. Where the phrase "or equal," or "or equal as approved by the Owner," occurs in the Contract Documents, the material or method must be so approved for this Work by the Owner prior to receipt of bids.

4. The decision of the Owner shall be final.

1.3 SUBMITTAL DOCUMENTS

1. Only Bidders proposing substitutes to the material or methods specified in this specification are required to submit the following documentation.
2. Roof System Test Data: Each manufacture must submit independent third part test reports on a multi-ply roof membrane system. The independent third party test data must be submitted on lab letterhead.
3. Test data must be submitted on the entire roof membrane system and not for individual roof components such as, base sheets, ply sheets, adhesives, cap sheets, flood coats and etc.
4. Test data must be conducted per test methods listed in the Section 7500 - Systems Roofing
5. Independent test laboratory shall be ISO/IEC 17025 certified.
6. A list of five (5) jobs of similar size where the proposed materials have been used, under similar conditions as specified.
7. Shop Drawings:
   A. Make Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work.
   B. Owner will review and comment on required changes. The Contractor may make and distribute corrected copies as are required for his purposes.
8. Copy of the roofing supplier's warranty which meets all requirements of the specified warranty.
9. Individual product identification, including material supplier's literature and MSDS sheets.
10. Letter from material supplier signed by a corporate officer, on company stationery, confirming that all bidding documents have been approved, that the site has been inspected and meets the requirements for suitability, and that the specified warranty shall be provided upon satisfactory completion of the project.
11. Material supplier providing the roofing warranty shall be ISO 9001:2008
    A. Submit a copies of the material suppliers Certificates of Registration
    B. Certificates of Registration shall have listed: Design, Manufacturer and Distribution in the Scope of Approval and/or Activity
12. Verify material supplier is a financially stable organization with the ability to protect the building Owner from both product liability and warranty claims relating to roofing that might arise during the course of the warranty period. It is the intent of the building Owner to establish requirements that will protect him, be fair to all suppliers and ensure that requirements are in line with the exposure of the supplier. The following information will be provided by the material supplier that will issue the warranty and will be submitted by the prime bidder:
    A. A certificate of insurance for product liability with minimum limits in accordance with the following formula:

(a) Product Liability Insurance will be a minimum aggregate coverage, not less than 5% of total company sales, with coverage of not less than 1 million dollars per occurrence.

(b) First dollar coverage (no self-insured retention or deductibles).

(c) Coverage provided by an admitted company licensed to do business in CT, with an A.B. Best rating of A- or better.

B. An affidavit signed by a corporate officer stating that they are not currently, nor have been within the last five (5) years, involved in litigation regarding asbestos content of their materials. Or provide a list of all pending asbestos related litigation, an estimate of the dollar amount of all potential asbestos related liability and a summary of all asbestos related settlements over the last five years.

C. An affidavit signed by a corporate officer that the cost of the warranty claims has not exceeded 2% of that company's total roofing product sales in any of the last five (5) years.

13. Any proposed substitute materials or methods must also be accompanied by the following documentation:

A. A detailed analysis of the roofs being bid on.

B. A complete specification of the proposed substitute. If, after review, the substitute is found to be acceptable, copies will be provided to each bidder who has picked up the original specification.

C. Written explanation of why substitutions should be considered is required.

1.4 CONSTRUCTION PROGRESS SCHEDULE:

A. Submittals:

1. Submit initial progress schedule in duplicate within 15 days after date of Notice to Proceed for Architect review

2. Revise end resubmit as required.

3. Submit revised schedules with each Application for Payment, identifying changes made since from previous version.

B. Format – One of the following:

1. Computer generated horizontal bar chart with separate line for each major section of work or operation, identifying first work day of each week.

2. Computer generated network analysis diagram using the critical path method, generally as outlined in Associated General Contractors of America AGC, publication "The Use of CPM in Construction – A Manual for General Contractors and the Construction Industry."

C. Indicate the following:

1. Indicate complete sequence of construction by activity, identifying work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

2. Indicate estimated percentage of completion for each item of work at each submission.

3. Indicate submittal dates required for shop drawings, product data samples, and product delivery dates.

4. Indicate delivery dates for items furnished by Owner and under Allowances.

1.5 SCHEDULE OF VALUES:

A. Submittal:

1. Submit initial schedule in duplicate with 15 days after date of Owner- Contractor Agreement. After review by Architect revise and resubmit as required.

2. Submit revised schedule with each Application for Payment, reflecting changes since previous submittal.

B. Format:

1. Submit typed schedule on AIA Form G703 – Application and Certificate for Payment Continuation Sheet. Contractor's standard form or media-driven printout will be considered on request.

2. Utilize the table of Contents of this Project Manual. Identify each line item with number and title of the major specification Section.

3. Identify Site mobilization.

C. For Unit Cost Allowance, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.

D. Include separately from each line item a directly proportional amount of Contractor's overhead and profit.

1.6 PROPOSED PRODUCTS LIST:

A. Within 10 days after date of Notice to Proceed, submit complete list of major products proposed for us, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standard.

1.7 PRODUCT DATA:

A. Submit the number of copies which the Contractor requires, plus two copies which will be retained by the Architect.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement Manufacturers standard data to provide information unique to this product.

C. After review, distribute in accordance with Submittal Procedures above. Provide copies for Record Documents described in Section 01700 Contract Closeout.

1.8 SHOP DRAWINGS:

A. Submit the number of opaque reproductions which the Contractor requires, plus two copies which will be retained by the Architect.

B. After review, distribute in accordance with Submittal procedures above and for Record Documents described in Section 01 70 00.

1.9 SAMPLES:

A. Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittal for interfacing work.

B. Submit samples of finishes in selected custom or standard colors, patterns, and textures for Architect selection.

C. Identify each sample. Include full Project information.

D. Submit the number of samples specified in individual specification sections or the number required by Contractor, plus one which will be retained by the Architect. Observe Submittal Procedures, above, relating to color submittals.

E. Reviewed samples which may be used in the Work are indicated in individual specification sections.

1.10 MANUFACTURER'S INSTRUCTIONS:

A. When specified in individual Specification Sections, submit manufacturer's printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

B. Identify conflicts between manufacturer's instructions and Contract Documents.

1.11 MANUFACTURER'S CERTIFICATES:

A. When specified in individual specification sections, submit manufacturer's certificate to Architect for review, in quantities specified for Project Data.

B. Indicate that material or product conforms to or exceeds specified requirements. Submit supporting references date, affidavits, and certifications as appropriate.

1.12 DOCUMENT REVIEW:

A. When required by individual Specification Section, require installer and agent of manufacturer of product system to:

1. Review the Contract Documents.

2. Verify that systems are appropriate for the intended use.

3. Submit a statement of concurrence signed by installer and manufacturer.

B. Submit three copies of the statement of concurrence to Architect for review and acceptance.

C. Do not proceed with installation until Architect has reviewed and accepted statement of concurrence.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

1.1 GENERAL SCOPE:

A. The General Conditions, Special Conditions, Instruction to Bidders, and all other parts set forth in Part 1 of Specifications are hereby made a part hereof unless specifically excepted.

1.2 QUALITY ASSURANCE:

A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' approved instructions including each step in sequence. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.

C. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

D. Use only skilled mechanics thoroughly trained and experienced in the necessary crafts to produce workmanship of specified quality.

E. Secure products in place with positive anchorage devices designed and size to withstand stresses, vibration, physical distortion and disfigurement.

1.3 REFERENCES:

A. Conform to specified standards by date of issue as follows:

1. Code listings: For standards which are part of the Building Code in effect for this product, comply with the edition date published in the Building Code.

2. Non-code listings: For standards which are not a part of the Building Code in effect for this Product, use the edition in effect at the date of Notice to Proceed, except w here otherwise specified in product sections.

B. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in reference documents.

1.4 MANUFACTURERS' FIELD SERVICES AND REPORTS:

A. When specified in individual Specification Sections, required material supplier or manufacturer to provide qualified staff personnel to observe site conditions, conditions of

surfaces and installation, and quality of workmanship; to start-up equipment: to test, adjust and balance equipment as applicable; and to initiate instructions when necessary.

B. Require observer to report observations, Site decisions and Site instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.

C. Submit to Architect a written report by observer in duplicate within 7 days of observation.

1.5 TESTING LABORATORY SERVICES:

A. Employ and pay for services of an Independent Testing Laboratory to perform inspections, tests, and other services required by individual Specification Sections. Select laboratory and submit to Architect for approval.

B. Direct Laboratory to perform services in accordance with requirements of governing authorities and with specified standards.

C. Submit reports to Architect in duplicate, giving observations and results of tests, indicating compliance or non- compliance with specified standards and with Contract Documents.

D. Cooperate with testing laboratory personnel: furnish tools, samples of materials, design mix, equipment, storage and assistance as requested.

1. Notify Architect and Testing Laboratory 24 hours prior to expected time for operations requiring testing services.

2. Make arrangements with Testing Laboratory and pay for additional samples and tests for Contractor's convenience.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

1.1 GENERAL SCOPE:

A. The General Conditions, Special Conditions, Instructions to Bidders, and all other parts set forth in Part 1 of the Specifications are hereby made a part hereof unless specifically excepted.

1.2 TEMPORARY UTILITIES:

A. Electricity:

1. Contractor shall provide all electrical power and such additional power outlets as may be required for construction operations, with branch wiring and distribution boxes. Provide flexible power cords as required. Contractor shall be responsible for all cost associated with electrical power.

2. Provide main service disconnect and overcurrent protection at convenient location.

3. Permanent Building convenience receptacles shall not be utilized during construction. Coordinate use with Owner personnel.

4. Electrical power required shall not be furnished to the Contractor by the Owner.

B. Temporary lighting:

1. Provide and maintain adequate lighting for construction operations.

2. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

3. Maintain lighting and provide routine repairs.

4. Permanent Building lighting may be utilized during construction.

5. All temporary wiring, lighting fixtures and accessory parts shall be removed when no longer needed and the permanent systems in each area has been installed.

C. Temporary Telephone Service:

1. Provide, maintain and pay for telephone service to project site from time of project mobilization through project completion.

2. The location of the telephone shall be as determined by the Contractor.

3. The telephone shall be made available for use by the Contractor and his his/her sub-contractors.

4. The Contractor shall pay for all charges and fees in connection with temporary telephone service installation and final removal upon project completion. The Contractor shall also pay for all monthly charges, including the cost of all calls.

D. Temporary Water Service:

1. The Owner shall provide temporary water to the Contractor from location(s) designated by the Owner. The Owner shall be responsible to pay for all water used by the Contractor.

2. The Contractor shall provide all temporary additional water lines as may be required for construction operations, with all branch lines, fittings, and fixtures as required. Contractor shall be responsible for all cost associated with temporary additional water lines.

3. The Contractor shall provide backflow preventers at convenient location(s) if required. The Contractor shall be responsible for all cost associated with backflow preventers.

4. The Contractor shall make every effort to conserve water. Failure of the Contractor to conserve water may result in forfeiture of the right to use Town of Orange facilities.

E. Temporary sanitary facilities:

1. The Contractor shall provide all temporary toilet and sanitary facilities as may be required for construction operations. Contractor shall be responsible for all cost associated with temporary toilets and sanitary facilities.

2. Permanent Building toilets and sanitary facilities shall not be used during construction.

1.3 ENVIRONMENTAL CONTROLS:

A. Comply with applicable Federal, State, and local laws, regulations, and ordinances and the following requirements for environmental pollution control and abatement in performing construction activities throughout the Building.

B. Rubbish Disposal:

1. Do not burn, bury or dispose of debris and waste materials on the Project Site in an unauthorized manner. Contractor shall coordinate and pay for all dumpsters for debris and rubbish removal associated with the work.

2. Provide dumpster for non-contaminated metal for Owner to recycle metal and collect fee.

C. Dust:

1. Keep dust within acceptable levels at all times, including non-working hours, weekends and holidays, in conformance with State and local regulations.

2. Only wet grinding or cutting of concrete, masonry, and asphaltic concrete will be allowed on exterior surfaces. Dry cutting or grinding may be used on interior surfaces provided openings are covered.

3. Mechanical dry sweeping not permitted: Vacuuming, wet mopping, approved limited dry hand, wet or damp sweeping is acceptable.

4. During loading operations, water down debris and waste materials to allay dust.

5. Select method of dust control and pay all costs incurred.

D. Air pollution:

1. Do not permit or cause air pollution from mist, smoke, vapor, gas, odorous substances and particulate matter.

2. Do not operate any gasoline or diesel-powered vehicle or equipment on the Building Site which emits visible smoke.

E. Noise: Muffle internal combustion engine-powered equipment to minimize noise and properly maintain to reduce noise to acceptable levels.

F. Others

1. If spray application is allowed under the other Specification Sections, use 'airless spray' process only.

2. Where the requirements of other Project Manual Sections are in conflict with this Section, the more stringent requirement shall govern.

3. Suspension of work: Violation of any of these requirements or any other pollution control requirements which may be specified in other sections may cause suspension of the work creating such violation. No additional compensation will be allowed for remedial measures to correct the offense and no extension of time will be granted for delays caused by such suspensions. If no corrective action is taken by the Contractor within 72 hours after a suspension is ordered, the Owner reserves the right to take whatever action is necessary to correct the situation and to deduct costs incurred in taking such action from monies due the Contractor.

1.4 TEMPORARY CONTROLS:

A. Barriers:

1. Provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of Site, and to protect existing Building facilities and adjacent properties from damage from construction operations and demolition.

2. Provide barricades required by governing authorities for public rights-of-way and for public access to existing Building and facilities.

3. Protect non-owned vehicular traffic, stored materials, Site and other structures and facilities from damage.

4. Contractor shall be responsible for all cost associated with the construction, maintenance, and removal of all barriers and fences.

B. Protection:

1. Protect installed work and existing improvements. Provide special protection where specified in

individual Specification Sections.

2. Control traffic and activity to prevent damage to components and services.

3. Provide temporary and removable protection for installed products.

4. Landscaping:

   a. Protect existing and new landscaping against damage from construction operations on the property.

   b. Do not dispose of paint, petroleum products, dirty water or other eleterious materials on or around roots.

   c. Do not burn trash under or near shrubs or trees.

   d. Do not permit compaction of root areas within drip line by foot, vehicle or machine traffic, or by the storage of equipment, gravel, earth fill, supplies or materials.

   e. Do not damage trunks or limbs by maneuvering vehicles or stacking material and equipment too close.

   f. Do not allow puddling or continuous running water under trees or on landscaped areas.

   g. Do not allow traffic on landscaped areas.

1.5 CONSTRUCTION FACILITIES:

A. Security:

1. Provide security and facilities, to protect Work, and existing improvements, and Owner's operations from unauthorized entry, vandalism, and theft.

2. Coordinate with Owner's security program for all facilities.

B. Access:

1. Maintain access to fire hydrants free of obstructions.

2. Only designated Site paved areas may be used for construction traffic.

C. Parking:

1. Arrange with Owner's personnel for designated Site parking areas to accommodate construction personnel.

D. Field Offices and sheds:

1. Construction sheds: Provide as required for protection and secure storage of the Contractor's apparatus and materials.

E. Progress Cleaning:

1. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in a clean and orderly condition.

2. Remove debris and rubbish prior to enclosing pipe chases, plenums, attics, crawl spaces and other closed or remote spaces.

3. Broom and vacuum clean areas prior to start of surface finishing. Continue cleaning to eliminate dust.

4. Remove waste material, debris, and rubbish from construction areas daily. Dispose of debris in an authorized manner.

1.6 REMOVAL OF TEMPORARY UTILITIES AND FACILITIES:

A. Remove temporary utilities, equipment, facilities and materials prior to Final Inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent new facilities used during construction to specified condition.

1.7 ENVIRONMENTAL CONTROLS:

A. Comply with applicable Federal, State, and Local Laws, regulations and ordinances and the following requirements for environmental pollution control and abatement in performing construction activities.

B. Hazardous Materials: Abatement will be performed as part of this contract. Comply with all requirements of the Contract.

C. Coordinate Construction work with abatement work. Verify abatement schedules with the Owner's representative and the Architect.

END OF SECTION

SECTION 01 7 0 00

CONTRACT CLOSEOUT

1.1 GENERAL SCOPE:

A. The General Conditions, Special Conditions, Instructions to Bidders, and all other parts set forth in Part 1 of the Specifications are hereby made a part hereof unless specifically excepted.

1.2 CLOSEOUT PROCEDURES:

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's final review.

B. Provide submittals to Architect/Owner that are required by governing or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

D. Owner will occupy portions or all of the Buildings and site specified in section 01 0 0 00.

E. Comply with requirements for Final Observation of the Work as set forth in Special Conditions, Section B; coordinate with the requirements set forth in this Section 01 70 00.

1.3 FINAL CLEANING:

A. Execute final cleaning prior to final review by the Architect.

B. Clean equipment, site and fixtures to a sanitary condition.

C. Remove waste and surplus materials, rubbish, and construction facilities from the Building(s) and from the site.

1.4 ADJUSTING:

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS:

A. Maintenance of documents and samples:

1. Maintain on Site one set of the following record documents:

a. Contract Drawings.

b. Specifications.

c. Addenda.

d. Change Orders and other Modifications to the Contract.

e. Reviewed shop drawings, product data, and samples.

2. Store Record Documents separate from Documents used for construction.

B. Recording:

1. Record concurrently with construction progress on reproducible drawings provided for this purpose. Do not conceal Work until actual revisions to the Work are recorded.

2. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

a. Manufacturer's name and product model number.

b. Product substitution or alternates utilized.

c. Changes made by Addenda and Modifications.

3. Record documents and shop drawings: Legibly mark each item to record actual construction including the following:

a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

b. Field changes of dimension and detail.

c. Details not on original Contract Drawings.

4. Other documents: Maintain manufacturer's certifications, inspection certifications and field test records required by individual Specifications Sections.

5. Delete Architect title block from all Record Documents.

C. Submittals:

1. At completion of each stage of Work submit Record Documents for review by Architect.

2. At Contract close-out, submit Record Documents with transmittal letter in duplicate, containing date, project title, list of documents and contractor's name, address, and signature. Arrange documents in sequence with index.

3. Submit the marked-up reproducible and two prints for each record drawing and three copies of each 8 1/2" x 11 drawing.

1.6 OPERATION AND MAINTENANCE DATA:

A. Prepare and submit two sets of operating and maintenance manuals prior to final inspection.

1. 8 1/2 x 11 inch three D side ring binders with durable plastic covers.

2. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when more than one binder is required.

3. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

B. Contents of manuals:

1. Prepare a Table of Contents for each volume with each Product or system description identified.

2. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.

3. Part 2: Operation and maintenance instructions arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:

a. Significant design criteria.

b. List of equipment.

c. Parts list for each component.

d. Operating instructions.

e. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

4. Part 3: Project documents and certificates including the following:

a. Shop drawings and product data.

b. Certificates.

c. Photocopies of warranties and bonds.

D. Submittal:

1. Submit one copy of completed volumes in final form 15 days prior to final review with Architect comments. Revise content of documents as required prior to final submittal.

2. Submit final volumes revised within ten days after final review.

1.7 WARRANTIES:

A. Provide notarized copies of each warranty and bond.

1. Execute and assemble documents from subcontractors, suppliers, and manufacturers.

2. Assemble in three D side ring binder with durable plastic cover.

3. Prepare binder covers with printed title "WARRANTIES AND BONDS" and title of project.

4. Provide Table of Contents.

B. Submit prior to final Application for payment.

C. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.8 STATEMENT OF APPLICATION:

A. When required by individual Specification Section, upon completion of the work and as condition of its acceptance, submit a statement in duplicate signed by the product installer stating the following:

1. Materials conform to Specifications.

2. Products were installed in accordance with Specifications and the manufacturers' written instructions.

3. Installation was proper and adequate for the conditions of installation and performance.

B. When required by individual Specification Section, Contractor shall jointly execute statement of application.

1.9 SPARE PARTS AND MAINTENANCE MATERIALS:

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Specification Sections.

B. Deliver to Project Site and place in location as directed. Obtain receipt prior to final payment.

END OF SECTION

Facility Support Services, LLC

Environmental & Safety Consulting Engineers

May 28, 2013 FSS PN: 22813

Orange Board of Education
Attn: Mr. Michael Luzzi
Director of Facilities
637 Orange Center Road
Orange, CT 06477

RE: Specifications: Asbestos Abatement
Race Brook School Boilers
107 Grannis Road
Orange, CT 06477

Dear Mr. Luzzi:

Enclosed please find the Specifications for Asbestos Abatement (Section 02080) and associated work to support the upcoming demolition of two boilers in the Race Brook School Boiler Room, located at 107 Grannis Road in Orange, Connecticut. These Specifications have been prepared to satisfy the requirements of standards for asbestos abatement in the State of Connecticut.

If you have any questions regarding these Specifications, please contact the undersigned at our Hamden, CT office at (203) 288-1281. Thank you for this opportunity to have served your environmental needs.

Sincerely,

Facility Support Services, LLC (FSS)

Christopher M. Hudacek
Project Manager
CTDPH Project Designer #000239

Enclosure

Facility Support Services, LLC

Environmental & Safety Consulting Engineers

ASBESTOS ABATEMENT SPECIFICATIONS

RACE BROOK SCHOOL

BOILER ROOM
(TWO BOILERS)
107 GRANNIS ROAD
ORANGE, CT 06477

Prepared For:

Orange Board of Education
637 Orange Center Road
Orange, Connecticut 06477

Prepared By:

Facility Support Services, LLC
2685 State Street
Hamden, Connecticut 06517

Christopher Hudacek
CTDPH Project Designer #000239

May 28, 2013
FSS Project No: 22813

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TECHNICAL SPECIFICATION

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Division II	Section 02075	Selective Demolition
	Section 02080	Asbestos Abatement

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Contractor Qualifications.

B. Contractor Use of Site and Premises.

C. Work Sequence.

D. Owner's Operations.

E. Closeout and Punch List.

F. Cleaning.

G. Emergency Calls

1.2 CONTRACTOR QUALIFICATIONS

A. The Contractor selected must appear on the approved list of Asbestos Abatement Contractors on file at the State of Connecticut Department of Public Health (CTDPH). Only State of Connecticut licensed asbestos abatement supervisors and workers shall perform asbestos abatement work activities.

B. The Contractor shall obtain and pay for all required permits, and prepare and file all original and amended local, state, and EPA pre-notification forms immediately following award of the work.

C. The Contractor shall conduct personal exposure air monitoring for airborne fibers as prescribed by OSHA during the project performance.

D. The Owner reserves the right to award this Contract to the Contractor who best meets all contractor qualifications and Owner's interests.

1.3 CONTRACTORS USE OF SITE AND PREMISES

A. Limit use of site and premises as follows:
   1. Owner occupancy.
   2. Work by Owner.
   3. Use of site and premises by public.

B. Coordinate use of the premises, including use of restroom facilities and utilities under direction of Owner.

C. Assume full responsibility for protection and safekeeping of products under this Contract.

1.4 WORK SEQUENCE

A. Work must be performed to accommodate Owner's requirements and work by other trades. Coordinate abatement schedule and operations with the Owner and Consultant. Re-occupancy by owner and other trades shall occur following completion of work by the Contractor and successful air clearance sampling by the Consultant.

B. The Owner may occupy portions of the building during the Work. However, no children shall be permitted to occupy any portion of the building during the duration of abatement project. The Contractor is responsible for creating a plan to accommodate Owner occupancy needs and remaining construction/renovation work.

1.5 OWNER'S OPERATIONS

A. Schedule the Work to accommodate this requirement.

B. Maintain means of egress.

C. Coordinate Work with the Owner.

D. Maintain the fire alarm and fire detection systems at all times when the building is occupied during construction.

E. Maintain a permanent means of egress during activities. Provide and maintain a temporary means of egress as required by the Fire Marshall.

1.6 CLOSEOUT AND PUNCH LIST

A. The Contractor shall carefully check his/her own work and that of any Subcontractor as the work is being performed. Unsatisfactory work shall be corrected immediately.

B. When the Contractor determines that he is substantially complete, that is, has less than one percent of his Contract remaining to be completed, he shall prepare for submission to the Consultant, a list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents.

C. Upon receipt of the Contractor's list of items to be completed or corrected, the Consultant will promptly make a thorough inspection and prepare a "punch list" setting forth in accurate detail any items on the Contractor's list and any additional items that are not acceptable.

D. When the "punch list" has been prepared, the Consultant will arrange a meeting with the Contractor to identify and explain all punch list items and answer questions on the work that must be completed before final acceptance.

E. The Contractor shall correct all "punch list" items or shall cause the correction of the "punch list" items within a time frame to be established when the "punch list" is made. The time frame for the completion of the "punch list" shall not exceed the completion date of the Contract. Should the "punch list" not be completed within the specified time frame, the Owner may invoke the rights given under the General Conditions.

F. The Consultant shall not be expected to inspect any area more than once for the preparation of the "punch list" items. If, during an inspection, the Consultant discovers five (5) or more deficient conditions, then the area shall be declared "Not Ready" for Inspection.

G. All inspections and sampling required for asbestos abatement compliance will be performed by the Consultant.

1.7 CLEANING

A. Throughout the abatement period, the Contractor shall maintain the building and site free of rubbish, debris, surplus materials, and other items not required for the Work. Remove such materials from the site daily to prevent accumulations. Remove all construction debris from work areas, and remove all hazardous waste and asbestos waste as required by the most current federal, state, and local regulations and the requirements of the specifications.

1.8 EMERGENCY CALLS

A. The Contractor shall provide the Consultant and Owner with a telephone number where the Contractor or Contractor's Representative can be reached during non-working hours.

B. At the direction of a duly authorized representative of the Owner, the Contractor may be required to dispatch all necessary personnel and equipment to any point on the work site to clear obstructions or make safe any conditions deemed necessary by the Owner or Consultant.

1.9 ADDITIONAL GENERAL REQUIREMENTS

A. The Abatement Contractor shall employ an English-speaking competent Asbestos Abatement Supervisor with at least three (3) years experience on projects of similar scope and magnitude who shall be responsible for all work involving asbestos abatement as described in the Specifications and defined in the applicable regulations, and have full-time daily supervision of the same. The Supervisor shall be the "Competent Person" as defined by OSHA regulations. The Contractor shall provide, on-site, at least one English-speaking foreman at all times when work is in progress. The supervisor and foreman must be thoroughly experienced in asbestos-containing materials removal work, knowledgeable of all applicable federal, state, and local regulations and capable of skillfully executing all work promptly, efficiently and in compliance with all requirements of these specifications. The Owner reserves the right to have any supervisory or foreman personnel removed from the project if they do not demonstrate the requisite qualifications.

B. The Contractor shall allow work performed under this contract to be inspected, if required, by local, state, federal, and any other authorities having jurisdiction over such work. The Contractor shall immediately notify the Owner and Consultant and shall maintain written evidence of such inspection for review by the Owner and Consultant.

C. The Contractor shall incur the cost of all fines resulting from regulatory non-compliance as issued by federal, state, and local agencies. The Contractor shall incur the cost of all work requirements mandated by federal, state, and local agencies as a result of regulatory non-compliance or negligence.

D. The Contractor shall immediately notify the Owner and Consultant of the delivery of all permits, licenses, certificates of inspection, approval or occupancy, etc., and any other such instruments required under codes by authorities having jurisdiction, regardless of to who issued, and shall cause them to be displayed to the Owner and Consultant for verification and recording.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The Contractor shall present a working schedule to the Owner. Variations, amendments, and corrections to the schedule will be discussed, and the Owner will inform the Contractor of additions or changes in the scheduling requirements for the project.

B. The Contractor shall submit any revised schedule no later than three days following initial schedule submission. Upon approval from the Owner, the Contractor will receive a "Notice to Proceed" with the work of the Contract.

C. Any subsequent changes in the work schedule must be approved by the Owner

D. Refer to all other applicable sections of the specification for coordination with other trades. The Contractor shall coordinate work with all other activities at this occupied site.

1.2 TIME FOR COMPLETION AND WORKING HOURS

A. Upon award of contract from the Owner, the Contractor shall immediately file notification to CTDPH and provide a copy of notification to Owner, order materials, supplies, and components for the work of this project.

B. The Contractor shall begin the work immediately upon receipt of the written "Notice to Proceed" from the Owner. The date of the commencement of the work is termed the "Abatement Start Date." The Contractor will be required to complete all work of this Contract within the time period stipulated in the finalized schedule. The last day in the schedule is termed as "Contract Completion Date".

C. If conditions arise that are beyond the control of the Contractor and force delays in the performance of the Work, the Owner shall immediately be notified. The Contractor shall state the reason for the delay and shall estimate the expected duration of the delay. Any application for an extension of the Contract completion date shall be made under proper change order procedures. The acceptance of the cause for delay and change order is subject to the Owner's review and approval.

D. Work hours will be established in coordination with the Owner.

E. Any extra hours or days per week worked by the Contractor or Sub-Contractors shall be at no extra cost to the Owner. Denial of extra hours or days per week by the Owner shall not be grounds for extra time allotted to the overall Contract time.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

PART 1 – GENERAL

1.1 SUMMARY

A. A unit price is an amount proposed by the Contractor and stated on the proposal as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by Change Order in the event the project Scope of Work is altered.

B. Unit prices include material, any direct or indirect expenses of the Contractor or Sub-Contractor, profit, insurance, bonding, and any applicable taxes. The same unit price shall apply whether the work is added or deducted.

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 FINAL CLEANING

A. Unless otherwise specified under Sections of this Specification, the Contractor shall perform final cleaning operations specified prior to final inspection.

B. Maintain the project site free from accumulations of waste, debris and rubbish caused by operations. At the completion of the work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces; leave the project clean and ready for work of others under separate contract.

C. Cleaning shall include all surfaces, interior and exterior, in which the Contractor has had access.

D. Use only those materials that will not create hazards to health or property.

1.3 ABATEMENT CLOSEOUT DOCUMENTS

A. Submit to the Owner, final completed copies of the Waste Shipment Records, signed by all transporters and the designated disposal site owner/operator.

B. Submit to the Consultant, copies of all notifications & permits and all worker certifications (certificates, training, medical, and fit-test).

C. The Contractor must be able to provide Certified Payroll documentation to Orange Board of Education, or its Representative or Project Auditors upon formal request.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

DIVISION II

SPECIAL CONDITIONS

FOREWORD

Supplementing Division I of the Specifications for the work to be performed under this Contract, DIVISION II, SPECIAL CONDITIONS, shall apply particularly to this Contract.

The enforcement of the requirements of any of the Special Conditions shall not be construed as waiving any of the rights of the Owner, contained in any of the other provisions of the Contract.

The Contract documents, including without limitation, these Special Conditions, shall be interpreted and construed as far as is reasonably possible to be in addition to, supplementary to and consistent with each other.

PART 1 - GENERAL

1.1 SUMMARY

A. Provide selective demolition as necessary to remove existing plumbing and electrical as required for the removal of the boilers.

B. Boiler sections and any metal components removed during abatement shall be reserved as property of the Town of Orange BOE.

C. Boiler pads shall be left in place for reuse.

1.2 PROJECT CONDITIONS

A. Occupancy:

1. Areas of the building in which selective demolition will occur will be unoccupied during work.

B. Existing Conditions:

1. After the project has begun, the Contractor is responsible for the condition of the structures to be selectively demolished.

2. Unforeseen Conditions: Should unforeseen conditions be encountered that affect design or function of project, investigate and fully submit an accurate, detailed, written report to the office of the Owner/Consultant. While awaiting a response, reschedule operations if necessary to avoid delay of the overall project.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and sealed.

B. As practicable, arrange operations to reveal unknown or concealed conditions for examination and verification before removal or demolition.

C. Verify actual conditions to determine, in advance, whether removal or demolition of any element will result in structural deficiency, overloading, failure, or unplanned collapse.

1. Demolish and remove connections to all electrical and plumbing fixtures required to remove asbestos-containing materials.

3.2 PREPARATION

A. Traffic:

1. Do not obstruct walks or public ways without the written permission of governing authorities and of the Owner. Where routes are permitted to be closed, provide alternate routes, if required.

B. Protection:

1. Provide for the protection of persons passing around or through the area of demolition.
2. Perform demolition so as to prevent damage to adjacent improvements and facilities to remain.
3. Protect walls, floors, and other new or existing work from damage during demolition operations.

3.3 POLLUTION CONTROLS

A. Control as much as practicable the spread of dust and dirt.

B. Observe environmental regulations.

C. Do not allow water usage that may result in freezing or flooding.

D. Do not allow adjacent improvements to remain to become soiled by demolition operations.

3.4 DEMOLITION - GENERAL

Not Applicable.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. Promptly dispose of materials resulting from demolition operations. Non-contaminated material shall be disposed of as general waste or recycled as applicable. Do not allow materials to accumulate on site.

B. All rubbish and waste material from the Work shall be neatly stacked or kept in suitable containers and removed from the premises daily. The premises shall be kept clean and in an orderly condition at all times to the satisfaction of the Owner and the Consultant.

C. Transport materials resulting from demolition operations and legally dispose of off-site.

D. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

3.6 CLEANING

A. Throughout the construction period, the Contractor shall maintain the building and site free of rubbish, debris, surplus materials, and other items not required for the Work. Remove such material from the site daily to prevent accumulations. Remove all construction debris from work areas, and remove all hazardous waste and asbestos waste, as required, by the most current federal, state, and local regulations and the requirements of the specifications.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General Provisions of Contract, including Supplementary Conditions and other Division 1 Sections, apply to this Section.

B. Refer to other Sections of these Specifications to determine the type and extent of work therein affecting the work of this Section, whether or not such work is specifically mentioned herein.

1.2 SCOPE OF WORK

A. Work outlined in this section includes all that is necessary for the complete removal and disposal of asbestos-containing and asbestos-contaminated materials (ACM) identified in the areas as detailed below for Race Brook School Boiler Room. The Contractor is responsible for verification of all quantities of ACM scheduled for removal. This verification shall include an on-site walk-through inspection of the work area. **All fiberglass duct, fiberglass flue/exhaust, and fiberglass pipe & fitting insulation throughout Boiler Room shall be removed during abatement project along with any mudded hangers that are encountered and disposed of as asbestos waste.** Any mercury containing switches and/or gauges discovered during project shall be removed and disposed of by the Contractor in accordance with all applicable State and Federal Regulations.

TABLE 1: LIST OF ACM

MATERIAL	LOCATION	ESTIMATED QUANTITY
Boiler components	Assumed present throughout interior of each boiler unit	2 boiler units
Boiler exhaust/flue insulation	Rear of each boiler throughout southwest portion of Boiler Room	35 linear feet
White pipe seam sealant assoc. w/ fiberglass pipe insulation	Throughout entire Boiler Room	125 linear feet
Brown duct mastic daubs (beneath fiberglass insulation)		25 square feet

1.3 DEFINITIONS

The following definitions relative to asbestos abatement apply:

1. ABATEMENT - Procedures to control fiber releases from asbestos-containing materials; includes removal, encapsulation, and enclosure.

2. AIR MONITORING - The process of measuring the airborne fiber concentration within an area or within a person's breathing zone.

3. AMENDED WATER - Water to which a surfactant has been added.

4. ASBESTOS - The name given to a number of naturally occurring fibrous silicates. This includes the serpentine forms and the amphiboles and includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite, or any of these forms, which have been chemically altered.

5. ASBESTOS PROJECT MONITOR (APM) - A professional capable of conducting air monitoring and analysis of samples for airborne fiber concentrations. This individual should be an industrial hygienist, an environmental scientist, or an engineer with experience in asbestos air monitoring and worker protection equipment and procedures. This individual should have demonstrated proficiency in conducting air sample collection in accordance with 29 CFR 1910.1001 and 29 CFR 1926.1101.

6. ASBESTOS WORK AREA - a regulated area as defined by OSHA 29 CFR 1926.1101 where asbestos abatement operations are performed which is isolated by physical barriers to prevent the spread of asbestos dust, fibers, or debris. The regulated area shall comply with requirements of regulated area for demarcation, access, respirators, prohibited activities, competent persons and exposure assessments and monitoring.

7. ASBESTOS FELT – a product made by saturating felted asbestos with asphalt or other suitable binder, such as a synthetic elastomer.

8. ASBESTOS FIBERS – Those asbestos particles with a length greater than five (5) microns and a length to diameter ratio of 3:1 or greater.

9. ASPHALT SHINGLES, COMPOSITION SHINGLES OR STRIP SLATES – (Pitched Roof Shingle): a roofing material manufactured by saturating a dry felt with asphalt then coating the saturated felt with a harder asphalt mixed with a fine mineral, glass fiber, asbestos or organic stabilizer. All or part of the weather side may be covered with mineral granules, or with powdered talc or mica.

10. BASE FLASHING (ROOF) – the flashing provided by upturned edges of a watertight membrane on a roof. May contain metal and associated waterproofing material or combination of roofing felts and waterproofing at the joint between a roofing surface and a vertical surface such as a wall or parapet. Also base flashing may be present at perimeter of completely flat roofing.

11. BUILT-UP ROOFING – Composition Roofing, Felt and Gravel Roofing, Gravel Roofing) - a continuous roof covering made up of laminations or plies of saturated or coated roofing felts, alternated with layers of asphalt or coal-tar pitch and surfaced with gravel, paint or finish coat.

12. CAULKING - resilient mastic compound often having a silicone bituminous or rubber base. Used to seal cracks, fill joints and prevent leakage. Typical applications: around windows and doors, at joints between two dissimilar materials. (i.e. masonry to wood, masonry to steel etc.).

13. CLEAN ROOM - An uncontaminated area or room, which is a part of the worker decontamination enclosure with provisions for storage of workers' street clothes and protective equipment.

14. CLEARANCE SAMPLING - Final air sampling performed aggressively after the completion of the abatement project in a regulated area. Clearance sampling can be conducted by either of the following two methods:

    (A) Air samples collected by the air sampling professional having a fiber concentration of less than 0.01 fibers/cc of air in each of five (5) samples collected inside the containment will denote acceptable clearance sampling by Phase Contrast Microscopy (PCM).

    (B) Five air samples collected inside the containment by the air sampling professional having an average asbestos concentration of less than 70 structures per square millimeter of air will denote acceptable clearance sampling for Transmission Electron Microscopy (TEM).

15. COMPETENT PERSON - As defined by 29 CFR 1926.1101, a representative of the Abatement Contractor who is capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure. In addition has authority to take prompt corrective measures to eliminate such hazards during asbestos removal. Competent person shall be properly trained in accordance with Environmental Protection Agency's (EPA) Model Accreditation Plan.

16. CURTAINED DOORWAY - A device to allow ingress and egress from one area to another while permitting minimal air movement between the areas. Two curtained doorways spaced a minimum of six feet apart can form an airlock.

17. DAMP PROOFING - application of a water impervious material to surface such as wall to prevent penetration of moisture, typically at foundation or below grade surface.

18. DECONTAMINATION ENCLOSURE SYSTEM - A series of connected areas, with curtained doorways between any two adjacent areas, for the decontamination of workers and equipment. A decontamination enclosure system always contains at least one airlock and is adjacent and connected to the regulated area, where possible.

19. ENCAPSULANT - A liquid material which can be applied to asbestos-containing materials which controls the possible release of asbestos fibers from the materials either by creating a membrane over the surface (bridging encapsulant) or penetrating the material and binding its components together (penetrating encapsulant).

20. EQUIPMENT ROOM – Any contaminated area or a room that is part of the worker decontamination enclosure with provisions for storage of contaminated clothing and equipment.

21. FIXED OBJECT - Unit of equipment or furniture in the work areas that cannot be removed from the work area.

22. FRIABLE ASBESTOS MATERIALS - Any material that contains more than 1% asbestos by weight, that can be crumbled, pulverized or reduced to powder by hand pressure.

23. GLAZING COMPOUND - any compound used to hold window glass in place, also referred to as putty, or glaziers' putty. Is not field-applied, usually installed during manufacture of windows.

24. GLOVE BAG - A manufactured polyethylene bag type of enclosure with built-in gloves such as is placed with an airtight seal around asbestos-containing material and which permits the asbestos-containing materials contained by the bag to be removed without releasing asbestos fibers to the atmosphere. The use of glove bag is permitted for removal and repair of small amount (less than 3 linear feet/3 square feet) of ACM.

25. HEPA FILTER - High Efficiency Particulate Air (HEPA) filter in compliance with ANSI Z9.2-1979.

26. HEPA VACUUM EQUIPMENT - Vacuum equipment equipped with a HEPA filter system for filtering the effluent air from the unit.

27. MOVABLE OBJECT - Unit of equipment or furniture in the work area that can be removed from the work area.

28. NEGATIVE AIR PRESSURE EQUIPMENT - A portable local exhaust ventilation system equipped with HEPA filtration used to create negative pressure in a regulated area (negative with respect to adjacent unregulated areas) and capable of maintaining a constant, low velocity air flow into regulated areas from adjacent unregulated areas.

29. NESHAPS - National Emissions Standard for Hazardous Air Pollutants regulations enforced by the EPA.

30. PERMISSIBLE EXPOSURE LEVEL (PEL) - The average airborne concentration of asbestos fibers to which an employee is allowed to be exposed over an eight-hour period. The PEL established by OSHA 29 CFR 1926.1101 is 0.1 fibers per cubic centimeter of air averaged over an eight-hour time period. An airborne fiber concentration of 1.0 fibers /cc averaged over a sampling period of 30 minutes is the Excursion Limit. The Contractor is responsible for maintaining work areas in a manner that this standard is not exceeded.

31. REGULATED AREA - An area established by the employer to demarcate where Class I, II, and III asbestos work is conducted and any adjoining area where debris and waste from such asbestos work accumulate, and a work area within which airborne concentrations of asbestos fibers may exceed the PEL.

32. SHOWER ROOM - A room between the clean room and the equipment room in the work decontamination enclosure with hot and cold running water and suitably arranged for employee showering during decontamination. The shower room is located in an airlock between the contaminated area and the clean area.

33. WATERPROOFING - material, usually a membrane or applied compound (tar/mastic), used to make a surface impervious to water. Includes concealed conditions (applications around doors, windows, and in wall cavities), sometimes combined with felts.

1.4 SUBMITTALS

A. The Contractor shall submit the following to the Owner/Consultant prior to the start of the project:

1. Evidence that the Contractor is certified to perform asbestos abatement work in the State of Connecticut.

2. Schedule to the Owner and the Consultant, which defines a timetable for executing and completing the project, including set-up, removal, cleanup, decontamination, and air clearance monitoring.

3. The identity and licensing of the hauling contractor and the landfill to be used.

4. Plans and construction details for the construction of the decontamination enclosure systems and the isolation of the work areas as may be necessary for compliance with this specification and applicable regulations.

5. Connecticut certificate of training (both initial and current refresher), current respirator fit test records, and current medical records for each employee who may be on the project site. No individual shall provide services as an asbestos abatement site supervisor or as an asbestos abatement worker without a license to do so issued by the CTDPH.

6. Detailed product information on all materials and equipment proposed for asbestos abatement work on this project.

7. Pertinent information regarding the qualifications of the Project Supervisor (Competent Person) for this project as well as a list of past projects supervised by the person.

B. The following shall be submitted to the Consultant during the work:

1. Training, State certification, respirator fit test, and medical records for employees to start work.

2. Signed copy of the Certificate of Workers Acknowledgment found at the end of this section for each worker who is to be at job site.

C. The following shall be submitted to the Owner at the completion of work:

1. Completed Punch List.

2. Completed copies of Waste Shipment Records (WSR).

1.5 REGULATIONS AND STANDARDS

A. The Contractor shall be solely responsible for conducting this project and supervising all work in a manner which will be in conformance with all federal, state, and local regulations and guidelines pertaining to asbestos abatement. Specifically, the Contractor shall comply with the requirements of the following:

1. U.S. Environmental Protection Agency (USEPA) National Emissions Standards for Hazardous Air Pollutants (NESHAP) Regulations (40 CFR 61, Subpart M);

2. USEPA Asbestos-Containing Materials in Schools Regulations (40 CFR Part 763, Final Rule and Notices);

3. Occupational Safety and Health Administration (OSHA) Asbestos Regulations (29 CFR 1910.1001 and 1926.1101);

4. State of Connecticut Department of Public Health (CTDPH) Standards for Asbestos Abatement Sections 19a-332a-1 through 19a-332a-16 inclusive and Sections 20-440-1 through 20-440-9 inclusive;

5. CTDPH Asbestos-Containing Materials in schools regulations 19a-333-1 through 19a-333-13;

6. State of Connecticut Department of Energy & Environmental Protection (CTDEEP) Regulations, Section 22a-209-8(i) and Section 22a-220 of the Connecticut General Statute.

7. Connecticut Basic Building Code (BOCA)

8. National Fire Protection Association (NFPA) Life Safety Code;

9. Local health and safety codes, ordinances or regulations pertaining to asbestos abatement and all national codes and standards including Association for Standards of Testing and Materials (ASTM), American National Standards Institute (ANSI), and Underwriter's Laboratories (UL).

10. Occupational Safety and Health Administration (OSHA) (29 CFR 1910 Subpart D) and (29 CFR 1926 Subpart M) Fall Protection.

1.6 EXEMPTIONS

A. Any deviations from these Specifications require the written approval and authorization from the Owner and Consultant.

B. Any deviation in work practices identified in CTDPH Standards for Asbestos Abatement, Sections 19a-332a-1 to 19a-332a-23, Sections 19a-333-1 through 19a-333-13, Sections 20-440-1 to 20-440-9, Section 20-441, and Section 19a-332e-1 to 19a-332e-2, <u>must</u> be requested in writing and approved in writing by the CTDPH.

1.7 FINAL VISUAL INSPECTION AND CLEARANCE AIR SAMPLING

A. Following the completion of the final cleaning phase of the work in a contained work area, the Consultant shall conduct a final visual inspection of the area. The Contractor shall be responsible for meeting final visual criteria, which is the absence of visible debris, as specified in CTDPH regulation 19a-332a-12(b).

B. Following the completion of the final visual inspection, and upon which time the Consultant agrees that the Contractor has met the final visual criteria and the work area has been encapsulated, the Consultant will collect final clearance air samples in work area(s) as required. The Owner shall be responsible for payment of the sampling and analysis of the first round of final air clearance samples only for a particular work area. The Contractor shall be responsible for payment of all costs associated with the collection and analysis of additional final air clearance samples if the first round samples fail to meet the designated clearance criteria of 0.010 fibers/cubic centimeter (f/cc) by phase contrast microscopy (PCM) or <70 structures per square millimeter (s/mm) by transmission electron microscopy (TEM).

1.8 NOTIFICATIONS, POSTINGS, SUBMITTALS, AND PERMITS

A. The Contractor shall make the following notifications and provide submittals to the following agencies prior to the commencement of removal work. This notification is required ten (10) calendar days prior to the start of the abatement project:

1. State of Connecticut
   Department of Public Health
   Indoor Air Program
   410 Capitol Avenue
   P.O. Box 340308
   Hartford, CT 06134-0308

   Note: Satisfies the requirement to notify the EPA (except when the amount of ACM to be abated is less than 10 linear/25 square feet or when the work involves demolition with zero asbestos. EPA needs to be notified directly in those situations)

B. The minimum information included in the notification to these agencies includes:

1. Name and address of site owner/operator.

2. Site location.

3. Amount of friable and non-friable asbestos-containing materials to be removed.

4. Work schedule, including proposed start and completion dates.

5. Asbestos removal procedures to be used.

6. Name and location of disposal site for generated asbestos waste, residue, and debris.

1.9 WORK SITE SAFETY PLAN

A. The Contractor shall establish a set of emergency procedures and shall post them in a conspicuous place at the work site. The safety plan should include provisions for the following:

1. Evacuation of injured workers.

2. Emergency and fire exit routes from all work areas.

3. Emergency first aid treatment.

4. Local telephone numbers for emergency services including ambulance, fire, and police.

5. Methods to notify appropriate personnel in the event of a fire or other emergency requiring evacuation of the site or area.

6. Site safety plan for fall protection.

B. The Contractor is responsible for training all workers in these procedures.

1.10 CONTROL OVER REMOVAL WORK

A. At the discretion of the owner, all work procedures shall be continuously monitored by the Consultant's Asbestos Project Monitor (APM) to determine that areas outside the designated work area(s) have not been contaminated.

B. Prior to work on any given day, the Contractor's designated "Competent Person" shall discuss the day's work schedule with the APM to evaluate job tasks with respect to safety procedures and requirements specified to prevent contamination outside the work area. This includes a visual survey of the work area(s) and the decontamination enclosure systems.

C. The Contractor shall maintain control of and be responsible for access to all work areas to ensure the following requirements:

1. Non-essential personnel are prohibited from entering the area.

2. All authorized personnel entering the work area shall read the "Worker Protection Procedures" which are posted at the entry points to the enclosure system, and shall be equipped with properly fitted respirators and protective clothing.

3. All personnel who are exiting from the decontamination enclosure system shall be properly decontaminated.

4. Asbestos waste that is taken out of the work area must be properly bagged and labeled in accordance with these specifications. The surface of the bags shall be decontaminated. Asbestos waste leaving the enclosure system must be immediately transported off site or immediately placed in locked, posted temporary storage on site, and removed within 24 hours of the project conclusion. The Contractor will seek permission of the Owner to place a temporary dumpster at a suitable location.

5. Any material, equipment, or supplies that are brought out of the decontamination enclosure system shall be cleaned and decontaminated by wet cleaning and/or HEPA vacuuming of all surfaces.

1.11 PROPER WORKER PROTECTION

A. This section describes the equipment and procedures required for protecting workers against asbestos contamination and other workplace hazards except for respiratory protection.

B. All workers are to be accredited and certified as Asbestos Abatement Workers as required by the CTDPH.

C. The Contractor is required to be certified, accredited, and licensed as required by the CTDPH.

D. In accordance with 29 CFR 1926.1101, all workers shall receive a training course covering the dangers inherent in handling asbestos, the dangers of breathing asbestos dust, proper work procedures, and proper worker protective measures. This course must include but is not limited to the following:

1. Methods of recognizing asbestos.

2. Health effects associated with asbestos.

3. Relationship between smoking and asbestos in producing lung cancer.

4. Nature of operations that could result in exposure to asbestos.

5. Importance of and instruction in the use of necessary protective controls, practices and procedures to minimize exposure including:
   a. Engineering controls
   b. Work practices
   c. Respirators

d. Housekeeping procedures
e. Hygiene facilities
f. Protective clothing
g. Decontamination procedures
h. Emergency procedures
i. Waste disposal procedures

6. Purpose, proper use, fitting, instructions, and limitations of respirators as required by 29 CFR 1910.134.

7. Appropriate work practices for the work.

8. Requirements of medical surveillance program.

9. Review of 29 CFR 1926.

10. Pressure differential systems.

11. Work practices including hands on or on-job training.

12. Personal Decontamination procedures.

13. Air monitoring, personal and area.

E. The Contractor shall provide medical examinations for all workers who may encounter an airborne fiber level of 0.1 f/cc or greater for an eight-hour Time Weighted Average (TWA). In the absence of specific airborne fiber data, provide medical examinations for all workers who will enter the work area for any reason. Examination shall at a minimum meet OSHA requirements as set forth in 29 CFR 1926.1101. In addition, provide an evaluation of the individual's ability to work in environments capable of producing heat stress in the worker.

F. Submit the following to the Consultant for review. The Contractor shall not start work until the Consultant reviews the submittals and indicates that they are acceptable.

1. Certificates from an EPA-approved AHERA Abatement Workers course for each worker as evidence that each Asbestos Abatement Worker is accredited as required by the AHERA Regulation 40 CFR 763 Appendix C to Subpart E, April 30, 1987.

2. Evidence that the Contractor is certified to perform asbestos abatement work by the State of Connecticut Department of Public Health.

3. An original signed copy of the Certificate of Worker's Acknowledgment found at the end of this section, for each worker who is to be at the job site or enter the Work Area.

4. Documents verifying that each worker has had a medical examination within the last 12 months as part of compliance with OSHA medical surveillance requirements. Submit, at a minimum, for each worker the following:
   a. Name and Social Security Number.
   b. Physicians Written Opinion from examining physician including at a minimum the following:
      1) Whether worker has any detected medical conditions that would place the worker at an increased risk of material health impairment from exposure to asbestos.
      2) Any recommended limitations on the worker or on the use of personal protective equipment such as respirators.
      3) Statement that the worker has been informed by the physician of the results of the medical examination and of any medical conditions that may result from asbestos exposure.

5. Information that was provided to physician in compliance with 29 CFR 1926.1101.

6. A statement that the worker is able to wear and use the type of respiratory protection proposed for the project, and is able to work safely in an environment capable of producing heat/cold stress in the worker.

G. Certification signed by an officer of the company and notarized which states that exposure measurements, medical surveillance, and worker training records are being kept in conformance with the requirements of OSHA 29 CFR 1926.

1.12 CONTRACTOR'S AIR SAMPLING RESPONSIBILITY

A. The Contractor shall be responsible for monitoring airborne asbestos fiber concentrations in the workers' breathing zones and to establish conditions and work procedures for maintaining compliance with OSHA Regulations 29 CFR 1910.1001, and 1926.1101.

B. The Contractor's air sampling procedures shall ensure proper documentation of all personal air-sampling results. The Contractor shall provide a report of the results to the Consultant within 48 hours after sample collection. Documentation for personal sampling must be available at the job site for review by federal and/or state regulatory agencies.

C. All air sampling shall be conducted in accordance with methods described in OSHA Standards 29 CFR 1910.1001 and 1926.1101. The flow rate for air samples will not be less than 0.5 liters/minute and must not exceed 2.5 liters/minute.

1.13 RESTRICTIONS ON CONTRACTOR'S USE OF GROUNDS

A. The Contractor shall confine his/her operations to the actual work site, access routes and storage areas designated by the Owner. The Contractor may place a dumpster at a place designated by the Owner.

B. The Contractor shall have sole responsibility for providing all materials, equipment, or tools and any storage required shall be at the Contractor's own risk. The Owner will not assume responsibility for any loss of materials, equipment, or tools stored on its property.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name and product technical description.

B. Damaged or deteriorating materials shall not be used and shall be removed from the premises. Material that becomes contaminated with asbestos shall be decontaminated or disposed of as asbestos waste.

C. Polyethylene sheet in a roll size to minimize the frequency of joints shall be delivered to the job site with factory label indicating 4 or 6 mil thickness.

D. Polyethylene disposable bags shall be six (6) mil thick with pre-printed labels.

E. Tape and adhesive spray will be capable of sealing joints in adjacent polyethylene sheets and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water.

F. Surfactant (wetting agent), shall consist of fifty (50) percent polyoxyethylene ether and fifty (50) percent polyoxyethylene ester, or equivalent, and shall be mixed with water to provide a concentration of one (1) ounce surfactant to five (5) gallons of water or as directed by manufacturer.

G. Removal encapsulant shall be non-flammable factory prepared penetrating chemical encapsulant found acceptable to Consultant. Usage shall be in accordance with manufacturer's printed technical data.

H. The Contractor shall have available spray equipment capable of mixing wetting agent with water and capable of generating sufficient pressure and volume and having sufficient hose length to reach all areas where asbestos is present.

I. Impermeable containers are to be used to receive and retain any asbestos- containing or contaminated materials until disposal at an acceptable disposal site. (The containers shall be labeled in accordance with OSHA Standard 29 CFR 1926.1101) Containers must be both air and watertight.

J. Labels and signs, as required by OSHA Standard 29 CFR 1926.1101 will be used.

K. Encapsulant shall be bridging or penetrating type which has been found acceptable to the Consultant. Usage shall be in accordance with manufacturer's printed technical data.

L. A high efficiency particulate air (HEPA)-filtered local exhaust ventilation shall be utilized during the installation of enclosures and supports where asbestos-containing materials may be disturbed.

2.2 TOOLS AND EQUIPMENT

A. The Contractor shall provide all tools and equipment necessary for asbestos removal.

B. The Contractor's air monitoring professional shall have air-monitoring equipment of type and quantity to monitor operations and conduct personal exposure monitoring per OSHA requirements.

C. The Contractor shall have available sufficient inventory of dated purchase orders for materials necessary for the job including protective clothing, respirators, filter cartridges, polyethylene sheeting of proper size and thickness, tape and air filters.

D. The Contractor shall have available power cables or power sources such as generators (where required).

E. Exhaust air filtration system units shall contain HEPA filter(s) capable of sufficient air exhaust to create negative pressure of at least 0.02 inches of water column within each enclosure with respect to outside areas. Equipment shall be checked for proper operation by smoke tubes or differential pressure gauge before the start of each shift and at least twice during the shift. Adequate exhaust air shall be provided for a minimum of four (4) air changes per hour within the enclosure. No air movement system or air filtering equipment shall discharge unfiltered air outside, nor shall filtered air units be exhausted indoors from the work area.

F. Vacuum units, of suitable size and capacities for the project, shall have HEPA filter(s) capable of trapping and retaining at lead 99.97 percent of all monodispersed particles of 0.3 micrometers in diameter or larger.

G. The Contractor will have reserve units so that the exhaust air filtration system will operate continuously.

2.3 ELECTRICAL

A. All electrical installations shall be accomplished under the direction of a Licensed Electrician.

B. The Contractor shall furnish and install a portable ground fault circuit interrupter (GFCI) Power Supply Board and receptacles including the following:

1. All circuits individually GFCI-protected.

2. Weatherproof enclosure NEMA 3 (rain-tight) with receptacle covers.

3. Construction durable, 16-gauge steel construction.

4. At least two 20-amp circuits (for APM).

5. Main circuit breaker.

6. Components UL listed.

C. The Decontamination Facility shall be furnished with a power supply board with one 20-amp circuit for the APM.

D. The Contractor shall furnish and install wiring as follows:

1. Each 20-amp circuit provided for the APM shall have one run of 20-amp duplex outlets (watertight) each on 100 feet of No. 12 SO cord.

2. Size the wire to limit voltage drop to a maximum of 3% with length of run.

E. The Contractor will supply temporary lighting for all abatement work areas.

F. The Contractor will de-energize, lockout, and tag existing electrical components within the work area at their closest main source.

G. The Owner will furnish electrical power for the project.

PART 3 - EXECUTION

3.1 WORKER PROTECTION

A. General:

1. All asbestos abatement work shall be performed in accordance with 29 CFR 1910.1001, 29 CFR 1926.1101 and State of Connecticut regulations as specified herein. Personnel shall wear and utilize protective clothing and equipment as specified herein. Eating, smoking, drinking, chewing gum, or applying cosmetics shall not be permitted in the asbestos control area. Personnel of other trades not engaged in the abatement of asbestos shall not be allowed in the work area unless all the personnel protection provisions of this Specification are complied with by the trade personnel.

2. Engineering controls shall be used to minimize airborne fiber concentrations within the work area. A combination of personal protective equipment and work practices shall also be used to further reduce employee exposure to asbestos fibers.

3. The Contractor shall provide all authorized visitors with respirators, new filters, protective clothing, headgear, eye protection, footwear, and hard hats as in the procedures described herein and afford them the use of all facilities to keep them free of contamination from asbestos fibers.

4. The Contractor shall provide the decontamination facility for worker and equipment decontamination as well as the results of the personal air monitoring.

B. Respiratory Protection:

1. The Contractor shall select and provide at no cost to his/her employees respirators, which shall provide adequate protection to the employee as specified by Section 1910.1001(g) Table D-1 and Section 1926.1101(h) Table D-4.

2. Respiratory protection shall be worn by all persons potentially exposed to elevated airborne concentrations of asbestos fibers from the initiation of the asbestos abatement project until all areas have been given clearance. Clearance shall be conducted by the APM.

3. The Contractor shall provide Powered Air Purifying Respirators (PAPR) or Type C (continuous flow or pressure demand) supplied air respirators. respirators to all workers at the job site. If it is established, through collection and analysis of personal air samples in accordance with the OSHA Reference

Method (ORM) (See U.S. Department of Labor; Occupational Safety and Health Administration; Occupational Exposure to Asbestos; Title 29 CFR 1910.1001, "General Industry Standard." Title 29 CFR 1926.1101, "Construction Standard") that this respiratory protection is more than sufficient the Contractor may provide half face-piece air purifying respirators.

a. Once the exposure limits have been established, the respirators presented in 29 CFR 1910.1001 that afford adequate protection at such upper concentrations of airborne asbestos fibers shall be used.

b. The minimum personal sampling period shall be seven hours at a flow rate of 0.5 to 2.5 liters per minute. The samples shall be collected within the workers' breathing zone. Personal sampling shall be the responsibility of the Contractor. Personal sampling results shall be available on site no later than 24 hours after sampling.

c. The filters provided for both the cartridge respirators and the PAPR's shall be National Institute for Occupational Safety and Health (NIOSH) approved for asbestos fibers.

C. Protective Clothing:

1. The Contractor shall provide to all workers, foreman and superintendents, protective disposable clothing consisting of full body coveralls, head covers, and 18-inch high boot type covers or reusable footwear.

2. The Contractor shall provide eye protection and hard hats, as required, by job conditions and safety regulations.

3. Reusable footwear, hard hats and eye protection devices shall be left in the "contaminated equipment room" until the end of the asbestos abatement work.

4. Upon completion of asbestos abatement work, the footwear shall be disposed of as contaminated waste or cleaned thoroughly inside and out using soap and water before removing from work area or from equipment and access area.

5. All disposable protective clothing shall be discarded and disposed of as asbestos waste when the wearer exits from the workspace to the outside through the decontamination facilities.

6. The color of the disposable clothing worn outside the work area shall be a different color than the disposable clothing worn inside the work area.

D. Decontamination Procedures:

1. Each worker and authorized visitor without exception shall, upon entering the job site: remove street clothes in the clean change room and put on an appropriate respirator with new filters, and clean disposable protective clothing before entering the equipment room or the work area, except that workers intending to re-wear previously worn protective clothing stored in the equipment room shall enter the equipment room wearing only respirators.

2. Each time he/she leaves the work area, each worker and authorized visitor shall:

   a. Vacuum gross contamination from clothing before leaving the work area.

   b. Proceed to the equipment room and remove all clothing except respirator.

   c. Still wearing the respirator, proceed unclothed into the showers.

   d. Clean the outside of the respirator with soap and water while showering.

   e. Remove filters, wet them, and dispose of filters in the container provided for that purpose.

   f. Wash and rinse the inside of the respirator. After showering, dry off with disposable towels.

3. Following showering and drying off, each worker and authorized visitor shall proceed directly to the clean change room and dress in street clothes at the end of the day's work, or before eating, smoking, or drinking.

4. Contaminated reusable work footwear shall be stored in the equipment room when not in use in the work area. Upon completion of asbestos abatement work, footwear shall be disposed of as contaminated waste or cleaned inside and out using soap and water before removing these items from the work area or from the equipment and access area. Contaminated protective clothing shall be stored in the equipment room for reuse or placed in receptacles for disposal with other asbestos-contaminated materials.

3.2 WORK AREA PREPARATION

A. Where necessary, within regulated areas, shut down electrical power, including receptacles and light fixtures. Under no circumstances during the abatement process will existing lighting fixtures inside the regulated area be permitted to be operating. Provide GFCI devices, temporary power, and temporary lighting installed in compliance with the applicable electrical codes and by a licensed electrician.

B. Shut down and/or isolate heating, cooling, and ventilation air systems or zones to prevent contamination and fiber dispersal to other areas of the structure. During the work, vents within the work area shall be sealed with duct tape and polyethylene sheeting.

C. Seal off all openings, including, but not limited to, windows, corridors, doorways, skylights, ducts, grills, diffusers, and any other penetration of the work areas, with polyethylene sheeting a minimum of six (6) mil thick, sealed with duct tape.

D. Orange BOE employees shall remove moveable objects within the proposed work area to the extent possible before the work starts. The Contractor shall pre-clean the remaining moveable objects using HEPA vacuum equipment and/or wet cleaning methods as appropriate and remove such objects from work areas to a temporary location as assigned by the Owner.

E. Pre-clean fixed objects within the work areas, using HEPA vacuum equipment and/or wet cleaning methods as appropriate, and enclose with a minimum six (6) mil plastic sheeting sealed with duct tape.

F. Clean the proposed work areas using HEPA vacuum equipment or wet cleaning methods as appropriate. Do not use methods that raise dust, such as dry sweeping or vacuuming with equipment not equipped with HEPA filters.

G. After HEPA vacuum/wet cleaning, work area containment shall be constructed of a minimum of 2 layers of 6 mil polyethylene sheeting on the floors, and 2 layers of 4 mil sheeting on all walls. If Contractor elects to install ceiling of containment, one layer of 6 mil sheeting and a minimum of 2 layers of 4 mil sheeting shall be utilized.

H. Plywood, hardboard, or similar material should be placed on the floors to protect the poly sheeting from damage during demolition of the boilers. This material if porous must be disposed of as asbestos waste after removal procedures.

I. Install adequate number of HEPA ventilation units to achieve the required number of at least 4 air changes per hour and exhaust units to the exterior of the building.

3.3 DECONTAMINATION SYSTEM

A. The Contractor shall establish a decontamination enclosure (decon) contiguous to the work area consisting of equipment room, shower room, and clean room in series. The only access between contaminated and uncontaminated areas shall be through this decontamination enclosure.

B. Access between rooms in the decontamination system shall be through double-flap curtained openings. The clean room, shower room and the equipment room within the decontamination enclosure shall be completely sealed ensuring that the sole source of airflow through this area originates from uncontaminated areas outside the work area.

C. Construct the decontamination system with wood, metal, or other equivalent rigid framing and cover both sides with a double layer of six (6) mil polyethylene sheeting, spray glued or taped at the joints.

3.4 MAINTENANCE OF THE WORK AREA

A. Acceptance of Asbestos Control Area: The Contractor shall not begin removal unless the APM is in attendance. The control area must be constructed, the decontamination facility prepared and the supplies to be used assembled, barriers properly constructed, openings sealed, and other preparations made to allow the removal operation to proceed. If conditions are not acceptable, the Contractor shall correct deficiencies to comply with the specifications.

3.5 ASBESTOS REMOVAL PROCEDURE - GENERAL

A. The Contractor shall have a designated "Competent Person" on the job at all times to ensure establishment of a proper enclosure system and proper work practices throughout project.

B. Abatement work will not commence until authorized by on-site APM.

C. Spray asbestos materials with amended water using airless spray equipment or apply approved removal wetting agent to reduce the release of fibers during removal operation. The Consultant shall pre-approve the use of amended water as the wetting agent.

D. In order to maintain indoor airborne asbestos fiber concentrations to the minimum, the wet asbestos must be removed in manageable sections.

E. Remove <u>all</u> insulation from pipes, hangers, flue/exhaust, etc. throughout Boiler Room work area inside of negative pressure enclosure.

F. Fill disposal containers as removal proceeds, seal filled containers and clean containers before removal to equipment decontamination system. Wet clean each container thoroughly, double bag and apply caution label. Ensure that workers do not exit the work area thorough the equipment decontamination enclosure.

G. After completion of stripping work, all surfaces from which asbestos has been removed shall be wet brushed, using a nylon brush, wet wiped, and sponged or cleaned by an equivalent method to remove all visible material. During this work, the surfaces being cleaned shall be kept wet.

H. Remove and containerize all visible accumulations of asbestos-containing and/or asbestos-contaminated debris. During cleanup, utilize brooms, rubber dustpan, and rubber squeegees.

I. Sealed disposal containers, and all equipment used in the work area, shall be included in the cleanup and shall be removed from work areas via the equipment decontamination enclosure at an appropriate time in the cleaning sequence. All asbestos waste shall be placed in 6-mil polyethylene disposal bags and shall be double bagged in the equipment decontamination enclosure before removal from the site.

J. At any time during asbestos removal, should the APM suspect contamination of areas outside the work area(s), he/she shall cause all abatement work to stop until the Contractor takes steps to decontaminate these areas and eliminate the causes of such contamination. Unprotected individuals shall be prohibited from entering suspected contaminated areas until air sampling and visual inspections certify decontamination.

K. After completion of the initial final cleaning procedure but prior to encapsulation, a pre-sealant inspection shall be conducted by the Consultant. The pre-sealant inspection shall verify that ACM and residual dust has been removed from the work area.

3.6 ASBESTOS REMOVAL PROCEDURE – BOILERS & ASSOC. INSULATION

A. Prior to beginning the removal of boilers or associated materials, remove all movable objects from the work area.

B. Remove Boilers and associated insulation using the following procedure:

1. Wet all materials with amended water, removal encapsulant, or detergent solution, so that entire surface is wet. Do not allow puddle or run off to other areas. If a removal encapsulant is used, use in strict accordance with manufacturer's instructions.

2. Disconnect flue/exhaust and seal end/openings with 2 layers of 6 mil sheeting. Boiler flue/exhaust to be disposed of by others.

3. Keep materials continuously wet throughout removal operation. Continuously mist work area with amended water, removal encapsulant or detergent solution. Wet any debris generated as necessary to keep continuously wet.

4. Begin removal of asbestos materials.

5. After all accessible materials have been successfully removed including all mudded pipe fittings, boiler exhaust/flue insulation, hangers, etc.; the Contractor may begin to dismantle each of the two boilers.

6. Remove outer casing or access panels of each boiler.

7. Remove any materials that are exposed at this time as asbestos containing.

8. Unbolt or unfasten each section of boiler and carefully lower to floor.

9. Each section of boiler may be cleaned of any asbestos material; and removed from area if feasible, to remain in custody of Owner including all metal piping generated during project.

10. Any component that cannot be sufficiently cleaned must be disposed of as asbestos waste.

C. Debris and Waste

1. Whenever feasible, asbestos materials should be removed directly into labeled disposal bags. At the Contractor's option materials may be placed directly into durable leak-tight containers.

2. Shovel any debris into disposal bag, or place directly in steel leak-tight drums.

3. Place bagged waste in a second disposal bag during decontamination and dispose of as asbestos waste.

D. After completion of all boiler demolition work, the Contractor shall conduct final cleaning.

3.7 CONSULTANT AND SUSPENSION OF WORK

A. The Owner has designated FSS to perform the duties of the Consultant for this Contract. The Consultant will also act as the APM for the project.

B. The removal work shall be reviewed by the Consultant. The Contractor will request an inspection at least 24 hours in advance of requiring the inspection.

C. During the progress of the work, the Consultant, following approval by the Owner, shall have the right to make any changes, alterations, additions or omissions in the work or Specifications in accordance with the General Conditions.

D. The Consultant will recommend that the Owner order a suspension of work based on a determination of risk of adverse health and safety impacts on the environment, workers, or the general public, or failure to comply with the Specifications/regulations. The Contractor and the Owner will be notified in writing of the reason and of the recommended resolution.

E. The Consultant will provide oversight and visual inspection services throughout the Contract's duration. It shall be the Contractor's responsibility to comply with pertinent work standards and regulations.

F. The Consultant will conduct visual observations and perform inspections in work areas for evaluating that the work areas remain properly secured and isolated and specified work items are properly completed. Upon completion of work in a defined work area, the Consultant will conduct a final visual inspection for the purpose of evaluating work completion. Unsatisfactory conditions shall be immediately corrected in a manner specified by the Consultant and the contract documents. Final payments shall be approved only after the Owner receives all properly completed Waste Shipment Record Forms and other required documentation and records.

3.8 CONSULTANTS' AIR SAMPLING RESPONSIBILITIES

A. Air sampling shall be conducted by the Consultant to ascertain the integrity of controls that protect the building from asbestos contamination.

B. Consultant's APM shall collect and analyze air samples during the following time periods:

1. Pre-Abatement Period: The APM may collect samples prior to abatement work to establish baseline readings. These samples will be collected in and around the proposed work area. Pre-abatement air samples shall be collected as required to obtain a volume of 1,200 liters. Pre-abatement and during abatement Samples shall be analyzed by PCM methodology using the NIOSH 7400 protocol

2. Abatement Period: The APM will collect samples on a daily basis during the work period. A sufficient number of area samples shall be taken outside of the work area to judge the degree of cleanliness or contamination of the building during removal. Additional samples may be taken inside the work area at the discretion of the APM.

3. Post-Abatement Period: As required by the regulation, the APM shall conduct air sampling following the final cleanup phase of the project, once the "no visible residue" criterion, as established by the project monitor, has been met. Five (5) samples shall be collected inside the work area utilizing aggressive methods to comply with the State of Connecticut Department of Public Health Standards for Asbestos Abatement, sections 19a-332a-12, and 19a-332a-13 and United States Environmental Protection Agency (USEPA) Asbestos-Containing Materials in Schools regulation 40 CFR Part 763. Analysis of the samples to determine airborne concentrations of asbestos shall be conducted by Transmission Electron Microscopy (TEM) method with an upper limit of 70.0 structures per square millimeter (s/mm^2) as an average concentration of airborne fibers in five (5) samples in accordance with the above regulations.

C. The APM shall provide ongoing evaluation of the air quality within the building during removal, using his/her best professional judgments with respect to the State of Connecticut Department of Public Health guideline of 0.010 fibers/cc and the background air quality established during the pre-abatement period.

D. If the APM determines that the building air quality has become contaminated from the project, he/she shall immediately inform the Contractor to cease all removal operations and implement a work stoppage clean up procedure. The Contractor shall conduct a thorough cleanup of the areas of the building designated by the Consultant. No further removal work can take place until the APM has assessed that the building air has been decontaminated.

3.9 CONSULTANT'S INSPECTION RESPONSIBILITIES

A. Inspections shall be conducted by the APM throughout the progress of the abatement project. Inspections shall be conducted in order to document the progress of the abatement work as well as the procedures and practices employed by the Contractor.

B. The APM shall perform the following inspections during the course of abatement activities:

1. Pre-commencement Inspection. Pre-commencement inspections shall be performed at the time requested by the Contractor. The APM shall be informed sufficiently in advance of the time the inspection is needed. During the course of the pre-commencement inspection, the APM shall inspect the containment and surrounding work areas. This shall include, but not be limited to, inspection of barrier integrity, worker decontamination facility, utilization of power sources, and location and capacity of negative air filtration devices. If, during the course of the pre-commencement inspection, deficiencies are found, the Contractor shall perform the necessary adjustments in order to obtain compliance.

2. Work Area Inspections. Work area inspections may be conducted on a daily basis at the discretion of the Owner/Consultant. During the course of the work inspections, the APM shall observe the Contractor's removal procedures, verify barrier integrity, monitor negative air filtration devices, assess project progress, and inform the Contractor of specific remedial activities if deficiencies are noted.

3. Pre-sealant Final Visual Inspection. A pre-sealant inspection for each work area shall be conducted by the APM upon the request of the Contractor. The pre-sealant inspection shall be conducted after completion of the initial cleaning procedures, but prior to encapsulation. The pre-sealant inspection shall verify that no visible ACM or residual debris remain in the work area. If, during the course of the pre-sealant inspection, the APM identifies visible residual ACM or debris, the Contractor shall re-clean the work area until it is deemed acceptable by the APM.

3.10 WASTE DISPOSAL

A. All waste material shall be promptly wetted and placed in 6-mil polyethylene bags or wrapped in two layers of 6-mil polyethylene plastic sheeting as it is generated. A sufficient number of waste bags and/or plastic sheeting shall be located in the immediate work area (unused bags in the equipment room of the decontamination facility must be disposed of as contaminated waste). The Contractor shall count or measure the volume of each filled container leaving the work area, and maintain a written record of such.

B. Warning labels, having waterproof print and permanent adhesive, shall be affixed to the sides of all waste bags or transfer containers. Warning labels shall be conspicuous and legible, and contain the following words in accordance with OSHA 1926.1101:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

In addition to the above, affix ‘waste generator label’ to include the generator’s name and address on each waste container. Waste transport vehicles will have appropriate U.S. Department of Transportation signage on them for transportation of asbestos waste materials.

C. A fine water spray shall be used to keep the unbagged or unwrapped waste damp at all times.

D. Sealed waste shall be removed from the work area and stored in an on-site, enclosed, lined, and lockable dumpster or transported to the landfill. The temporary storage dumpster area shall be prominently identified and be kept locked.

E. Once a truckload of waste containers has accumulated, the Contractor shall arrange for transportation to the landfill. No temporary co-mingling of asbestos waste from this project with that from another site will be allowed.

F. Waste Transportation and Disposal Regulations:

1. It is the responsibility of the Contractor to determine and ensure compliance with the current waste handling regulations applicable to the work site and the current regulations for waste transportation to and disposal at each ultimate landfill. The Contractor shall comply fully with these regulations and with all U.S. Department of Transportation, EPA, and State of Connecticut Department of Energy and Environmental Protection (CTDEEP) requirements.

2. If required, the Contractor (or Subcontractor), at no additional cost, shall maintain a valid hazardous waste transporter's permit and identification number, and document and fully comply with any hazardous waste manifesting requirements.

G. Waste Disposal Procedure:

1. The Contractor shall incorporate in his/her proposal the estimated quantity of asbestos waste disposal to be generated during the work; the proposed final waste site; the estimated number of separate waste shipments (loads), and the current estimated transportation and landfill disposal fees (per cubic yard). Non-contaminated waste transport and disposal shall be solely the Contractor's responsibility. The Contractor shall review each of these items and resolve any discrepancies or deficiencies during the pre-construction site meeting.

2. The Contractor shall package, label, and remove all asbestos waste as specified in the specifications. Packaging shall be accomplished in a manner that minimizes waste volume, but so that waste containers will not tear or break.

3. The Contractor shall request, in advance, the APM to review the total volume of waste material to be removed from the site (total count of waste containers and total volume estimate to the nearest 0.5 cubic yard), and insert the quantity on the Waste Shipment Record (Appendix A) and on a hazardous waste manifest if required.

4. The Contractor shall provide legal transportation of this waste to the ultimate disposal landfill; and have the waste hauler and the landfill owner complete all other required manifests, dump slips, or other forms. The completed and fully signed (by all required parties) original of the Waste Shipment Record, and copies of the other forms, shall be returned within thirty (30) calendar days to the Owner for payment approval. No payments will be approved, or made for incomplete Waste Shipment Records.

5. All disposal of asbestos-containing and/or asbestos-contaminated material must be in compliance with requirements of and authorized by the Solid Waste Management Division, State of Connecticut Department of Energy and Environmental Protection (CTDEEP).

H. Waste Disposal Fees:

1. All Contractor contaminated waste handling costs, such as waste packaging, on-site/off-site storing/handling, transport/disposal, permitting, record keeping, and non-contaminated waste handling must be included in the Contractor's proposal as applicable to removal of asbestos materials and/or performance of the related abatement activities.

3.11 PROJECT RESTORATION

A project walk-through shall be conducted after the abatement portion of the project to identify areas or equipment damaged during the work. If the Owner determines that the damage is caused by acts or omissions of the Contractor, a punch list shall be developed. The Contractor shall be responsible for repair or replacement, or at the discretion of the Owner, payment for the work of another Contractor to complete the punch list. A second walk through shall be conducted after completion of punch list items.

END OF SECTION

CERTIFICATE OF WORKER'S ACKNOWLEDGMENT

PROJECT NAME _____ DATE _____

PROJECT ADDRESS _____

CONTRACTOR'S NAME _____

WORKING WITH ASBESTOS CAN BE DANGEROUS. INHALING ASBESTOS FIBERS HAS BEEN LINKED WITH VARIOUS TYPES OF CANCER. IF YOU SMOKE AND INHALE ASBESTOS FIBERS THE CHANCE THAT YOU WILL DEVELOP LUNG CANCER IS GREATER THAN THAT OF THE NON-SMOKING PUBLIC.

Your employer's contract with the Owner for the above project requires that: You be supplied with the proper respirator and be trained in its use; You be trained in safe work practices and in the use of the equipment found on the job; You receive a medical examination; These things are to have been done at no cost to you.

RESPIRATORY PROTECTION: You must have been trained in the proper use of respirators, and informed of the type respirator to be used on the above referenced project. You must be given a copy of the written respiratory protection manual issued by your employer. You must be equipped at no cost with the respirator to be used on the above project.

TRAINING COURSE: You must have been trained in the dangers inherent in handling asbestos and breathing asbestos dust and in proper work procedures and personal and area protective measures. The topics covered in the course must have included the following:

Physical characteristics of asbestos
Health hazards associated with asbestos
Respiratory protection
Use of personal protective equipment
Pressure Differential Systems
Work practices including hands on or on-job training
Personal decontamination procedures
Air monitoring, personal and area

MEDICAL EXAMINATION: You must have had a medical examination within the past 12 months at no cost to you. This examination must have included: health history, pulmonary function tests and may have included an evaluation of a chest x-ray.

By signing this document you are acknowledging only that the Owner of the building you are about to work in has advised you of your rights to training and protection relative to your employer, the Contractor.

Signature _____

Printed Name _____

Social Security # _____

Witness _____

Facility Support Services, LLC

Environmental & Safety Consulting Engineers

CONNECTICUT STATE PROJ. NO. TMP- 107-QGCV
BOILER AND VENTILATOR REPLACEMENT
PCB MATERIALS
ABATEMENT SPECIFICATIONS

Race Brook School
107 Grannis Road
Orange, Connecticut

Prepared For:

Orange Board of Education
637 Orange Center Road
Orange, Connecticut 06477

Prepared By:

Facility Support Services, LLC
2685 State Street
Hamden, Connecticut 06517

July 6, 2013
FSS Project Number: 34613

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FIGURES

Figure 1 Connecticut Regulated (PCB <50 mg/kg) Material Locations

ATTACHMENTS

Attachment 1 Notification of PCB Activity and PCB Inspection Report

PCB REMEDIATION TECHNICAL SPECIFICATIONS

1.0 PART 1 – GENERAL

As referred to in these Specifications the Project Owner is Orange Board of Education, the Project Architect is Rose & Tiso Co., LLC, the Project Engineer is Musco Engineering, LLC and the Project Consultant is Facility Support services, LLC (FSS).

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Project Contract, including General and Supplementary Conditions and other specification sections, apply to this section.

B. Reference is made to the Notification of PCB Activity, dated July 6, 2013 and PCB Inspection Report prepared by Facility Support Services, LLC dated July 6, 2013, included in Attachment 1.

C. PCB Remediation work will be carried out simultaneously with the abatement of asbestos containing materials. In addition to the requirements of this section all work will be carried out in accordance with requirements of the Facility Support Services, LLC, Asbestos Abatement Technical Specification dated July 6, 2013.

1.2 GENERAL REQUIREMENTS

A. The Remediation Contractor shall furnish all labor, materials, facilities, equipment, installation services, employee training, notifications, permits, licenses, certifications, agreements and incidentals necessary to perform the specified work. Work shall be performed in accordance with the contract documents, the latest regulations from the Occupational Safety and Health Administration (OSHA), the United States Environmental Protection Agency (USEPA), and all other applicable federal, state and local agencies. Whenever the requirements of the above references conflict or overlap, the more stringent provision shall apply.

B. All project personnel engaged in the work covered under this section shall be trained in accordance with OSHA Regulations 29 CFR 1910.1000 and 29 CFR 1910.1200. It should also be noted that work associated with PCB removal may also involve asbestos-containing materials during demolition and removal activities specified herein and Remediation Contractor shall perform required exposure assessment for asbestos in accordance with 29 CFR 1926.1101 for asbestos.

C. The Remediation Contractor shall provide a Project Health and Safety Officer having a minimum of eight (8) hours of supervisor training in hazardous waste site operations in accordance with the requirements of 29 CFR 1910. The supervisor must be on site at all times during abatement work.

D. This section specifies the procedures for removal and disposal of existing materials containing polychlorinated biphenyls (PCB), less than (<) 50 parts per million (mg/kg), in the form of mastics associated with coveboard and floor tiles that will

be removed as part of the replacement of the Race Brook School boiler heating system. This section also specifies the procedures for removal of floor tiles, cove board and mastics as <50 mg/kg PCB waste and the subsequent cleaning of adjacent substrate upon completion of work.

E. The quantities given in these specifications are provided to establish the order of magnitude of the abatement project. Actual quantities may vary. The Contractor is responsible for verification of all quantities of PCB containing materials scheduled for removal. This verification shall include a Pre-Bid/Pre-Abatement meeting to include an on-site walk-through inspection of the work area and review of PCB abatement requirements.

F. The Remediation Contractor shall disclose to all of his workers, supervisory personnel, subcontractors and consultants who will be at job site of the seriousness of the hazard of working with PCB-containing materials and of proper work procedures which must be followed.

G. The PCB containing materials scheduled for removal during this phase are also Asbestos Containing Materials (ACMs) and must be handled/disposed of as such.

H. Where in the performance of the work, workers, supervisory personnel, subcontractors, or consultants may encounter, disturb or otherwise function in the immediate vicinity of PCB containing materials, appropriate, continuous measures as necessary to protect all workers from the hazard of exposure shall be taken. Such measures shall include the procedures and methods described herein, regulations of the U.S. Occupational Safety & Health Administration (OSHA), U.S. Environmental Protection Agency (USEPA), and local requirements as applicable.

1.3 PROJECT WORK SCOPE/WORK STATEMENT

The project site is the renovation areas, as shown on Figure 1 located at the Town of Orange, Race Brook School, located at 107 Grannis Road in Orange, Connecticut. The proposed removal and disposal activities to be performed by Remediation Contractor shall include the following:

1. Pre-Abatement Meeting
2. Site preparation and controls to facilitate remediation of PCBs.
3. Health and Safety compliance in accordance with Occupational Safety and Health Administration (OSHA) requirements.
4. <50 mg/kg PCB Product Removal.
5. <50 mg/kg PCB Waste Removal.
6. Cleaning
7. Site Restoration and Demobilization

Work Statement

<50 mg/kg (Connecticut Regulated Materials*) PCB Contaminated Product Removal

PCB-01 Remove existing floor tiles, cove board and mastics at two classrooms for disposal as <50 mg/kg PCB Product Waste and Asbestos Containing Material Waste. All visible mastics shall be removed using hand tools to minimize the generation of dust. Contractor shall lay down polyethylene sheeting beneath the work area if the lower level is exposed to catch any particles prior to contacting the ground and collect any debris for disposal.

<50 mg/kg (Connecticut Regulated Materials*) PCB Contaminated Waste Removal

PCB-02 Remove existing substrate material as feasible and at the discretion of the Project Architect for disposal as <50 mg/kg PCB waste. Substrate surrounding the tiles and cove board (top, sides and bottom) will be cleaned with a PCB removing solvent (Capsur ® or similar, to be approved in advance by the Project Consultant). After cleaning, the substrate will be tested for PCB concentrations from at least two (2) locations in each classroom, and the air tested from each classroom by the Project Consultant. A delay for rapid laboratory turnaround of 3 days can be expected.

Based on the results of these tests, areas may have to be re-cleaned at the direction of the Project Consultant - if either 1) PCBs concentrations are found to be >1.0 mg/kg through bulk sample testing of remaining substrate (if any remain; material type is to be determined by the Project Consultant at the time of sampling), or 2) detection of PCBs in the air samples. Following re-cleaning, the Project Consultant shall collect another round of samples.

If area fails the second PCB tests (i.e., fails to meet the >1.0 mg/kg clean-up level or detection of PCBs in air), a coating of an epoxy paint encapsulate will be applied (type to be approved by the Project Consultant). Costs for the proper containerization and disposal of liquids/materials generated by cleaning procedures shall be included in the Lump sum cost for the project work.

* Connecticut Regulated Materials/Waste

Connecticut General Statutes including but not limited to C.G.S, Sections 22a-463 through 22a-469 regulate mastics or other building materials containing PCBs <50 mg/kg but ≥1 mg/kg. These materials include the mastics that were used in the original portion of the subject structure and meet the definition of "excluded products" as defined in 40 CFR Part 761.3. According to Orange Board of Education these products were manufactured prior to 1978 and installed during the original construction, and the PCB concentrations detected are not the result of dilution. These materials, which possess concentrations of PCB ≥1 mg/kg but less than 50 mg/kg, will be removed and disposed of as <50 mg/kg Connecticut Regulated PCB Contaminated Waste.

1.4 CONTRACTOR QUALIFICATIONS

A. All bidders shall submit a record of prior experience on PCB abatement projects, listing all completed jobs in the past 3 years, with projects of similar size and scope. The Contractor shall list the experience and training of the site supervisor and all on-site workers. The information that should be included is as follows:

1. Project Name and Address
2. Owner's Name and Address
3. Consultant
4. Contract Amount
5. Start Date and Completion Date
6. Extras and Change Orders

B. The Contractor selected must appear on the approved list of Asbestos Abatement Contractors on file at the State of Connecticut Department of Public Health (CTDPH). Only State-certified asbestos abatement supervisors and workers shall perform asbestos abatement work activities.

C. The Contractor must utilize only individuals that have obtained 40-Hour Hazardous Waste Operations & Emergency Response training to perform this work in addition to all other required training outlined in these specifications.

D. Submit a written statement regarding whether the Contractor has ever been found out-of-compliance with federal or state asbestos regulations pertaining to worker protection, removal, transport, or disposal.

E. The Contractor shall obtain and pay for all required permits, and prepare and file all original and amended local, state, and EPA pre-notification forms immediately following award of the work.

F. The Contractor shall conduct personal exposure air monitoring for airborne fibers as prescribed by OSHA during the project performance.

G. The Owner reserves the right to award this Contract to the Contractor who best meets all contractor qualifications and Owner's interests.

1.5 CONTRACTORS USE OF SITE AND PREMISES

A. Limit use of site and premises as follows:
   Owner occupancy.
   Work by Owner.
   Use of site and premises by public.

B. Coordinate use of the premises, including use of restroom facilities and utilities under direction of Owner.

C. Assume full responsibility for protection and safekeeping of products under this Contract.

1.6 WORK SEQUENCE

A. Work must be performed to accommodate Owner's requirements and work by other trades. Coordinate abatement schedule and operations with the Project Owner ,Orange Board of Education, the Project Architect, Rose & Tiso Co., LLC, the Project Engineer Musco Engineering, LLC and the Project Consultant Facility Support services, LLC (FSS). Re-occupancy by owner and other trades shall occur following completion of work by the Contractor and successful clearance sampling and inspection by the Consultant.

B. The Owner may occupy portions of the building for their normal activities during the Work. However, the work shall be conducted when school is not in session. The Contractor is responsible for creating a plan to accommodate Owner occupancy needs and remaining construction/renovation work.

1.7 OWNER'S OPERATIONS

A. Schedule the Work to accommodate this requirement.

B. Maintain means of egress.

C. Coordinate Work with the Owner and the Project Engineer

D. Maintain the fire alarm and fire detection systems at all times when the building is occupied during construction.

E. Maintain a permanent means of egress during construction. Provide and maintain a temporary means of egress as required by the Fire Marshall.

1.8 CLOSEOUT AND PUNCH LIST

A. The Contractor shall carefully check his/her own work and that of any Subcontractor as the work is being performed. Unsatisfactory work shall be corrected immediately.

B. When the Contractor determines that he is substantially complete, that is, has less than ten percent of his Contract remaining to be completed, he shall prepare for submission to the Consultant, a list of items to be completed or corrected. The failure to include any items on such list does not alter the responsibility of the Contractor to complete all work in accordance with the Contract Documents.

C. Upon receipt of the Contractor's list of items to be completed or corrected, the Consultant will promptly make a thorough inspection and prepare a "punch list" setting forth in accurate detail any items on the Contractor's list and any additional items that are not acceptable.

D. When the "punch list" has been prepared, the Consultant will arrange a meeting with the Contractor to identify and explain all punch list items and answer questions on the work that must be completed before final acceptance.

E. The Contractor shall correct all "punch list" items or shall cause the correction of the "punch list" items within a time frame to be established when the "punch list" is made. The time frame for the completion of the "punch list" shall not exceed the completion date of the Contract. Should the "punch list" not be completed within the specified time frame, the Owner may invoke the rights given under the General Conditions.

F. The Consultant shall not be expected to inspect any area more than once for the preparation of the "punch list" items. If, during an inspection, the Consultant discovers five (5) or more deficient conditions, then the area shall be declared "Not Ready" for Inspection.

G. All inspections and sampling required for PCB asbestos abatement compliance will be performed by the Consultant.

1.9 CLEANING

Throughout the construction period, the Contractor shall maintain the building and site free of rubbish, debris, surplus materials, and other items not required for the Work. Remove such materials from the site daily to prevent accumulations. Remove all construction debris from work areas, and remove all hazardous/regulated waste and asbestos waste as required by the most current Federal, State, and local regulations and the requirements of the specifications.

1.10 EMERGENCY CALLS

A. The Contractor shall provide the Consultant and Owner with a telephone number where the Contractor or Contractor's Representative can be reached during non-working hours.

B. At the direction of a duly authorized representative of the Owner, the Contractor may be required to dispatch all necessary personnel and equipment to any point on the work site to clear obstructions or make safe any conditions deemed necessary by the Owner or Consultant.

1.11 ADDITIONAL GENERAL REQUIREMENTS

A. The Abatement Contractor shall employ an English-speaking competent Supervisor with at least three (3) years experience on projects of similar scope and magnitude who shall be responsible for all work involving asbestos abatement as described in the Specifications and defined in the applicable regulations, and have full-time daily supervision of the same. The Supervisor shall be the "Competent Person" as defined by OSHA regulations. The Contractor shall provide, on-site, at least one English-speaking foreman at all times when work is in progress. The supervisor and foreman must be thoroughly experienced in asbestos and PCB-containing materials removal work, knowledgeable of all applicable federal, state, and local regulations and capable of skillfully executing all work promptly, efficiently and in compliance with all requirements of these specifications. The Owner reserves the right to have any supervisory or foreman personnel removed from the project if they do not demonstrate the requisite qualifications.

B. The Contractor shall allow work performed under this contract to be inspected, if required, by local, state, federal, and any other authorities having jurisdiction over such work. The Contractor shall immediately notify the Owner and Consultant and shall maintain written evidence of such inspection for review by the Owner and Consultant.

C. The Contractor shall incur the cost of all fines resulting from regulatory non-compliance as issued by federal, state, and local agencies. The Contractor shall incur the cost of all work requirements mandated by federal, state, and local agencies as a result of regulatory non-compliance or negligence.

D. The Contractor shall immediately notify the Owner and Consultant of the delivery of all permits, licenses, certificates of inspection, approval or occupancy, etc., and any other such instruments required under codes by authorities having jurisdiction, regardless of who issued, and shall cause them to be displayed to the Owner and Consultant for verification and recording.

1.12 REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where a conflict or overlap among regulations and/or these specifications exist, the most stringent requirements shall apply.

1. American National Standards Institute (ANSI)
   a. ANSI.Z89.1 Personnel Protective Equipment - Protective Headwear for Industrial Worker's Requirements (Latest Revision)
   b. ANSI.Z87
2. Code of Federal Regulations (CFR)
   a. 29 CFR Subpart D - Walking, Working Surfaces
   b. 29 CFR 1910.120 - Hazardous Waste Operations and Emergency Response (HAZWOPER).

c. 29 CFR 1910.134 - Respiratory Protection Standard
d. 29 CFR 191 0.146 - Permit-Required Confined Spaces
e. 29 CFR 1910.1000 - Air Contaminants (Table Z-1)
f. 29 CFR 1910.1200 - Hazard Communication
g. 29 CFR 1926.20 - General Health and Safety Provisions
h. 29 CFR 1926.57 - Ventilation
i. 29 CFR 1926.59 - Hazard Communication Program
j. 29 CFR 1926.62 - Lead Exposure in Construction
k. 29 CFR 1926.95 - Criteria for Personal Protective Equipment
l. 29 CFR 1926, Subpart H -Materials Handling, Storage, Use, and Disposal
m. 29 CFR 1926, Subpart L - Scaffolding
n. 29 CFR 1926, Subpart M -Fall Protection
o. 29 CFR 1926, Subpart X - Ladders
p. 29 CFR 1926, Subpart Z - Toxic and Hazardous Substances
q. 40 CFR 50.6 - National Primary and Secondary Ambient Air Quality Standards for Particulate Matter
r. 40 CFR 260 - Hazardous Waste Management System: General
s. 40 CFR 261 - Identification and Listing of Hazardous Waste
t. 40 CFR 262 - Standards Applicable to Generators of Hazardous Waste
u. 40 CFR 263 - Standards Applicable to Transporters of Hazardous Waste
v. 40 CFR 264 - Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
w. 40 CFR 265 - Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
x. 40 CFR 268 - Land Disposal Restrictions
y. 40 CFR 700 - Toxic Substances Control Act (TSCA)
z. 40 CFR 761- PCBs Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
aa. 49 CFR 105 - Hazardous Materials Program Definitions and General Procedures
ab. 49 CFR 171 - General Information, Regulations and Definitions
ac. 49 CFR 172 - Hazardous Material Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
ad. 49 CFR 173 - Shippers-General Requirements for Shipments and Packaging
ae. 49 CFR 177 - Carriage by Public Highway
af. 49 CFR 176 - Specifications for Packaging

3. National Institute for Occupational Safety and Health (NIOSH)
   a. Publication Number 87-106 Respiratory Decision Logic
   b. NIOSH /OSHA Booklet 3142 Lead in Construction
   c. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (NIOSH Publication 85-115)
4. U.S. Environmental Protection Agency (USEPA), Toxic Substances Control Act (TSCA)

a. Polychlorinated Biphenyl (PCB) Site Revitalization Guidance Under the Toxic Substances Control Act
b. 40 CFR Part 761.50 - Applicability (b) (1-8)
c. 40 CFR Part 761.61 - PCB Remediation Waste
d. 40 CFR Part 761.62 - PCB Bulk Product Waste
e. 40 CFR Part 761.79 - Decontamination

5. Center for Disease Control (CDC): Air Pollution and Respiratory Health.

6. Connecticut General Statutes C.G.S., Sections 22a-463 through 22a-469 regulating – Polychlorinated Biphenyls

1.13 DEFINITIONS

A. The following definitions as used within this technical specification as well as references to specific sections of the Code of Federal Regulation section 40 CRF Part 761 and C.G.S., Sections 22a-463 through 22a-469 are provided.

1. Bulk PCB Remediation Waste means waste containing PCBs as a result of a spill, release, or other unauthorized disposal, at the following concentrations: Materials disposed of prior to April 18, 1978, that are currently at concentrations ≥50 mg/kg PCBs, regardless of the concentration of the original spill; materials which are currently at any volume or concentration where the original source was ≥500 mg/kg PCBs beginning on April 18, 1978, or ≥50 mg/kg PCBs beginning on July 2, 1979; and materials which are currently at any concentration if the PCBs are spilled or released from a source not authorized for use under this part. PCB remediation waste means soil, rags, and other debris generated as a result of any PCB spill cleanup, as further defined in 40 CFR §761.3.
2. CERCLA means the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601-9657).
3. Chemical waste landfill means a landfill at which protection against risk of injury to health or the environment from migration of PCBs to land, water, or the atmosphere is provided from PCBs and PCB Items deposited therein by locating, engineering, and operating the landfill as specified in §761.75.
4. Cleanup Site means the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of a cleanup of PCB remediation waste, regardless of whether the site was intended for management of waste.
5. Containment means the enclosure within the building, which establishes a contaminated area and surrounds the location where PCB and/or other toxic or hazardous substance removal is taking place and establishes a Control Work Area.
6. Connecticut Regulated PCB Contaminated Materials/Waste means materials regulated by Connecticut General Statutes including but limited to C.G.S.,

Sections 22a-463 through 22a-469 regulating mastics or other building materials containing PCBs <50 mg/kg but ≥1 mg/kg.

7. Designated Facility means the off-site disposer or commercial storer of PCB waste designated on the manifest as the facility that will receive a manifested shipment of PCB waste.
8. Disposal means intentionally or accidentally to discard, throw away, or otherwise complete or terminate the useful life of PCBs and PCB Items. Disposal includes spills, leaks, and other uncontrolled discharges of PCBs as well as actions related to containing, transporting, destroying, degrading, decontaminating, or confining PCBs and PCB Items.
9. DOT means the United States Department of Transportation.
10. EPA identification number means the 12-digit number assigned to a facility by EPA upon notification of PCB waste activity under §761.205.
11. Excluded PCB products means PCB materials which appear at concentrations less than 50 mg/kg as defined in 40 CFR §761.3.
12. Fixed Object: means mechanical equipment, electrical equipment, fire detection systems, alarms, and all other fixed equipment, fixtures or other items, which cannot be removed from the work area.
13. Generator of PCB waste means any person whose act or process produces PCBs that are regulated for disposal under subpart D of 40 CFR Part 761, or whose act first causes PCBs or PCB Items to become subject to the disposal requirements of subpart D, or who has physical control over the PCBs when a decision is made that the use of the PCBs has been terminated and therefore is subject to the disposal requirements of subpart D. Unless another provision of 40 CFR Part 761 specifically requires a site-specific meaning, "generator of PCB waste" includes all of the sites of PCB waste generation owned or operated by the person who generates PCB waste.
14. HEPA: High Efficiency Particulate Air filtration efficiency of 99.97 percent down to 0.3 microns. Filtration provided on specialized vacuums and air filtration devices to trap particles.
15. High occupancy area means any area where PCB remediation waste has been disposed of on-site and where occupancy for any individual not wearing dermal and respiratory protection for a calendar year is: 840 hours or more (an average of 16.8 hours or more per week) for non-porous surfaces and 335 hours or more (an average of 6.7 hours or more per week) for bulk PCB remediation waste. Examples could include a residence, school, day care center, sleeping quarters, a single, or multiple occupancy 40 hours per week workstation, a school classroom, a cafeteria in an industrial facility, a control room, and a workstation at an assembly line.
16. Incinerator means an engineered device using controlled flame combustion to thermally degrade PCBs and PCB Items. Examples of devices used for incineration include rotary kilns, liquid injection incinerators, cement kilns, and high temperature boilers.
17. Laboratory means a facility that analyzes samples for PCBs and is unaffiliated with any entity whose activities involve PCBs.
18. Liquid PCBs means a homogenous flowable material containing PCBs and no more than 0.5 percent by weight non-dissolved material.

19. Low occupancy area means any area where PCB remediation waste has been disposed of on-site and where occupancy for any individual not wearing dermal and respiratory protection for a calendar year is: less than 840 hours (an average of 16.8 hours per week) for non-porous surfaces and less than 335 hours (an average of 6.7 hours per week) for bulk PCB remediation waste. Examples could include an electrical substation or a location in an industrial facility where a worker spends small amounts of time per week (such as an unoccupied area outside a building, an electrical equipment vault, or in the non-office space in a warehouse where occupancy is transitory).
20. Manifest means the shipping document EPA form 8700–22 and any continuation sheet attached to EPA form 8700–22, originated and signed by the generator of PCB waste in accordance with the instructions included with the form and subpart K of this part.
21. Marked means the marking of PCB Items and PCB storage areas and transport vehicles by means of applying a legible mark by painting, fixation of an adhesive label, or by any other method that meets the requirements of these regulations.
22. Municipal solid wastes means garbage, refuse, sludges, wastes, and other discarded materials resulting from residential and non-industrial operations and activities, such as household activities, office functions, and commercial housekeeping wastes.
23. Non-liquid PCBs means materials containing PCBs that by visual inspection do not flow at room temperature (25°C or 77°F) or from which no liquid passes when a 100 g or 100 ml representative sample is placed in a mesh number 60 ±5 percent paint filter and allowed to drain at room temperature for 5 minutes.
24. Non-porous surface means a smooth, unpainted solid surface that limits penetration of liquid containing PCBs beyond the immediate surface. Examples are: smooth un-corroded metal, natural gas pipe with a thin porous coating originally applied to inhibit corrosion, smooth glass, smooth glazed ceramics, impermeable polished building stone such as marble or granite, and high density plastics such as polycarbonates and melamines that do not absorb organic solvents.
25. On site means within the boundaries of a contiguous property unit.
26. PCB and PCBs means any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances, which contains such substance. Refer to §761.1(b) for applicable concentrations of PCBs. PCB and PCBs as contained in PCB items are defined in §761.3. For any purposes under this part, inadvertently generated non-Aroclor PCBs are defined as the total PCBs calculated following division of the quantity of mono-chlorinated biphenyls by 50 and di-chlorinated biphenyls by 5.
27. PCB Article means any manufactured article, other than a PCB Container, that contains PCBs and whose surface(s) has been in direct contact with PCBs. "PCB Article" includes capacitors, transformers, electric motors, pumps, pipes and any other manufactured item (1) which is formed to a specific shape or design during manufacture, (2) which has end use function(s) dependent in whole or in part upon its shape or design during

end use, and (3) which has either no change of chemical composition during its end use or only those changes of composition which have no commercial purpose separate from that of the PCB Article.

28. PCB Article Container means any package, can, bottle, bag, barrel, drum, tank, or other device used to contain PCB Articles or PCB Equipment, and whose surface(s) has not been in direct contact with PCBs.
29. PCB Bulk Product Waste means waste derived from manufactured products containing PCBs in a non-liquid state, at any concentration where the concentration at the time of designation for disposal is ≥50 mg/kg PCBs. PCB bulk product waste does not include PCBs or PCB Items regulated for disposal under §761.60(a) through (c), §761.61, §761.63, or §761.64. PCB bulk product waste is further defined in 40 CFR §761.3.
30. PCB Capacitor means any capacitor that contains ≥500 mg/kg PCB. Concentration assumptions applicable to capacitors appear under §761.2.
31. PCB Container means any package, can, bottle, bag, barrel, drum, tank, or other device that contains PCBs or PCB Articles and whose surface(s) has been in direct contact with PCBs.
32. PCB-Contaminated means a non-liquid material containing PCBs at concentrations ≥50 mg/kg but <500 mg/kg; a liquid material containing PCBs at concentrations ≥50 mg/kg but <500 mg/kg or where insufficient liquid material is available for analysis, a non-porous surface having a surface concentration >10 μg/100 cm^2 but <100 μg/100 cm^2, measured by a standard wipe test as defined in §761.123.
33. PCB Equipment means any manufactured item, other than a PCB Container or a PCB Article Container, which contains a PCB Article or other PCB Equipment, and includes microwave ovens, electronic equipment, and fluorescent light ballasts and fixtures.
34. PCB Item means any PCB Article, PCB Article Container, PCB Container, PCB Equipment, or anything that deliberately or unintentionally contains or has as a part of it any PCB or PCBs.
35. PCB waste(s) means those PCBs and PCB Items that are subject to the disposal requirements of subpart D in 40 CFR Part 761.
36. Porous surface means any surface that allows PCBs to penetrate or pass into itself including, but not limited to, paint or coating on metal; corroded metal; fibrous glass or glass wool; unglazed ceramics; ceramics with a porous glaze; porous building stone such as sandstone, travertine, limestone, or coral rock; low-density plastics such as Styrofoam and low-density polyethylene; coated (varnished or painted) or uncoated wood; concrete or cement; plaster; plasterboard; wallboard; rubber; fiberboard; chipboard; asphalt; or tar paper. For purposes of cleaning and disposing of PCB remediation waste, porous surfaces have different requirements than non-porous surfaces.
37. RCRA means the Resource Conservation and Recovery Act (40 U.S.C. 6901 et seq.).
38. Standard wipe sample means a sample collected for chemical extraction and analysis using the standard wipe test as defined in §761.123. Except as designated elsewhere in part 761, the minimum surface area to be sampled shall be 100 cm^2.

39. Storage for disposal means temporary storage of PCBs that have been designated for disposal.
40. SW–846 means the document having the title "SW-846, Test Methods for Evaluating Solid Waste,"
41. Totally enclosed manner means any manner that will ensure no exposure of human beings or the environment to any concentration of PCBs.
42. Transfer facility means any transportation-related facility including loading docks, parking areas, and other similar areas where shipments of PCB waste are held during the normal course of transportation. Transport vehicles are not transfer facilities under this definition, unless they are used for the storage of PCB waste, rather than for actual transport activities. Storage areas for PCB waste at transfer facilities are subject to the storage facility standards of §761.65, but such storage areas are exempt from the approval requirements of §761.65(d) and the recordkeeping requirements of §761.180, unless the same PCB waste is stored there for a period of more than 10 consecutive days between destinations.
43. Transporter of PCB waste means, for the purposes of subpart K of 40 CFR Part 761, any person engaged in the transportation of regulated PCB waste by air, rail, highway, or water for purposes other than consolidation by a generator.
44. Transport vehicle means a motor vehicle or rail car used for the transportation of cargo by any mode. Each cargo-carrying body (e.g., trailer, railroad freight car) is a separate transport vehicle.
45. TSCA means the Toxic Substances Control Act (15 U.S.C. 2601 et seq.).

1.14 SUBMITTALS

A. The following documents shall be submitted within 10 business days of project award to the Consultant prior to commencement of PCB Removal work:

1. Site Specific Health and Safety Plan (HASP): The Remediation Contractor shall prepare a site specific HASP plan for protection of workers and control of the work site in accordance with OSHA regulatory requirements. The HASP shall govern all work conducted at the site during the abatement of PCB Containing Materials and related debris; waste handling, sampling, waste management; and waste transportation. At a minimum, the HASP shall address the requirements set forth in 29 CFR 1910.120, as further outlined below:
   a. Health and Safety Organization
   b. Site Description and Hazard Assessment
   c. Training
   d. Medical Surveillance
   e. Work Areas
   f. Personal Protective Equipment
   g. Personal Hygiene and Decontamination
   h. Standard Operating Procedures and Engineering Controls

i. Emergency Equipment and First Aid Provisions
j. Equipment Decontamination
k. Air Monitoring
l. Telephone List
m. Emergency Response and Evacuation Procedures and Routes
n. Site Control
o. Permit-Required Confined Space Procedures
p. Spill prevention and Containment Plan
q. Heat and Cold Stress
r. Record Keeping
s. Community Protection Plan

2. Training Documentation: Documentation of OSHA 40-Hour HAZWOPER Training for all employees and subcontractors to be used for the abatement work, and 8-Hour HAZWOPER Supervisor Training for the designated on-site Health and Safety Officer for the abatement work.

3. PCB and or other Toxic or Hazardous Substances Disposal Plan: A written plan that details the Remediation Contractor's plan for transportation and disposal of PCB-containing or other Toxic or Hazardous Substance_wastes generated during the project. The Disposal Plan shall identify:
   a. Waste packaging, labeling, placarding and manifesting procedures.
   b. The name, address and 24-hour contact number for the proposed treatment or disposal facility or facilities to which waste generated during the project will be transported.
   c. The name, address, contact person(s) and state-specific permit numbers for proposed waste transporters, and EPA identification number for firms that will transport waste.
   d. The license plate numbers of vehicles to be used in transporting of the waste from the site to the disposal facility.
   e. The route(s) by which the waste will be transported to the designated disposal facility, and states or territories through which the waste will pass.

4. Material Safely Data Sheets: Material Safety Data Sheets (OSHA Form 174 or equivalent) and manufacturer's information shall be provided for all chemicals and materials to be used during the project including but not limited to specialty cleaners and chemical stripping products.

B. The following documents shall be submitted to the Consultant within fifteen (15) work days following removal of waste from the site:
   1 Waste Profile Sheets
   2. Pre-Disposal Analysis Test Results (If required by disposal facility)
   3. Manifests signed by the disposal facility
   4. Tipping Receipts provided by the disposal facility

5. Certification of Final Treatment/Disposal signed by the responsible disposal facility official.

C. PCB Work Closeout Submittals:

1. Disposal Site Receipts: Copy of waste shipment record and disposal site receipt showing the PCB-containing or other Toxic or Hazardous Substances materials have been properly disposed must be provided to the Project Consultant within 5 business days of disposal.

D. Product Data: Catalog sheets, specifications, and application instructions for any removal products, if used.

1.15 POSTING AND RECORD MAINTENANCE REQUIREMENTS

A. The following items shall be conspicuously displayed proximate but outside of abatement work areas. All signage must reviewed and approved by the Owner prior to posting.

1. Exit Routes -Emergency exit procedures and routes
2. Emergency Phone Numbers - A list indicating the telephone numbers and locations of the local hospital(s); the local emergency squad; the local fire department; the local police department; the Poison Control Center; Chemical Emergency Advise (CHEMTREC); the local Department of Health's local office; the Remediation Contractor (on-site and after hours numbers); and the environmental consultant (on-site and after hours numbers).
3. Warning Signs - Warning signs shall be in English and the language of any workers onsite who do not speak English, and be of sufficient size to be clearly legible and display the following or similar language in accordance with 29 CFR 1910.1200:

WARNING
REGULATED WASTE WORK AREA
NO SMOKING, EATING OR DRINKING
AUTHORIZED PERSONNEL ONLY
PROTECTIVE CLOTHING IS REQUIRED IN THIS AREA

B. The Remediation Contractor shall maintain the following items on-site and available for review by all employees and authorized visitors:

1. Remediation Contractor's Project Specific Health and Safety Plan
2. Certificates of Training for all employees and the project Supervisor
3. Codes, Standards and Publications
4. Material Safety Data Sheets (MSDS) for all chemicals used during the project.
5. Copies of the Remediation Contractor's written hazard communication, respiratory protection, and confined space entry programs.

C. Fees, Permits and Licenses. The Remediation Contractor shall pay all licensing fees, royalties, and other costs necessary for the use of any copyrighted or patented product, design, invention, or processing in the performance of the work specified in this Section.

1. The Remediation Contractor shall be solely responsible for costs, damages, or losses resulting from any infringement of these patent rights or copyrights. The Remediation Contractor shall hold the Owner and the Owner's Authorized Representatives harmless from any costs, damages, and losses resulting from any infringement of these patent rights or copyrights.
2. The Remediation Contractor shall be responsible for securing all necessary permits for work under this Section, including hauling, removal, and disposal, fire, and materials usage, or any other permits required to perform the specified work.

1.16 QUALITY ASSURANCE

A. The Remediation Contractor shall provide and assure that the quality of work practices and procedures to be utilized are consistent with the above listed agencies and regulations. Remediation Contractor shall utilize the latest edition, including all addenda, revisions and supplements for all regulatory agencies codes, etc.

B. Worker's Qualifications: The persons performing PCB Mastic abatement and their supervisors shall be personally experienced in PCB abatement work and shall have been regularly employed by a company performing hazardous materials abatement for a minimum of 3 years.

C. Pre-Abatement Conference: Before the Work of this Section is scheduled to commence, a conference will be held by the Owner at the Site for the purpose of reviewing the Contract Documents, discussing requirements for the Work, and reviewing the Work procedures.

1. The conference shall be attended by the Remediation Contractor, and the Owner's Authorized Representatives employed by the Owner.

1.17 REQUIREMENTS FOR WORKER HEALTH AND SAFETY

A. The Remediation Contractor is responsible and liable for the health and safety of all onsite personnel and the offsite community affected by the project. All onsite workers or other persons entering the abatement work areas, decontamination areas or waste handling and staging areas shall be knowledgeable of and comply with the requirements of the site specific Health and Safety Plan (HASP) at all times. The Remediation Contractor's HASP shall comply with all applicable federal, state and local regulations protecting human

health and the environment from the hazards posed by the work to be performed under this project.

B. Consistent disregard for the provisions of the HASP shall be deemed as sufficient cause for immediate stoppage of work and termination of the Contract or any Sub Contracts without compromise or prejudice to the rights of the Owner or the Owner's Authorized Representatives.

C. Any discrepancies between the Remediation Contractor's HASP and these specifications or federal and state regulations shall be resolved in favor of the more stringent requirements that provide the highest degree of protection to the project personnel and the surrounding community and environment

D. In addition to exposure concerns relating to the presence of PCB's, other health and safety considerations will apply to the work. The Remediation Contractor shall be responsible for recognizing such hazards and shall be responsible for the health and safety of Remediation Contractor employees at all times. It is the Remediation Contractor's responsibility to comply with all applicable health and safety regulations.

E. The HASP shall be reviewed by all persons prior to entry into the abatement, decontamination, or waste staging areas, whether a representative of the Remediation Contractor, owner, architect/engineer, environmental consultant, subcontractor(s), waste transporter or federal, state or local regulatory agency. Such review shall be acknowledged and documented by the Remediation Contractor's Health and Safety Officer by obtaining the name, signature and affiliation of all persons reviewing the HASP.

F. The HASP shall be maintained so as to be readily accessible and reviewable by all site personnel throughout the duration of the abatement project and until all waste materials are removed from the site and disposed of at the appropriate disposal facility.

G. The Remediation Contractor's on-site Health and Safety Officer shall be responsible for ensuring that project personnel and site visitors are informed of and comply with the provisions of the HASP at all times during the project.

1.18 WORK AREAS AND ZONES

A. The Remediation Contractor shall lay-out and clearly identify work areas in the field. Access by equipment, site personnel, and the public to the work areas shall be limited as follows:

1. Abatement Zone: The Abatement Zone(s) shall consist of all interior areas where removal of PCBs and other Toxic or Hazardous Substances and waste handling and staging activities are on-going and the immediately surrounding locale or other areas where contamination could occur. Each Abatement Zone for purposes of interior removal of PCB materials or

other Toxic or Hazardous Substances for disposal shall be performed within a containment (refer to section 3.01) to isolate work areas from non-work areas. The containment shall be visibly delineated with appropriate warning signs at all approaches to Abatement (including a PCB M_L marker), and be restricted from access by all persons except those directly necessary for the completion of the respective abatement tasks. The Abatement Zones shall be relocated and delineated as necessary as work progresses from one portion of the project site to another, to limit access to each abatement area and to minimize risk of exposure to site workers and the general public. Access shall be controlled at the periphery of the Abatement Zones to regulate the flow of personnel and equipment into and out of each zone and to help verify that proper procedures for entering and exiting are followed. All persons within the Abatement Zones shall wear the appropriate level of protection established in the HASP.

2. Decontamination Zone: The Decontamination Zone is the transition zone between the abatement area and the clean support zone of the project site, and is intended to reduce the potential for contaminants from being dispersed from the Abatement Zone to clean areas of the site. The Decontamination Zone shall consist of a buffer area surrounding each Abatement Zone through which the transfer of equipment, materials, personnel and containerized waste products will occur and in which decontamination of equipment, personnel, and clothing will occur. The Decontamination Zones shall be constructed as a three chamber decontamination unit for workers and a two chamber equipment room for waste load out as detailed in Section 3.02. All emergency response and first aid equipment shall be readily maintained in these Zones. All protective equipment and clothing shall be removed or decontaminated in the Decontamination Zone prior to exiting to the Support Zone.

3. Support Zone: The Support Zone will consist of the area outside the Decontamination Zones and the remainder of the project site. Administrative and other support functions and any activities that by nature need not be conducted in the Abatement or Decontamination Zone related to the project shall occur in the Support Zone, Access to the Abatement and Decontamination Zones shall be controlled by the Health and Safety Officer and limited to those persons necessary to complete the abatement work and which have reviewed and signed the HASP.

1.19 PERSONNEL PROTECTIVE EQUIPMENT

A. The Remediation Contractor shall be responsible to determine and provide the appropriate level of personal protective equipment in accordance with applicable regulations and standards necessary to protect the Remediation Contractor's employees from all hazards present.

B. The Remediation Contractor shall provide all employees with the appropriate safety equipment and protective clothing to ensure an appropriate level of

protection for each task, taking into consideration the chemical, physical, ergonomic and biological hazards posed by the site and work activities.

C. The Remediation Contractor shall establish in the HASP criteria for the selection and use of personal protective equipment (PPE).

D. The PPE to be utilized for the project shall be selected based upon the potential hazards associated with the project site and the work to be performed. Appropriate protective clothing shall be worn at all times within the Abatement Zone.

E. The Remediation Contractor shall provide the appropriate level of respiratory protection to all field personnel engaged in activities where respiratory hazards exist or there is a potential for such hazard to exit.

F. The Remediation Contractor shall provide, as necessary, protective coveralls, disposable gloves and other protective clothing for all personnel that will be actively involved in abatement activities or waste handling activities or otherwise present in the Abatement Zones. Coveralls shall be of Tyvek® or equivalent material. Should the potential for exposure to liquids exist, splash resistant disposable suits shall be provided and utilized.

G. Protective coveralls, and other protective clothing shall be donned and removed within the Decontamination Zone and shall be disposed of at the end of each day. Ripped coveralls shall be immediately replaced after appropriate decontamination has been completed to the satisfaction of the Health and Safety Officer. Protective clothing shall not be worn outside of the Decontamination Zone.

H. Hard Hats, protective eyewear, rubber boots and or other non-skid footwear shall be provided by the Remediation Contractor as required for workers and authorized visitors.

I. All contaminated protective clothing, respirator cartridges and disposable protective items shall be placed into proper containers to be provided by the Remediation Contractor for transport and proper disposal in accordance with 40 CFR 262 and 40 CFR § 761.61(a)(5).

1.20 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

A. The Remediation Contractor shall provide and maintain at the site, at a minimum, the following Emergency and First Aid Equipment:

1. Fire Extinguishers: A minimum one (1) fire extinguisher shall be supplied and maintained at the site by the Remediation Contractor throughout the duration of the project. Each extinguisher shall be a minimum of a 20 pound Class ABC dry fire extinguisher with Underwriters Laboratory approval per 29 CFR 1910.157.

2. First Aid Kit: A minimum 01 one (1) first aid kit meeting the requirements of 29 CFR 1910,151 shall be supplied and maintained at the site by the Remediation Contractor throughout the duration of the project.
3. Communications: Telephone communications (either cellular or land line) shall be provided by the Remediation Contractor for use by site personnel at all times during the project.

B. The Health and Safely Officer shall be notified immediately in the event of personal injury, potential exposure to contaminants, or other emergency. The Health and Safety Officer shall then immediately notify the Consultant.

1.21 STANDARD SAFETY AND HEALTH PROCEDURES AND ENGINEERING CONTROLS

A. The following provisions shall be employed to promote overall safety, personnel hygiene and personnel decontamination:

1. Each Remediation Contractor or Subcontractor shall ensure that all safety equipment and protective clothing to be utilized by its personnel is maintained in a clean and readily accessible manner at the site.
2. All prescription eyeglasses in use on this project shall be safety glasses conforming to ANSI Standard Z87.1. No contact lenses shall be allowed on the site.
3. Prior to exiting the delineated Decontamination Zone(s), all personnel shall remove protective clothing, and place disposable items in appropriate disposal containers to be dedicated to that purpose. Following removal of PPE, personnel shall thoroughly wash and rinse their face, hands, arms and other exposed areas with soap and tap water wash and subsequent tap water rinse. A fresh supply of tap water shall be provided at the site on each work day by the Remediation Contractor for this purpose.
4. All PPE used on site shall be decontaminated or disposed of at the end of each work day. Discarded PPE shall be placed in sealed DOT approved 55-gallon drums for off-site disposal.
5. Respirators, if necessary due to an upgrade to Level C PPE, shall be dedicated to each employee, and not interchanged between workers without cleaning and sanitizing.
6. Eating, drinking, chewing gum or tobacco, smoking, and any other practice that increases the likelihood of hand to mouth contact shall be prohibited within the delineated abatement and decontamination work zones. Prior to performing these activities, each employee shall thoroughly cleanse their face, hands, arms and other exposed areas.
7. All personnel shall thoroughly cleanse their face hands, arms and other exposed areas prior to using toilet facilities.
8. No alcohol, tobacco, illicit drugs or firearms will be allowed on the site at any time.
9. Contact with potentially contaminated surfaces should be avoided, if possible. Field personnel should minimize walking through standing

water/puddles, mud or other wet or discolored surfaces; kneeling on ground; and placing equipment, materials or food on ground or other potentially contaminated surface.

10. The use of the "Buddy System" shall be employed at all times while conducting work at the site. Each employee shall frequently monitor other workers for signs of heat stress or chemical exposure or fatigue: periodically examine others PPE for signs of wear or damage; routinely communicate with others; and notify the Health and Safety Officer in the case of an emergency.

B. Worker's must wear protective suits, protective gloves and eye protection. Respiratory protection shall be in accordance with OSHA regulation 1910.134 and ANSI Z88.2.

C. Any worker who dons a respirator must be trained as per OSHA and USEPA requirements, have medical clearance and must have recently received pulmonary function test (PFT) and respirator fit tested by a trained professional.

1. A personal air sampling program shall be in place as required by OSHA.
2. The use of respirators must also follow a complete respiratory protection program as specified by OSHA.

1.22 AIR MONITORING PLAN

In addition to its own air monitoring program the Contractor shall abide by the following Air Monitoring Plan to be performed by the Project Consultant:

Air Monitoring Plan

This Air Monitoring Plan (AMP) sets forth the procedures that will be used by the Project Consultant to conduct air monitoring and air sampling during the PCB remediation at the subject site. The primary objective of the air monitoring program is to monitor airborne PCB emissions generated during remediation and demolition activities at the facility and to limit the spread of any such emissions beyond the remediation area.

The focus of the monitoring will be to provide current information utilizing a combination of real-time monitoring of dust and pressure differential measurements inside and outside containment areas, and off-site laboratory analysis that will enable the project monitor to audit contractor performance and provide an initial assessment of cleaned areas.

Airborne dust concentrations will be monitored during remediation activities at monitoring points at the perimeter of containment areas using visual methods and/or a dust meter. For exterior excavations, if needed, dust monitoring will be performed at two down wind locations from the excavation areas.

A dust Action Level of either persistent visible dust, lasting longer than 1 minute, leaving the work area, or a reading of 300 $\mu g/m^3$, for at least 1 minute, will be established by the Project Consultant. If an exceedence of the Action Level is detected, background levels will be reviewed to determine if the source is on-site or off-site. If the source is on-site, activities will be halted and actions taken to suppress the dust to an acceptable level.

In addition to perimeter monitoring, the Site Remediation Contractor for this project will be proactive in minimizing the generation of dust by implementing control procedures, including regular covering of waste stockpiles and spraying and misting of the excavations, and masonry removal areas. Additional measures may include limiting or eliminating stockpiles, reducing the size of excavations, limiting hours of operation, and limiting operation in hot, dry weather.

In addition to dust monitoring, air samples may also be collected for PCBs concentrations. Sampling for PCBs may be performed at a frequency of up to daily during remediation work.

PCB in air samples will be collected using U.S. EPA Method TO-10A. This method involves collecting a 24-hour air sample using a modified polyurethane foam (PUF) sampler. Airborne PCBs are collected on a PUF cartridge preceded by a quartz fiber filter. Both the cartridge and the filter are submitted for laboratory analysis. Airborne PCB concentrations will be reported in nanograms per cubic meter (ng/m^3), and detection limits of approximately 5 ng/m^3 can usually be achieved.

The action level for perimeter PCB air sampling will be 150 ng/m^3.

One day of background sampling will be performed prior to the beginning of remedial activities. In addition, at least 2 days of post-remediation monitoring will be conducted after the PCB remediation activities are complete. If the results of this post-remediation sampling exceed 10 percent of the action level and are more than twice the background levels, additional periodic monitoring will be performed.

All perimeter air samples will be analyzed using the best turnaround time available. For PUF analysis this is typically 72 hours. Results will be either faxed or emailed directly from the lab to the Project Consultant. From there they will be disseminated to the parties. Any result exceeding 50 percent of the action level will be immediately forwarded to the Owner. All routine air data will be presented in tabular format as an attachment to the weekly report.

Any result exceeding 50 percent of this action level will be considered "elevated," and immediate measures will be taken to reduce perimeter PCB air concentrations. These initial measures may include:

- Increased use of water misting, on waste accumulation areas, and at tile/mastic removal areas;
- Altering work practices such as moving to other work locations on site, or working with different materials;

- Working a different shift (night, for example) to minimize volatilization; and,
- Reducing the area of waste that is exposed.

If PCB concentrations exceed the action level in any sample, all parties will be immediately notified and a meeting or conference call will be conducted to review the circumstances of the exceedance and determine what additional measures are necessary to prevent a recurrence. Such measures may include a reduced work shift or handling less material per day.

If a pattern of repeated exceedances emerges, all PCB excavation and handling activities will cease and all potential sources will be covered until an alternative material handling plan can be developed. Such measures may include a reduced work shift, handling less material per day, or backfilling excavations more quickly.

Quality control samples for air sampling will consist of trip blanks. The trip blank will consist of a PUF cartridge and a quartz fiber filter. The cartridge and filter will be prepared by the laboratory and shipped in a cooler with the other media. The trip blank will not be opened in the field. A minimum of one blank PUF sample per week will be submitted to the laboratory for analysis along with the samples. Blank samples will be numbered, logged, and labeled in the same manner as actual PUF samples, and no information will be provided to the laboratory that distinguishes them as blanks.

Each sample, including quality control samples, will be identified with a unique sample number. This number will provide easy identification of the sample in field logs, field data sheets, analytical reports, chain-of-custody forms, and project reports. Sample number and corresponding sample information such as site name, sampling date, and sample location will be kept in a sample log. All air sample cartridges and tubes will be labeled in the field and include the following information:

- Sample location
- Sample number
- Date sampled
- Sampler's initials

Upon completion of each sampling event, the samples collected (and any quality control samples) will be packaged in a cooler for overnight shipment to the analytical laboratory, or delivered by courier.

PUF cartridges will be capped at both ends, labeled, wrapped in aluminum foil, placed in padded sample bottles, and carefully packaged in the sample cooler to minimize jostling. The sample cooler will then be filled completely with packing material such as Styrofoam peanuts to prevent shifting and damage during shipment. The signed chain-of-custody documents (discussed in the following subsection) will be placed in a large zipper-sealed bag and affixed to the inside of the cooler lid. The cooler will then be sealed with packing tape, and custody seals will be affixed to ensure the integrity of the chain of custody.

The results of air sampling will be reviewed by the Project Consultant upon receipt from the laboratory. If airborne PCB concentrations at the site perimeter exceed the action level of 150 ng/m^3, the measures described in above will be implemented.

At the conclusion of remedial activities, and post remediation dust and accumulated accessible visible dust removal by the remediation contractor, the Project Consultant will conduct one round of 24 hour air monitoring for PCB Homologues at 2 locations in the proximity of the work area.

A summary of air monitoring activities completed on this project along with all air sampling data generated will be included in the final project report. The report will address any incident in which action levels were exceeded and the actions taken to reduce airborne emissions to acceptable levels.

1.23 UNIT PRICING

A. A unit price is an amount proposed by the Contractor and stated on the proposal as a price per unit of measurement for materials or services that will be added to or deducted from the Contract Sum by Change Order in the event the project Scope of Work is altered.

B. Unit prices include material, any direct or indirect expenses of the Contractor or Sub-Contractor, profit, insurance, bonding, and any applicable taxes. The same unit price shall apply whether the work is added or deducted.

C. The Contractor shall provide unit pricing on the attached rate sheet.

2.0 PART 2 – PRODUCTS

2.1 ABATEMENT PRODUCTS

A. All materials shall be delivered in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.

B. Disposal Drums: Metal or fiberboard with locking ring tops, with warning labels as required by OSHA, and/or EPA.

C. Respirators: Type: Approved by the Mine Safety and Health Administration (MSHA), Department of Labor, or the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

D. Vacuum Cleaners: Type: Vacuums equipped with HEPA filters.

E. Polyethylene Sheeting: Type: Minimum 6 mil., opaque, fire retardant polyethylene sheets.

F. Cleaning Products:
Remediation Contractor where required for PCB extraction shall use utilize specialty cleaning products such as Capsur, TechXtract or other cleaners for use in decontaminating porous and non-porous surfaces to remain. All such products shall be utilized in accordance with manufacturer's specifications as intended. Remediation Contractor shall ensure appropriate use and disposal associated with use in accordance with the MSDS sheets for each product utilized. It shall be incumbent upon the Remediation Contractor to determine the need for use of specialty products to meet required cleaning verification levels established herein and in accordance with the Work Plan.

2.2 GENERAL EQUIPMENT

A. A sufficient supply of disposable mops, rags, and sponges for work area cleaning and decontamination shall be available.

B. A sufficient supply of scaffolding, ladders, lifts, and hand tools (e.g., scrapers, wire cutters, brushes, utility knives, wire saws, etc.) shall be provided as needed.

2.3 PERSONNEL PROTECTION

A. Safety equipment (e.g., hard hats meeting the requirements of ANSI Standard Z89.1-1981, eye protection meeting the requirements of ANSI Standard Z87.1-1979, safety shoes meeting the requirements of ANSI Standard Z41.1-1967, disposable PVC gloves or other work gloves), shall be provided to all workers and authorized visitors.

B. Non-skid footwear shall be provided to all abatement workers. Disposable clothing shall be adequately sealed to the footwear to prevent body contamination.

3.0 PART 3 - EXECUTION

3.1 WORK AREA PROTECTION – ABATEMENT ZONE

A. Protection of Existing Construction: Perform PCB Bulk Product Waste and Bulk PCB Remediation Waste removal work without damage or contamination of adjacent areas, soil and existing construction.

B. During all remediation activities, Remediation Contractor shall maintain control of all entrances and exits to the project site to ensure only authorized personnel enter the work areas and are afforded proper personal protective equipment and as required respiratory protection. All approaches to work areas shall be demarcated with appropriately worded warning signs.

C. Work zones shall be established in accordance with this section to include abatement zone, decontamination zone and support zone.

D. Ground protection to prevent debris from escaping the abatement zone and to protect areas outside of abatement zone from PCB contamination shall be utilized. Protection shall include the use of water impervious membrane covering which shall be secured to the ground surface. Edges shall be raised to prevent water run-off used for dust control during channel cutting and demolition of structures. The membrane shall be covered with a single layer of 6-mil polyethylene sheeting securely fastened to foundation.

E. All other openings to the building interior such as unit ventilation, ducts, and grilles shall be securely sealed with a single layer of 6-mil polyethylene sheeting from the building exterior. Unit ventilation, ducts and grilles on adjacent buildings which could be affected by emissions from the work area will also be sealed with a single 6-mil polyethylene sheeting.

F. Ground protection and isolation barriers shall remain in place throughout work to collect dust and debris resulting from PCB Bulk Waste removal and PCB Remediation Waste removal. All debris generated during operations including but not limited to visible floor tiles or mastics, dust and debris shall be HEPA vacuumed continuously throughout the work shift and at the end of a work shift to avoid accumulation. Any tears or rips that occur in protections shall be repaired or removed and replaced with new protections.

G. Warning Signage: Post warning signs in accordance with 29 CFR 1910.1200 at all approaches to the work area. Signs shall be conspicuously posted to permit a person to read signs and take precautionary measures to avoid exposure to PCBs or other Toxic or Hazardous Substances. These signs should include the PCB M_L markers at each entrance to the work area.

H. Waste Containers for PCB Bulk Product Waste: Appropriate waste containers shall be placed adjacent to abatement zones. Containers shall be lined covered and secured.

3.2 DECONTAMINATION ZONE

A. The Remediation Contractor shall establish contiguous to the work area, a decontamination enclosure consisting of equipment room, shower room, and clean room in series. The only access between contaminated and uncontaminated areas shall be through this decontamination enclosure. The Remediation Contractor shall ensure that employees enter and exit the Abatement Zone through the decontamination area.

B. Access between rooms in the decontamination system shall be through double flap curtain opening airlocks.

C. Construct the decontamination systems with wood or metal framing, 3/8" sheathing and cover both sides with a double layer of six (6) mil polyethylene sheeting, spray glued or taped at the joints. Caulk joints watertight at floor, walls, and ceiling.

D. The Remediation Contractor shall visually inspect barrier several times daily to assure effective seal and the Remediation Contractor shall repair defects immediately.

E. Equipment room: The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment.

F. Shower area: Shower facilities shall be provided which comply with 29 CFR 1910.141(d)(3). The showers shall be adjacent both to the equipment room and the clean room.

G. Clean change room: The clean room shall be equipped with a locker or appropriate storage container for each worker's use. Following showering, each worker must then change into street clothing in clean change areas.

H. Decontamination area entry procedures: The Remediation Contractor shall ensure that all workers follow proper decontamination procedures for entry into a Regulated Work area including but not limited to the following:

1. Enter the decontamination area through the clean room.
2. Remove and deposit street clothing within a locker provided for their use.
3. Don protective clothing and respiratory protection before leaving the clean room.
4. Before entering the Abatement Zone, the Remediation Contractor shall ensure that workers pass through the equipment room.

I. Decontamination area exit procedures: The Remediation Contractor shall ensure that all workers follow proper decontamination procedures for exit from a Regulated Work area including but not limited to the following:

1. Before leaving the regulated area, workers shall remove all gross contamination and debris from their protective clothing.
2. Workers shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.
3. Workers shall shower prior to entering the clean room.
4. After showering, workers shall enter the clean room before changing into street clothes.
5. All equipment and surfaces of containers filled with PCB waste must be cleaned prior to removing them from the equipment room or area.

3.3 <50 mg/kg PCB BULK PRODUCT WASTE MATERIAL

Refer to Figure 1, for PCB Bulk Product locations.

A. <50 mg/kg PCB Contaminated Waste Materials including mastics and adjacent floor tiles and cove board shall be handled and removed from specified locations for proper disposal.

B. Materials shall be removed in a manner which does not breakdown the materials into fine dust or powder to the extent feasible. Equipment and tools to be utilized shall include hand tools only to remove materials from adjacent substrates.

C. Any dry or brittle mastic materials or other PCB Contaminated waste shall be removed with additional engineering controls such as use of a HEPA vacuum to remove accumulated dust or debris during removal.

D. Sequence of removal shall follow the following general requirements:

a. Floor tiles and cove boards shall be removed in their entirety for disposal as <50 mg/kg, Connecticut Regulated PCB Contaminated Remediation Waste in accordance with C.G.S, Sections 22a-463 through 22a-469.

b. PCB Contaminated mastics shall be removed from all remaining surfaces and properly containerized for disposal as <50/mg/kg, Connecticut Regulated, PCB Contaminated Waste in accordance with C.G.S, Sections 22a-463 through 22a-469.

c. Surfaces from which PCB mastics has been removed shall be cleaned with a PCB extracting agent (CAPSUR® or similar) and wire brush to remove all visible mastic prior to proceeding with removal of PCB Contaminated Waste. All rags and other cleaning materials used to decontaminate and clean remaining surfaces shall also be properly disposed as <50 mg/kg PCB Waste in accordance with C.G.S., Sections 22a-463 through 22a-469.

E. Waste shall be immediately placed in disposal containers/storage trailers. The containers shall not be emptied into other containers to avoid dispersal of dust or fugitive emissions.

F. The use of minimal but sufficient quantities of water to wet the generated dust prior to collection shall be utilized. Under no circumstances shall the PCB waste show evidence of free liquid water, pooling or ponding within the waste stream. Any liquid used to wet the dust and debris to control fugitive emissions shall be properly containerized and decontaminated in accordance with C.G.S., Sections 22a-463 through 22a-469.

G. <50 mg/kg PCB Bulk Product Waste shall be stored for disposal in accordance with C.G.S, Sections 22a-463 through 22a-469 regulating mastics or other building materials containing PCBs <50 mg/kg but ≥1 mg/kg. Waste generated includes both asbestos and PCB <50 mg/kg. The waste shall be containerized in accordance with requirements of project asbestos abatement specifications. Facility proposed for disposal shall be permitted to accept non-friable asbestos waste with PCB <50 mg/kg.

H. All waste containers shall be appropriately labeled in accordance with C.G.S., Sections 22a-463 through 22a-469 regulating mastics or other building materials containing PCBs <50 mg/kg but ≥1 mg/kg.

3.4 CLEANING AND DECONTAMINATION

A. The Remediation Contractor shall be responsible for complete cleaning and decontamination of the Abatement Zone upon completion of work. The Abatement Zone will be required to meet proposed Verification Sampling limits established in the Work Plan.

B. The Remediation Contractor shall utilize HEPA vacuum and wet cleaning products to remove all visible dust and debris from all surfaces within the work area. If specialty products are utilized the Remediation Contractor shall utilize in accordance with manufacturer's specifications including any additional safety and disposal requirements for such use.

C. Any liquid used to wet the dust and debris to control fugitive emissions shall be collected and decontaminated in accordance with C.G.S., Sections 22a-463 through 22a-469.

D. All rags and other cleaning materials used to clean shall also be properly disposed as <50 mg/kg PCB Contaminated Waste. All PCB Contaminated Waste shall be stored for disposal in accordance with C.G.S., Sections 22a-463 through 22a-469.

E. Equipment to be utilized in connection with the removal of PCB Bulk Product Waste, Bulk PCB Contaminated waste and PCB Contaminated soil including waste collection or that will or may come in direct contact with the site contaminants shall be

decontaminated prior to leaving the site to prevent migration of the contaminated residues from the project site.

F. All non-disposable equipment and tools employed in the course of the project will be decontaminated at the conclusion of each work day through the following sequence:
   1. Initial tap water rinse, to remove gross soil
   2. Tap water and laboratory grade detergent (Alconox® or similar) wash
   3. Tap water rinse

G. The wash water and decontamination liquids shall be captured and containerized in DOT approved 55-gallon drums for off-site disposal as <50 mg/kg PCB contaminated waste in accordance with C.G.S., Sections 22a-463 through 22a-469.

3.5 POST ABATEMENT INSPECTION AND SAMPLING

A. The Owner has retained an industrial hygiene firm (Owner's Consultant, Facility Support Services, LLC) to perform periodic inspections and sampling during the work. Site visits shall be scheduled based on the progress of the work and at critical time periods.

B. The Owner's Consultant shall perform inspections for visible emissions of dust. Work may be stopped and dust control measures applied at the direction of the Owner's Consultant.

C. The Owner's Consultant shall perform post removal and decontamination visual clearance inspection, sampling and air monitoring as necessary to determine complete removal of PCB's.

D. Once verification sampling has documented the Abatement Zone meets required criteria the Remediation Contractor shall be permitted to remove decontamination unit and critical barriers. These areas shall be subjected to a visual inspection to ensure no visible dust or debris is present.

3.6 ON-SITE WASTE MANAGEMENT AND DISPOSAL OF SOLID HAZARDOUS WASTES

A. All solid waste material, containment system components, used personnel protective equipment, and other solid wastes generated during the work, shall be placed directly in appropriate waste receptacles immediately upon removal from its in-situ position. Suitable waste receptacles may consist of roll-off containers or DOT-approved 55-gallon drums.

B. The Remediation Contractor shall be responsible for all packaging, labeling, transport, disposal and record-keeping associated with PCB or PCB contaminated waste in accordance with all federal, state and local regulations.

C. The Remediation Contractor shall ensure that the person transporting the waste holds a valid permit issued in accordance with appropriate federal, state, and local regulations.

D. The Remediation Contractor shall provide to the transporter at the time of transfer appropriate shipping records or uniform waste manifests as required by the federal, state and local regulations with a copy to the Owner and Owner's Consultant.

E. Remediation Contractor shall maintain proper follow up procedures to assure that waste materials have been received by the designated waste site in a timely manner and in accordance 761.61(a)(5)(v)(A)and with all other federal, state and local regulations.

F. If roll-off containers are to be utilized for containerization of the abatement wastes the following shall apply:

G. All roll-off containers or other similar vessels utilized shall be watertight and lined with 6-mil polyethylene sheeting or equivalent impermeable lining, and equipped with a secured and impermeable cover.

H. The impermeable cover shall remain securely in place at all times when material is not being actively placed in the vessels. The Remediation Contractor shall be responsible for ensuring that the cover remains securely intact until the container is removed from the site.

I. If 55-gallon drums are to be utilized for waste containerization, the drums shall consist of suitable DOT-approved 55-gallon drums that are watertight and free of corrosion, perforations, punctures, or other damage. All drums shall be securely covered and sealed at the conclusion of each work day.

J. The waste containers shall remain staged at the site with a secure impermeable cover in place until the materials are transported from the site to be delivered to the designated disposal facility.

K. A waste roll-off and drum staging area shall be designated prior to initiation of the abatement work, and approved by the Project Engineer and Owner's Consultant.

L. The Contractor shall provide copies of the waste manifests and bill of lading and weigh slips to the Project Consultant within 5 business days of disposal.

M. Waste manifests must show chain of custody. Provide required copies of the waste shipment records for wastes to the Owner's Consultant as required. Any chemicals, solvents or other products used during decontamination shall be properly containerized. Waste must be disposed in accordance with all state and federal regulations Connecticut General Statutes including but limited to C.G.S., Sections 22a-463 through 22a-469.

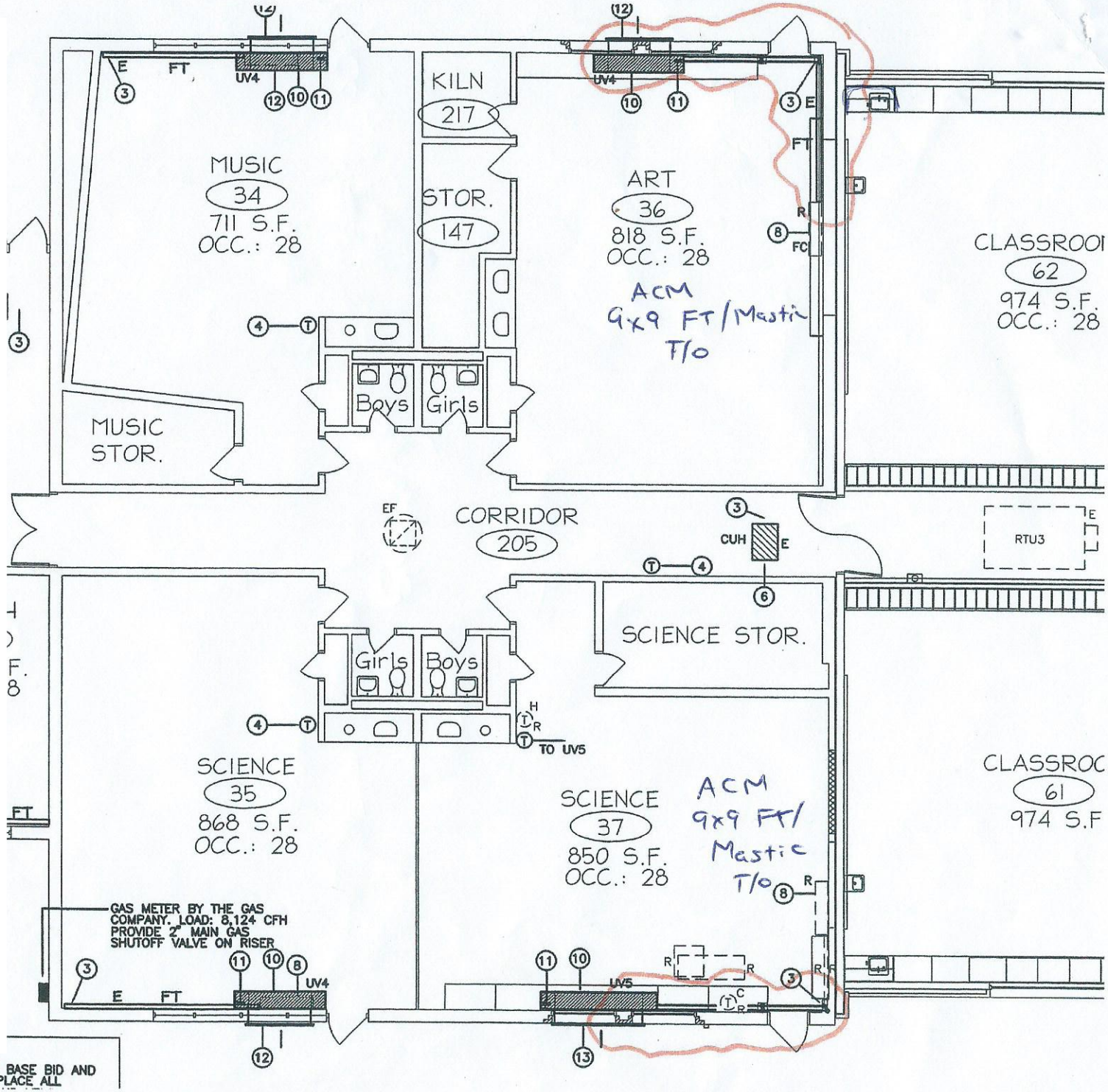
N. All contaminated waste shall be carefully loaded on trucks or other appropriate vehicles for transport. Before and during transport, care shall be exercised to insure that no unauthorized persons have access to the material.

O. Transporters of the waste are prohibited from "back hauling" any freight after the disposition of the Owner's waste stream until decontamination of the vehicle and/or trailer is assured.

END OF SECTION

FIGURES

Figure 1
Site Map
Race Brook School
Boiler and Ventilator Project



ATTACHMENT A

BID FORM

BID FORM
PCB BUILDING MATERIALS ABATEMENT SPECIFICATIONS
Orange Board of Education
Boiler Replacement Project
Race Brook School
107 Grannis Road in Orange, Connecticut

A. Every attempt has been made to accurately depict the extent of the material and scope of work in this specification. The bidder shall visit the work site to determine exact quantities and the degree of difficulty of working in these areas. When there is a disagreement on the nature or composition of the materials to be removed, the Contractor may engage the Owner's Consultant to test the materials. The Contractor shall pay costs in connection with the testing and there shall be no claim delay.

B. The locations of PCB Containing Materials indicated on the drawings and the extents of work included in this specification are only best estimates that are limited by the physical constraints. Locations of PCB materials different from that indicated on drawings but within the limits of the project work area are considered as having no impact on contract price and time of this contract. Where additional PCB abatement work is required beyond the above variations, the special unit prices and time will be adjusted under provisions of applicable clause in the contract. Additional or reduced abatement work beyond the variations stated will be a basis for adjustment of the contract price.

C. Unit prices and provisions are to be included in and become part of the contract, and shall be used in evaluating additions to or deductions from the work as specified in the specification. All special unit prices include all ancillary costs inherent with the work preformed including but not limited to overhead, profit, permitting and cost of disposal.

BASE BID

LUMP SUM COST

The base bid shall include all costs associated with the project work as described with exception of the excavation, removal loading/transport/disposal of soil and asphalt. Payment will be including but not limited to the site preparation, permit/plan preparation, mastic, tile and cove board removal/disposal, substrate cleaning, cleaning liquid handling/disposal, health and safety engineering controls and equipment decontamination (decontamination to include the removal, transfer, storage, transportation and disposal of decontamination liquids, including the use of a vacuum tank truck if deployed) with all work being completed following all applicable regulations.

Removal and Disposal of PCB Contaminated Building Materials L.S. $_____

Unit cost rates:

Remediation Type	Unit	Unit price
Removal of Substrate	Square Foot	$_____/sq. ft.
Disposal PCB impacted substrate <50 mg/kg	Ton	$_____/tn.
Substrate Replacement	Square Foot	$_____/sq. ft.

Notes:

1. All prices must include all labor and equipment, loading and transport

A mandatory Pre-Bid Meeting will be held at the project site at a time and date to be determined

Attachment 1

Notification of PCB Activity and PCB Inspection Report

Facility Support Services, LLC

Environmental & Safety Consulting Engineers

July 6, 2013

Mr. Gary Trombly
Connecticut Department of Energy and
Environmental Protection
79 Elm Street
Hartford, CT 06106

RE: Notification of PCB Activity, Race Brook School, Orange, Connecticut (FSS# 34613)

Dear Mr. Trombly,

On behalf of the Orange Board of Education (Orange BOE), Facility Support Services, LLC (FSS) is sending this letter to serve as Notification of the abatement of <50 mg/kg PCB containing mastic materials associated with floor tiles and cove board of Race Brook School located at 107 Grannis Road in Orange, Connecticut. This work will be done as part of a boiler and ventilator replacement project planned to be completed by the Orange BOE during August 2013.

This Notification follows the detection of PCB concentrations of up to 22 mg/kg in cove board mastic, as documented in the attached PCB Inspection & Bulk Sampling of Roofing Materials report, prepared by FSS, dated July 6, 2013.

The abatement will be conducted by a contractor to be selected through public bid, following specifications to be prepared by FSS and the project Architect Rose & Tiso Co., LLC, Fairfield, CT. The PCB abatement specifications will include that the PCB mastics be removed by appropriately trained and monitored personnel in accordance with the OSHA HAZWOPER standard under 29 CFR 1910.120 and that the PCB mastic is containerized and disposed of in accordance with applicable regulations under 40 CFR 761 and affiliate State of Connecticut regulations. The specifications will also include requirements that the substrate be cleaned with PCB extracting solvent (Capsur®, or similar) after the mastic removal.

Follow-up verification sampling will be completed after removal of the mastic materials of the substrate at four (4) cove board and four (4) floor tile location. Samples will be collected and tested for PCBs concentrations by Soxhlet extraction. The project specifications will include instructions to perform additional cleaning and/or removal of substrate if concentrations of PCB >1.0 mg/kg are detected.

A summary report will be issued at the conclusion of the project documenting the PCB abatement activities.

2685 State Street • Hamden, CT 06517
Phone: 203-288-1281 • Fax: 203-248-4409
Website: www.fssteam.com • Toll Free: (866) 377-7495

If you have any questions, or if we can be of further assistance, please contact the undersigned at (203) 288-1281.

Sincerely,
Facility Support Services, LLC

Kevin Bogue

Kevin Bogue, LEP, CHMM
Project Manager

cc: Mike Luzzi, Orange BOE

Attachment A – July 6, 2013 PCB Inspection Report

Attachment A

June 5, 2013 PCB Inspection Report

Facility Support Services, LLC

Environmental & Safety Consulting Engineers

July 6, 2013

Town of Orange
Board of Education
Attn: Michael Luzzi
637 Orange Center Road
Orange, Connecticut 06477

RE: PCB Inspection of Flooring Components, Race Brook Elementary School; Orange, Connecticut (FSS #26513)

Dear Mr. Luzzi,

At the request of the Orange Board of Education, Facility Support Services, LLC (FSS) conducted an inspection of flooring components proposed to be disturbed as a result of proposed renovations on July 2, 2013 of suspect PCB containing materials associated with the floor of Rooms 36, 37 and 62 of Race Brook School located at 107 Grannis Road in Orange, Connecticut.

The floor system was inspected by Mr. Kevin Bogue of FSS; a Connecticut Licensed Environmental Professional (LEP) and Certified Hazardous Materials Manager (CHMM). A total of six (6) bulk samples were collected. The materials sampled from the area include mastics associated with cove board and floor tiles in Rooms 36 and 37.

Based on the inspection and discussions with facility personnel regarding the age of the building, no materials were sampled in Room 62 as this portion of the building was constructed around 2002, after the ban on PCB-containing materials by the United States Congress in 1979

Samples of materials were delivered under full chain of custody and analyzed for 2 day turn-around time by Complete Environmental Testing, Inc. (CET), via EPA Method 3540C with Soxhlet extraction. This is currently the approved EPA test method. CET is an accredited laboratory (PH #01160). Copies of the laboratory analytical results can be found in Attachment A of this report. The following table summarizes PCB laboratory results.

Sample ID	Material Sampled	Location	PCB (mg/kg)
20130702_S1	Tan mastic associated with and brown cove board	Room 36	0.6
20130702_S2	Tan mastic associated with brown cove board	Room 37	22
20130702_S3	Black mastic associated with 12x12 floor tile	Room 36	1.1
20130702_S4	Black Mastic associated with 9x9 floor tile	Room 36	1.4
20130702_S5	Black mastic associated with 12x12 floor tile	Room 37	2.1
20130702_S6	Black Mastic associated with 9x9 floor tile	Room 37	0.54

mg/kg = milligrams per kilogram

2685 State Street ● Hamden, CT 06517
Phone (203) 288-1281 ● Fax (203) 248-4409
Website: www.fssteam.com ● Toll Free: (866) 377-7495

The data revealed that PCBs were detected in the following materials:

- **Tan Mastic associated with brown cove board, Rooms 36 & 37**
- **Black Mastic associated with 12”x12” beige floor tiles and underlying 9”x9” brown floor tiles, Rooms 36 & 37**

Please note that FSS has made reasonable effort to locate and identify all PCB containing materials associated with the roof. However, any materials discovered during renovation activities which have not been included in this survey or previously sampled must be presumed to contain PCBs until such time that bulk samples can be collected and analyzed for PCB content. In addition, the removal and disposal of the PCB containing materials should be performed by properly trained individuals in accordance with 29 CFR 1910.120 and other applicable OSH regulations.

Given the levels of PCBs detected in building components (i.e., < 50 ppm), this project will be driven primarily by the Connecticut Department of Energy and Environmental Protection (CTDEEP), versus by the Environmental Protection Agency (EPA). FSS has contacted Gary Trombly of the CTDEEP who heads the PCB for the State of Connecticut to discuss this project. The CTDEEP does not require a written workplan to address identified PCB-containing materials, however, confirmatory sampling to ensure that all PCB containing components have been removed and no leaching of PCBs to underlying components have occurred will be required. A scope of work should be developed for the contractor that would include the removal and proper disposal of floor tiles and cove board.

Following removal of PCB containing materials, confirmatory sampling will be conducted for PCB in remaining/adjoining components. Confirmatory sampling shall ensure that remaining PCB levels are below 1 ppm. If levels do not meet this criterion, abatement of additional materials will need to occur, or the school system can encapsulate the substrate as interim measure and obtain an annual exemption from the CTDEEP for remaining PCB components (according to the State of Connecticut Regulations 22a-466), pending CTDEEP approval.

FSS is pleased to assist you with this project. If you have any questions, or if we can be of further assistance, please contact the undersigned at (203) 288-1281.

Sincerely,
Facility Support Services, LLC

Kevin Bogue

Kevin Bogue, CHMM
Project Manager

Attachment A: Laboratory Analytical Data

ATTACHMENT A

LABORATORY ANALYTICAL DATA

COMPLETE ENVIRONMENTAL TESTING, INC.

80 Lupes Drive
Stratford, CT 06615

Tel: (203) 377-9984
Fax: (203) 377-9952
e-mail: cet1@cetlabs.com

Client: Mr. Chris Hudacek
Facility Support Services
2685 State Street
Hamden, CT 06517

Analytical Report

CET # 13070041

Report Date: July 5, 2013
Client Project: Racebrook, Orange
Client Project #: 34713

Connecticut Laboratory Certification PH 0116
Massachusetts Laboratory Certification M-CT903
Rhode Island Certification 199

New York Certification 11982
Florida Laboratory Certification E871064

SAMPLE SUMMARY:

This report contains analytical data associated with the following samples only:

CETID	Client Sample ID	Matrix	Collection Date	Collection Time	Receipt Date
AF37109	20130702-S1	Solid	7/2/2013		07/02/2013
AF37110	20130702-S2	Solid	7/2/2013		07/02/2013
AF37111	20130702-S3	Solid	7/2/2013		07/02/2013
AF37112	20130702-S4	Solid	7/2/2013		07/02/2013
AF37113	20130702-S5	Solid	7/2/2013		07/02/2013
AF37114	20130702-S6	Solid	7/2/2013		07/02/2013

Sample temperature upon receipt was 5.6 degrees C

PREP ANALYSIS:

Soxhlet Extraction [EPA 3540C]

Client ID	20130702-S1	20130702-S2	20130702-S3	20130702-S4	20130702-S5
CET ID	AF37109	AF37110	AF37111	AF37112	AF37113
Date Analyzed	7/2/2013	7/2/2013	7/2/2013	7/2/2013	7/2/2013

Soxhlet Extraction [EPA 3540C]

Client ID	20130702-S6
CET ID	AF37114
Date Analyzed	7/2/2013

ANALYSIS:

EPA 8082 PCBs [EPA 8082A] Units: mg/kg (As Rec'd)

Client ID	20130702-S1	20130702-S2	20130702-S3	20130702-S4	20130702-S5
CET ID	AF37109	AF37110	AF37111	AF37112	AF37113
Date Analyzed	7/3/2013	7/3/2013	7/3/2013	7/3/2013	7/3/2013
Dilution	1.0	20.0	2.0	2.0	2.0
PCB-1016	ND < 0.25	ND < 5.0	ND < 0.50	ND < 0.50	ND < 0.50
PCB-1221	ND < 0.25	ND < 5.0	ND < 0.50	ND < 0.50	ND < 0.50
PCB-1232	ND < 0.25	ND < 5.0	ND < 0.50	ND < 0.50	ND < 0.50
PCB-1242	ND < 0.25	ND < 5.0	ND < 0.50	ND < 0.50	ND < 0.50
PCB-1248	ND < 0.25	19	ND < 0.50	ND < 0.50	ND < 0.50
PCB-1254	0.60	13	1.1	1.4	2.1
PCB-1260	ND < 0.25	ND < 5.0	ND < 0.50	ND < 0.50	ND < 0.50
PCB-1268	ND < 0.25	ND < 5.0	ND < 0.50	ND < 0.50	ND < 0.50
TCMX (Surr 1) 50-150	53	+	42 L	41 L	47 L
DCB (Surr 2) 50-150	48 L	+	38 L	34 L	36 L

EPA 8082 PCBs [EPA 8082A] Units: mg/kg (As Rec'd)

Client ID	20130702-S6
CET ID	AF37114
Date Analyzed	7/3/2013
Dilution	2.0
PCB-1016	ND < 0.50
PCB-1221	ND < 0.50
PCB-1232	ND < 0.50
PCB-1242	ND < 0.50
PCB-1248	ND < 0.50
PCB-1254	0.54
PCB-1260	ND < 0.50
PCB-1268	ND < 0.50
TCMX (Surr 1) 50-150	58
DCB (Surr 2) 50-150	38 L

Questions related to this report should be directed to David Ditta, Timothy Fusco, or Robert Blake at 203-377-9984.

Sincerely,

David Ditta
Laboratory Director

Report Comments:

1. ND is None Detected at the specified detection limit.
2. All analyses were performed in house unless a Reference Laboratory is listed.
3. Samples will be disposed of 30 days after the report date.
4. Sample Result Flags:
   E - The result is estimated, above the calibration range.
   H - The surrogate recovery is above the control limits.
   L - The surrogate recovery is below the control limits.
   B - The compound was detected in the laboratory blank.
   P - The Relative Percent Difference (RPD) of dual column analyses exceeds 40%.
   D - The RPD between the sample and the sample duplicate is high. Sample homogeneity may be a problem.
5. All results met standard operating procedures unless indicated by a data qualifier next to a sample result, or a narration in the QC report.

CET # 13070041

Volatile Soils Only:

Date and Time in Freezer
Client:
CET:

CHAIN OF CUSTODY RECORD

CET
COMPLETE ENVIRONMENTAL TESTING, INC.

80 Lupes Drive
Stratford, CT 06615
Tel: (203) 377-9984
Fax: (203) 377-9952
e-mail: cet1@cetlabs.com
Bottle Request e-mail: bottleorders@cetlabs.com

Matrix: A=Air, S=Soil, W=Water, DW=Drinking W., C=Cassette, Solid, Wipe, Other (Specify)

Turnaround Time ** (check one): Same Day *, Next Day *, 2 Days *, Std (5-7 Days)

Sample ID	Date/Time	Matrix	Same Day *	Next Day *	2 Days *	Std (5-7 Days)	8260 CT List	8260 Aromatics	8260 Halogens	CT ETPH	8270 CT List	8270 PNAs	PCBs by Soxhlet	Pesticides	Herbicides	13 Priority Poll	8 RCRA	TOTAL	TCLP	SPLP	Field Filtered	Lab To Filter	TOTAL # OF CONT.	NOTE #
20030702-S1	7/2/13	Solid			X								X										1	
-S2					X								X										1	
-S3					X								X										1	
-S4					X								X										1	
-S5					X								X										1	
-S6					X								X										1	

Organics: 8260 CT List, 8260 Aromatics, 8260 Halogens, CT ETPH, 8270 CT List, 8270 PNAs, PCBs by Soxhlet, Pesticides, Herbicides

Metals (check all that apply): 13 Priority Poll, 8 RCRA, TOTAL, TCLP, SPLP, Field Filtered, Lab To Filter

Additional Analysis

PRESERVATIVE (Cl–HCl, N–HNO_3, S–H_2SO_4, Na–NaOH, C=Cool, O–Other)

CONTAINER TYPE (P–Plastic, G–Glass, V–Vial, O–Other)

Soil VOCs Only (M=MeOH B=Sodium Bisulfate W=Water F=Empty Vial E=Encore)

RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
Ken Bogue	7/2/13 12:21	Parker
RELINQUISHED BY:	DATE/TIME	RECEIVED BY:
RELINQUISHED BY:	DATE/TIME	RECEIVED BY:

NOTES: need results before Friday 3:00 pm.

Client / Reporting Information

Company Name: Facility Support Services LLC

Address: 2685 State St. Hamden, CT 06518

City: Chris Hudacek State: CHudacek@FSS@SNET.NET Zip:

Report To: E-mail:

Phone #: 203.288-1281 Fax #: 203.248-4409

Project Information

Project Contact: C. Hudacek PO #: —

Project: Race Brook Project #: 34713

Location: Orange, CT Collector(s): K. Bogue

QA/QC: ☒ Std ☐ Site Specific (MS/MSD) * ☐ RCP Pkg * ☐ DQAW *

Data Report: ☒ Email ☐ PDF ☐ Excel ☐ Other

RSR Reporting Limits (check one): ☐ GA ☐ GB ☐ SWP ☒ Other (specify) PPM

Lab Use:
Evidence of Cooling: Y or N
Temp Upon Receipt ____ °C

SHEET 1 OF 1

* Additional charge may apply. ** TAT begins when the samples are received at the Lab and all issues are resolved. TAT for samples received after 3 p.m. will start on the next business day.

REV. 12/11

SECTION 02 00 50

DEMOLITION, CUTTING, PATCHING, REFINISHING AND REFURBISHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

The general provisions of the Contract apply to the work specified in this Section.

1.2 DESCRIPTION OF WORK

A. The extent of demolition, cutting, patching, refinishing and refurbishing work is as noted on the Drawings and specified herein.

1. Cutting, coring and alteration work shall be performed by Trades who normally provide the respective kinds of materials and finishes.
2. Patching, refinishing, refurbishing and repairs to existing work shall be performed by Trades who normally provide the respective kinds of finish work.

B. Where demolition and removals are indicated, the work includes removal of existing materials including all auxiliary materials, accessories, anchorage, adhesives, and etc., down to sound bare substrates.

C. This work includes removal, storage, protection and reinstallation of existing work as required to accommodate alterations indicated.

D. Protect existing work to remain.

E. Cut and patch existing work as required by alterations.

F. Refinish all surfaces of patched work so as to provide uniform finish which renders patching imperceptible from a distance of 3 feet, and to Engineers satisfaction.

1.3 SUBMITTALS

A. Submit complete and detailed Schedule of all items of work under this Section, for review by Engineer.

Review by Engineer in no way alleviates Contractor's full and undivided responsibility for completeness, accuracy, safety, or feasibility of operations, methods, equipment, manpower, and approval by governing authorities. Submit schedule no less that five (5) working days prior to start of work.

1.4 JOB CONDITIONS

A. Temporary partitions and enclosures shall be erected prior to commencing any adjacent demolition that will create conditions of public hazard.

B. Maintain all existing utilities, keep in service, and protect against damage during demolition, cutting and coring operations. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by Owner. Contractor and Owner will shut off any utilities serving areas

requiring demolition. Contractor shall disconnect and seal these utilities before starting demolition operations as part of this work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials as required by alterations for patching, repairing, refinishing and refurbishing of existing work, that are equal in quality to existing materials to remain, except where other materials are specifically called for on Drawings or herein. Exposed materials shall be exact match to existing exposed similar materials.

PART 3 - EXECUTION

3.1 DEMOLITION, CUTTING, CORING

A. Coordinate demolition, cutting, coring, alteration work to minimize disturbance and interruption of Owner's activities. Contractor shall not use compressor, drill, or cut concrete without Owner' and Engineer's acceptance of schedule. Notify Architect/Engineer of intent to start demolition 3 days prior to start of work.

B. Provide reinforcing where patching of existing construction so requires in order to maintain the original structural integrity of assemblies prior to cutting.

C. Cutting and patching shall be limited to that necessary to complete all work and to this end, the Contractor shall closely coordinate and supervise the work of all trades and subcontractors prior to performing cutting.

D. Cutting and patching shall be neatly and carefully done in a thorough and workmanlike manner. Patching, repairing, and refinishing shall be performed by the trades or subcontractors who normally provide and install the respective kinds of materials and finishes. Patches and repairs shall be as inconspicuous as possible, and shall be subject to approval by the Architect/Engineer.

E. Work indicated to be removed shall include removal of all auxiliary materials, accessories, anchorage, etc. No residual shall remain from work to be removed. Contractor shall employ whatever means necessary, as acceptable to Owner and Engineer, to provide complete and thorough removal of existing work. If shot blasting is required to remove residual adhesives, mastics and similar materials, Contractor shall provide same as required to achieve specified substrate conditions at no extra cost.

F. Materials or items designated to be reused shall be as shown on the Drawings. Remove such items with care, under the supervision of the trade responsible for reinstallation; protect and store until installed. Replace materials or items damaged during removal with similar new construction of equal quality.

G. Materials or items demolished and not designated as the property of the Owner or to be reinstalled, shall become the property of the Contractor and shall be removed from the Project.

H. Execute the work in an orderly and careful manner, with the least possible disturbance to the public, adjacent properties, and Owner.

I. Where alterations occur or new work and old work join, cut, remove, patch, repair, or refinish adjacent surfaces as required by job conditions, and leave in condition equal to or better than condition prior to the commencing of the work. The materials and workmanship employed in the alterations, unless otherwise shown or specified, shall be equal in quality to that of the original work. Alteration work shall be performed by the various respective trades that normally perform

that particular item of work.

J. Clean existing surfaces of dirt, grease, loose paint, and so on before refinishing.

K. Cut out imbedded anchorage, supports, and attachment items as required to properly provide for patching and repair of the respective finishes.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.

2. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 1 Section "Special Project Procedures"..

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with ANSI A10.6 and NFPA 241.

1.5 PROJECT CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. 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.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

3.3 PREPARATION

A. 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.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

3. Cover and protect furniture, furnishings, and equipment that have not been removed.

4. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 1 Section "Temporary Facilities and Controls."

C. Temporary Shoring: 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.

3.4 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. 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, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

3 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.

4. Maintain adequate ventilation when using cutting torches.

5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

7. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:

1. Store items in a secure area until delivery to Owner.

2. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Protect items from damage during transport and storage.

3. 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.

D. 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 reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

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.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 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.

END OF SECTION

SECTION 03 30 00

CONCRETE

PART 1 GENERAL

1.1 1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemen-tary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 RELATED SECTIONS

A. Section 09 65 19 – Resilent Flooring.

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified:

1. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
2. ACI 301 "Specifications for Structural Concrete for Buildings".
3. ACI 318 "Building Code Requirements for Reinforced Concrete".
4. ACI 318.1 "Building Code Requirements for Structural Plain Concrete".
5. ANSI/ASCE 9-91 “Standard Practice for Construction and Inspection of Com-posite Slabs”.
6. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

1.4 1.04 SUBMITTALS

A. Product Data: Submit data for proprietary materials and items, including rein-forcement and forming accessories, admixtures, patching compounds, water-stops, joint systems, dovetail anchor slots, non-shrink grout, steel dowel pins and caps, curing compounds, dry-shake finish materials, and others as requested by Architect.

B. Shop Drawings; Reinforcement: Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedule, stirrup spacing, tie spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include additional reinforcement required at control joints, construction joints and openings through concrete structures. Show wall reinforcing in elevations. Provide detailed layout drawing for dowels to masonry walls; include additional reinforcing required at masonry openings, control joints and ends of walls.

PART 2 PRODUCTS

2. 1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct form-work for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system

shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 "High Den-sity Overlaid PLYFORM", Class I.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be un-exposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Dovetail Anchor Slots: 1" wide X 1" deep X 5/8" throat dovetail anchor slots fabri-cated of 22 gage galvanized steel, with removable foam filler to prevent channel from filling with concrete.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "AA100 Dovetail Anchor Slots"; AA Wire Products Company.
(b) "No. 100 Standard Dovetail Slot"; Heckmann Building Products, Inc.

D. Tapered Forms for Wall Control Joints in Walls: Rigid, durable plastic rustication strips shaped to the geometry indicated on the construction documents.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Product: Subject to compliance with requirements, provide the following:

(a) "Rustication Strip"; Vanguard Plastics Corp.

E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces or the bonding of surface finish materials.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Reinforcing Bar Coupling System: ASTM A615, Grade 60, deformed bar material with thread corresponding to threaded coupler to be cast in prior concrete placement. The completed dowel bar splice system must be capable of develop-ing 125% of the rebar yield strength. Bar size and length as indicated.

(1) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) “Dowel Bar Substitution and Splice System - Dowel-In (DI)”; Richmond
1. Screw Anchor Company
(b) “LENTON Form Saver”; ERICO Products, Inc.

C. Steel Wire: ASTM A 82, plain, cold-drawn, steel.

D. Welded Wire Fabric: ASTM A 185, welded steel wire fabric.

E. Supports for Reinforcement: Provide supports for reinforcement including bol-sters, chairs, spacers and other devices for spacing, supporting and fastening re-inforcing bars and welded wire fabric in place. Use wire bar type supports com-plying with CRSI specifications, unless otherwise acceptable.

1. For footings, use concrete bricks of the correct height to support bottom bars.
2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs. Concrete bricks may also be used to support bottom bars in slabs-on-grade.
3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, unless otherwise acceptable to Architect.

(1) Use one brand of cement throughout project, unless otherwise acceptable to Architect

B. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 120. Use of ground granulated blast-furnace slag not to be less than 25% nor more than 35% of the cement content by weight. The resulting blend of portland cement and ground granulated blast-furnace slag shall meet the requirements of ASTM C595, "Standard Specification for Blended Hydraulic Cements, Type 1S".

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(a) "NewCem"; Blue Circle Atlantic.

C. Normal Weight Aggregates: ASTM C 33, and as herein specified. Provide ag-gregates from a single source for exposed concrete.

1. For exterior exposed surfaces, do not use fine or coarse aggregates contain-ing spalling-causing deleterious substances.

2. Local aggregates not complying with ASTM C 33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Architect.

D. Water: Clean, fresh, drinkable and free of substances injurious to concrete.

E. Air-Entraining Admixture: ASTM C 260.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Sika Aer"; Sika Corporation
(b) "Micro-Air"; Master Builders
(c) "Darex AEA"; W.R. Grace.
(d) "AEA-92"; Euclid Chemical Co.

F. Water-Reducing Admixture: ASTM C 494, Type A, and contain not more than 0.1% chloride ions.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Eucon WR-75"; Euclid Chemical Co.
(b) "Pozzolith 122-N"; Master Builders
(c) "Plastocrete 161"; Sika Corporation
(d) "WRDA with HYCOL"; W.R. Grace

G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G and containing not more than 0.1% chloride ions.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "WRDA 19"; W. R. Grace
(b) "Sikament 300"; Sika Corporation
(c) "Rheobuild 1000" or “Pozzolith 440N”; Master Builders

H. Mid-Range Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.1% chloride ions.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) “Daracem 55”; W. R. Grace
(b) “Eucon MR”; Euclid Chemical Co.
(c) “Polyheed”; Master Builders
(d) “Sikament HP”; Sika Corporation

I. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1% chloride ions.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Accelguard 80"; Euclid Chemical Co.
(b) "Pozzutec 20"; Master Builders

(c) "Plastocrete-161FL"; Sika Corporation

J. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and contain not more than 0.1% chloride ions.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Pozzolith 100-XR"; Master Builders
(b) "Eucon Retarder 75"; Euclid Chemical Co.
(c) "Daratard-17"; W. R. Grace
(d) "Plastiment"; Sika Corporation

K. Calcium chloride or admixtures containing more than 0.1% chloride ions are not permitted.

2.4 RELATED MATERIALS

A. Vapor Barrier: Provide vapor barrier cover over prepared base material where indicated. Use only materials which are resistant to decay when tested in ac-cordance with ASTM E 154, as follows:

1. Polyethylene sheet not less than 8 mils thick.

B. Non-metallic, Non-Shrink Grout: CRD-C 621, factory pre-mixed grout.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Set Grout"; Master Builders
(b) "NS-Grout"; Euclid Chemical Co.
(c) "SikaGrout 212"; Sika Corporation

C. Chemical Hardener: Colorless aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent, containing not less than 2 lbs. of fluorosilicates per gal.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Surfhard"; Euclid Chemical Co.
(b) "Lapidolith"; Sonneborn-Contech.
(c) "Burk-O-Lith"; The Burke Co.

D. Curing and Sealing Compound: High solids resin rubber copolymer curing, seal-ing, hardening and dustproofing compound for concrete complying with ASTM C 309:

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Super Floor Coat"; Euclid Chemical Company
(b) "Masterkure"; Master Builders

E. Liquid Membrane Forming Curing Compound: Liquid type membrane-forming curing compound complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Moisture loss not more than 0.055 gr./sq. cm. when ap-plied at 200 sq. ft./gal.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Masterkure"; Master Builders.
(b) "EucoCure"; Euclid Chemical Co.
(c) "Spartan-Cote"; The Burke Co.

F.Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "EucoWeld"; Euclid Chemical Co.
(b) "Acrylic Bondcrete"; The Burke Co.
(c) "Everbond"; L&M Construction Chemicals

G. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project re-quirements.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Sikadur 32 Hi-Mod"; Sika Corporation
(b) "Euco #452 Epoxy System"; Euclid Chemical Co.
(c) "Concresive Liquid (LPL)"; Master Builders

H. Compressible Filler: Styrofoam SM brand as manufactured by Dow Chemical Company, or approved equal.

I. Compressible Backup Material: Closed-cell polyethylene foam rod.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(a) "Ethafoam Sealant Backer Road"; Dow Chemical Company

J. Epoxy Joint Sealant: Two-component, epoxy sealant for filling control and con-struction joints in slabs-on-grade.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Euco 700"; Euclid Chemical Company
(b) "Sikadur CJR"; Sika Corporation
(c) "Sikadur 51 NS/SL"; Sika Corporation
(d) "Masterfill 300"; Master Builders

K. Joint Sealant: Flexible sealant for sealing isolation joints in slabs-on-grade and exposed-to-view control joints in concrete walls.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide one of the fol-lowing:

(a) "Mono"; Tremco Sealant Systems

L. Roofing Cement: Medium consistency, asphalt flashing cement complying with ASTM D2822, Type I; for use in control joints in concrete walls which are not ex-posed-to-view.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(a) "Flashing Cement"; Koppers Industries, Inc.

M. Expansion Joint Material: As indicated on the construction drawings at isolation joint and expansion joint locations in slabs-on-grade.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(i) "Sealtight Fibre Expansion Joint Filler" by W.R. Meadows, Inc.

N. Premolded joint filler: A self-sealing asphalt expansion joint forming material complying with ASTM D994-71 and AASHO M33-70.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(a) "Asphalt Expansion Joints"; A.H. Harris & Sons, Inc.

O. Dowel Anchoring Adhesive: Adhesive for anchoring reinforcing bars into existing concrete construction.

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(i) "HIT HY 150 Injection Adhesive Anchor"; Hilti Corp.

P. Pre-formed Metal Keys: Galvanized steel keyway system for forming construction joints and control joints in slabs-on-grade. System to include anchor stakes and keyway splicing accessories

(1) Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

(2) Products: Subject to compliance with requirements, provide the following:

(i) “Key-Loc Joint System”; A.H. Harris & Sons, Inc.
(ii) “Keyed Kold Joint”; Burke

2.05 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

1. If trial batch method used, use an independent testing facility acceptable to Construction Manager for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Construction Manager.

2. If field experience method is used, field experience data should be not more than 12 months old relative to the anticipated date on which concrete con-struction will commence.

B. Submit written reports to Architect of each proposed mix for each class of con-crete at least 15 days prior to start of work. Do not begin concrete production un-til mixes have been reviewed by Architect.

C. Design mixes to provide normal weight concrete with the following properties, as indicated on drawings and schedules:

1. 3,000 psi 28-day compressive strength (f'c); W/C ratio, 0.58 maximum (non-air-entrained), 0.46 maximum (air-entrained); minimum 5½ sacks of cement per cubic yard of concrete; mix to be pumpable.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

E. Admixtures:

1. Use water-reducing admixture, mid-range water-reducing admixture or high-range water-reducing admixture (super plasticizer) in concrete as required for placement and workability. Use high-range water-reducing admixture in con-crete for all columns, basement walls and retaining walls which are greater than 8'-0" in height. Use mid-range or high-range water-reducing admixture for all supported slabs.

2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50° F (10° C).

3. Use air-entraining admixture in exterior exposed concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content of 5½% with a tolerance of □1½%.

F. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Ramps, slabs, and sloping surfaces: Not more than 3".
2. Reinforced foundation systems: Not less than 1" and not more than 3".
3. Concrete containing HRWR admixture (super plasticizer): Not more than 8" after addition of HRWR to verified 2"-3" slump concrete.
4. Other concrete: Not more than 4".

2.06 CONCRETE MIXES

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.

1. Delete the references for allowing additional water to be added to the batch for material with insufficient slump. Addition of water to the batch will not be permitted.

2. During hot weather, or under conditions contributing to rapid setting of con-crete, a shorter mixing time than specified in ASTM C 94 may be required.

(1) When air temperature is above 85° F (30° C), reduce mixing and delivery time to 60 minutes.

3. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.

PART 3 EXECUTION

3.1 FORMS

A. Design, erect, support, brace and maintain formwork to support vertical and lat-eral loads that might be applied until such loads can be supported by concrete structure. Construct

formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain ac-curate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, control joints, recesses, mold-ings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, waterstops, and other features required in work. Use selected mate-rials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.

D. Provide and install dovetail anchor slots where indicated. Fasten securely to formwork to prevent displacement during concrete placement operations. Install flush against formwork with foam fillers properly inserted to protect channel from filling with concrete. Dovetail anchor slots are to be installed vertically at the spacing indicated and are to be located no nearer than 8 inches and no further than 12 inches from any control joint, expansion joint or end of wall.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy remov-al.

F. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of con-crete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous loca-tions.

G. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

H. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

1. Unless otherwise indicated, provide ties so portion remaining within concrete after removal is 1" inside concrete and will not leave holes larger than 1" di-ameter in concrete surface.

I. Provisions for Other Trades: Provide openings in concrete formwork to accom-modate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

J. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to re-ceive concrete. Remove chips, wood, sawdust, ice, standing water, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement to eliminate mortar leaks and maintain proper alignment.

3.2 PLACING REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required. Support bottom bars in footings and slabs-on-grade with concrete bricks.

D. Place reinforcement to obtain coverages indicated for concrete protection. Ar-range, space and securely tie bars and bar supports to hold reinforcement in po-sition during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Footing dowels to piers, pilasters, columns, grade beams and walls are to be se-curely tied to bottom mat of reinforcing in footing / pile cap. Wet-setting of dowels in freshly placed concrete is not permitted without the authorization of the Ar-chitect.

F. Install welded wire fabric in sheets with lengths as long as practicable; use of welded wire fabric in rolls is not permissible. Lap adjoining sheets at least one full mesh, unless otherwise noted; lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

G. Fasten dowels into existing concrete construction where shown on drawings using dowel anchoring adhesive. Hammer drill holes in existing concrete to the depth indicated on the drawings using the bit diameter recommended by the adhesive manufacturer. Clean holes and install dowels in accordance with the manufacturer's recommendations. Allow adhesive to cure prior to placing con-crete.

3.3 JOINTS

A. Construction Joints in Walls and Footings: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Architect.

1. Provide keyways at least 1½" deep in construction joints in walls; accepted bulkheads designed for this purpose may be used for slabs.

2. Provide keyways at least 1½" deep in construction joints between walls and footings.

3. Place construction joints perpendicular to main reinforcement. Continue rein-forcement across construction joints in walls except where otherwise noted.

B. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs on ground and vertical surfaces, such as col-umns, foundation walls, grade beams, machine foundations, and elsewhere as indicated. Coat slab edges with form-coating compound to inhibit bond as indi-cated on design drawings.

C. Control Joints in Slabs-on-Ground: Construct control joints in slabs-on-ground to form panels of patterns as shown. Form control joints by saw cutting as soon as possible after slab finishing as may be safely done without dislodging aggregate or shredding concrete surface.

D. Construction Joints in Slabs-on-Ground: Construct construction joints in slabs-on-grade at locations noted on plan and where concrete slab placements are terminated. Construction joints not specified on plan are to be located only at lo-cations designated as control joints on plan.

1. Form joints using a bulkhead. Install smooth steel dowel pins at spacing indi-cated through bulkhead. Dowel pins to be installed strictly horizontal in center of slab, perpendicular to the joint line. Prior to placing adjacent section of slab, apply two coats of form-coating compound to edge of existing slab, grease dowel pins, and install steel dowel caps.

2. Not less than seven days after placement of the second section of the slab, construction joints are to be saw-cut as indicated to permit the installation of the epoxy joint filler.

E. Control Joints in Walls: Construct control joints in concrete walls at locations not-ed on plan. Form control joints by adding tapered forms to main wall forms and splicing and cutting reinforcing as shown. At walls greater than 12" in thickness, add parting plates as shown.

F. Expansion Joints in Walls: Construct expansion joints in walls at locations noted on plan. Form joints using a bulkhead. Install smooth steel dowel pins at spacing indicated through bulkhead. Dowel pins to be installed strictly horizontal in center of wall, perpendicular to the joint line. Prior to placing adjacent section of wall, install premolded joint filler, grease dowel pins, and install steel dowel caps.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place con-crete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto.

1. Electrical conduit installed in concrete slabs on steel deck (composite or non-composite) shall have an outside diameter not greater than 0.83” and shall be provided with a minimum 3/4" concrete cover. Minimum spacing between ad-jacent conduits to be 18”. No crossovers of conduit are permitted in concrete slabs on steel deck.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and in-termediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units sufficiently strong to support types of screed strips by use of strike-off templates or accepted compacting type screeds.

3.5 PREPARATION OF FORM SURFACES

A. Clean re-used forms of concrete matrix residue. Repair and patch as required to return forms to acceptable surface condition.

B. Coat contact surfaces of forms with a form-coating compound before reinforce-ment is placed. Coating material shall be compatible with final concrete finish.

C. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise pro-tect against rusting. Rust-stained steel formwork is not acceptable. Form oil shall be compatible with final concrete finish.

3.6 PREPARATION OF EXISTING CONCRETE SURFACES

A. Where concrete is to be placed on or adjacent to existing concrete plank or other concrete surfaces, roughen surface by chipping or scarifying. Remove dirt, loose material, oil, grease, paint or other contaminants, leaving a clean surface.

B. Prior to placing concrete, dampen existing concrete surface, but do not leave standing water. Broom-on a coat of thin neat cement grout over dampened sur-face immediately before placing concrete. Apply neat cement grout only to areas which will receive concrete before grout sets or dries.

3.7 CONCRETE PLACEMENT

A. Preplacement Inspection: Before placing concrete, inspect and complete form-work installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in set-ting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.

B. Coordinate the installation of joint materials and vapor barriers with placement of forms and reinforcing steel.

1. All joints in vapor barriers shall be overlapped 6" and shall be sealed with va-por barrier tape.

2. All punctures in vapor barrier shall be sealed with vapor barrier tape.

C. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", and as herein specified.

D. Do not place any concrete for footings until footing subgrade has been inspected by Geotechnical Engineer. Area excavated for footings shall be free of water, frost and foreign materials when concrete is placed.

E. Prior to placing concrete slabs on steel deck, the steel deck shall be free of soil, debris, oil, standing water, ice, loose mill scale or coating, ceramic arc shields from shear connectors, and all other foreign matter.

F. Prior to placing concrete in forms, the forms and abutting concrete surfaces shall be free of soil, debris, standing water, ice, and all other foreign matter.

G. Notify Architect 48 hours prior to placing operations so that reinforcing steel may be observed. No concrete shall be placed until such observations have been made or waived.

H. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, pro-vide construction joints as herein specified. Deposit concrete as nearly as practi-cable to its final location to avoid segregation.

I. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with recommended practices of ACI 309.

2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effec-tiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of con-crete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of rein-forcement and other embedded items without causing segregation of mix.

3. At congested areas and boxouts, supplement the internal vibration by external form vibration.

J. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

3. At supported slabs on steel deck, deflection of the steel deck and supporting structural steel framing will produce ponding of the concrete in some areas. The Contractor shall provide additional concrete as required to maintain a level floor surface.

K. No water is to be added to the concrete mix in the field unless authorized by the structural engineer.

L. Maintain reinforcing in proper position during concrete placement operations.

3.8 COLD WEATHER PLACING

A. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.

1. When air temperature has fallen to or is expected to fall below 40° F (4° C), uniformly heat water and aggregates before mixing to obtain a concrete mix-ture temperature of not less than 50° F (10° C), and not more than 80° F (27° C) at point of placement.

B. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

C. Do not use calcium chloride, salt or other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.

3.9 HOT WEATHER PLACING

A. When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90° F (32° C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calcu-lated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

3. Fog spray forms, reinforcing steel and subgrade just before concrete is placed.

B. Do not use water-reducing retarding admixture unless otherwise accepted in mix designs.

3.10 FINISH OF FORMED SURFACES

A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the fin-ish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

B. Smooth Form Finish: For formed concrete surfaces exposed-to-view or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, paint-ing or other similar system. This is as-cast concrete surface obtained with se-lected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar un-formed surfaces occurring adjacent to formed surfaces, strike-off smooth and fin-ish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, un-less otherwise indicated.

3.11 MONOLITHIC SLAB FINISHES

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.

1. After placing slabs, plane surface so that depressions between high spots do not exceed 1/2" under a 10' straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.

1. After screeding, consolidating, and leveling concrete slabs, do not work sur-face until ready for floating. Begin floating when surface water has disap-peared or when concrete has stiffened sufficiently to permit operation of pow-er-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane so that depressions between high spots do not exceed 5/16" under a 10' straightedge. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uni-form, smooth, granular texture.

2. Surfaces not receiving trowel finish shall conform to the following local flatness and levelness tolerances:

(1) Specified Overall Value: FF 15 / FL 13
(2) Minimum Local Value: FF 13 / FL 10

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint or other thin film finish coating system.

1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface plane so that depressions between high spots do not exceed " under a 10' straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.

3.12 CONCRETE CURING AND PROTECTION

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Begin final curing procedures immediately following initial curing and before con-crete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.

D. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified.

1. Provide moisture curing by following methods.

(1) Keep concrete surface continuously wet by covering with water.

(2) Continuous water-fog spray.

(3) Covering concrete surface with specified absorptive cover, thoroughly sat-urating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.

2. Provide moisture-cover curing as follows:

(1) Cover concrete surfaces as soon as final finishing operations are complete (within 2 hours) with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Provide curing compound to interior slabs with resilient flooring, carpet over cushion, or left exposed; and to exterior slabs, walks, and curbs, as follows:

(1) Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours). Apply uniformly in continuous operation by power-spray or roller in accordance with manu-facturer's directions. Recoat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.

(2) Do not use membrane curing compounds on surfaces which are to be covered with coating material applied directly to concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, flooring (such as ceramic or quarry tile, glue-down carpet), painting, or other coatings and finish materials, unless otherwise acceptable to Architect.

(3) Curing compounds to be compatible with adhesives used for resilient flooring.

E. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams and supported slabs, sides of walls, and other similar surfaces, by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

F. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by application of appropriate curing method.

G. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

H. Sealer and Dustproofer: Apply a second coat of specified curing and sealing compound only to surfaces given a first coat.

3.13 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of walls, pier, and similar parts of the work, may be removed after cumulatively curing at not less than 50° F (10° C) for 24 hours after placing concrete, provided concrete is suffi-ciently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

B.

C. At control joints in walls, remove tapered forms when main wall forms are re-moved.

3.14 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delami-nated or otherwise damaged form facing material will not be acceptable for ex-posed surfaces. Apply new form coating compound as specified for new form-work.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

3.15 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or re-quired to complete work.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

1. Grout between base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled.

3.16 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect.

B. Cut out honeycomb, rock pockets, voids over ¼" in any dimension, and holes left by tie rods and bolts, down to solid concrete but, in no case to a depth of less than 1". Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.

1. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar will match color surround-ing. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.

C. Repair of Formed Surfaces: Remove and replace concrete having defective sur-faces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, hon-eycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with dry pack mortar, or precast cement cone plugs secured in place with bonding agent.

D. Repair concealed formed surfaces, where possible, that contain defects that ef-fect the durability of concrete. If defects cannot be repaired, remove and replace concrete.

E. Repair for Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish.

Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.

1. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets and other objectionable conditions.

2. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.

3. Correct low areas in unformed surfaces during, or immediately after comple-tion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Pro-prietary patching compounds may be used when acceptable to Architect.

F. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective ar-eas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact and finish to blend with adjacent finished concrete. Cure in same man-ner as adjacent concrete.

G. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part portland cement to 2½ parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.

H. Perform structural repairs with prior approval of Architect for method and proce-dure, using specified epoxy adhesive and mortar.

I. Repair methods not specified above may be used, subject to acceptance of Ar-chitect.

3.17 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Owner will employ a testing laboratory to perform tests and to submit test reports. Prior to engagement of a testing service, the Architect shall evaluate any proposed testing laboratories and indicate to the Owner if there are any rea-sonable objections to any to the proposed testing laboratories.

B. Sampling and testing for quality control during placement of concrete shall include the following, as directed by Architect. All field sampling and testing is to be performed by an ACI-Certified Concrete Field Testing Technician (Grade 1).

1. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

2. Slump: ASTM C 143; one test at point of discharge for each truck load of concrete; additional tests when concrete consistency seems to have changed. For concrete containing HRWR admixture (super plasticizer), test slump before and after addition of HRWR admixture.

3. Air Content: ASTM C 173, volumetric method for lightweight or normal weight concrete; ASTM C 231 pressure method for normal weight concrete; one test for each set of compression test specimens.

4. Concrete Temperature: ASTM C 1064; test hourly when air temperature is 40°F (4°C) and below and when 80°F (27°C) and above; otherwise test each time a set of compression test specimens is molded.

5. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cured test specimens are required.

6. Compressive Strength Tests: ASTM C 39; one set for each day's pour, ex-ceeding 5 cu. yds. plus additional sets for each 50 cu. yds. over and above the first 25 cu. yds. of each concrete class placed in any one day; one specimen tested at 7 days, two specimens tested at 28 days, and one specimen retained in reserve for later testing if required.

(1) When frequency of testing will provide less than 5 strength tests for a given class of concrete, conduct testing from at least 5 randomly selected batches or from each batch if fewer than 5 are used.

(2) When strength of field-cured cylinders is less than 85% of companion la-boratory-cured cylinders, evaluate current operations and provide correc-tive procedures for protecting and curing the in-place concrete.

(3) Strength level of concrete will be considered satisfactory if averages of sets of three consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.

C. Test results of slump, air content and compressive strength tests will be reported in writing to Owner, Architect, Structural Engineer and Contractor within 24 hours of when compressive strength tests are made. Reports of tests shall contain the following:

1. Date of concrete placement
2. Project identification name
3. Project location
4. Name of inspector and ACI Certfication No.
5. Name of concrete supplier
6. Weather
7. Air temperature
8. Concrete type and class
9. Design compressive strength at 28 days
10. Concrete mix proportions, materials and admixtures
11. Location of concrete batch in structure
12. Batch ticket identification number
13. Time concrete batched
14. Time concrete placed
15. Slump
16. Air content

17. Concrete temperature
18. Compressive strength tests shall include breaking strength and type of break for both 7-day and 28-day tests

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive de-vice may be permitted but shall not be used as the sole basis for acceptance or rejection.

E. Additional Tests: The testing service will make additional tests of in-place con-crete when test results indicate specified concrete strengths and other character-istics have not been attained in the structure, as directed by Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

F. The Contractor shall be responsible for scheduling with the testing laboratory, and shall provide free access for its personnel and labor required in helping to obtain and handle samples of concrete.

G. The Contractor shall provide an electrically heated, covered box with automatic control to maintain inside temperature between 60 and 80° F, adequate to store the required number of concrete cylinders (12 minimum), to be placed in the box immediately after molding and kept there for 24 to 72 hours until delivery to the laboratory.

END OF SECTION

SECTION 04 30 30

CAVITY WALL MASONRY SYSTEM

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

A. Provide masonry cavity wall construction conforming to the following Specification Section.

B. System shall include:

1. Exterior Concrete Masonry Wall Construction (Cavity Wall System).
2. Reinforcement, Anchorage, and Accessories.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 05120 - Structural Steel: Placement of steel.

1.3 RELATED SECTIONS

A. Section 01 45 00 - Quality Control.

B. Section 07 20 70 - Firestopping: Firestopping at penetrations of masonry work.

C. 07 92 00 - Joint Sealers: Rod and sealant at control and expansion joints.

1. 4 REFERENCES

A. ACI 530 - Building Code Requirements for Masonry Structures.

B. ACI 530.1 - Specifications For Masonry Structures.

C. ASTM A82 - Cold-Drawn Steel Wire for Concrete Reinforcement.

D. ASTM A123 - Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.

E. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate.

F. ASTM A525 - Steel Sheet, Zinc Coated, (Galvanized) by the Hot-Dip Process.

G. ASTM A580 - Stainless and Heat-Resisting Steel Wire.

H. ASTM B370 - Copper Sheet and Strip for Building Construction.

I. ASTM C55 - Concrete Building Brick.

J. ASTM C90 - Load-Bearing Concrete Masonry Units.

K. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

L. IMIAC - International Masonry Industry All-Weather Council: Recommended Practices and Guide Specification for Hot Weather Masonry Construction.

M. UL - Fire Resistance Directory.

1.5 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide data for masonry units and reinforcement.

C. Samples: Submit two samples of units to illustrate color, texture and extremes of color range.

D. Design Data: Indicate required mortar strength, masonry unit assembly strength in all planes and supportive test data.

E. Manufacturer's Certificate: Submit manufacturer’s certificate under provisions of Section 01400. Certify that Products meet or exceed specified requirements.

1.6 QUALIFICATIONS

A. Installer: Company specializing in the performance of Work specified in this section with minimum five years documented experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code and UL Assembly requirements for fire rated masonry construction.

1.8 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section, under provisions of Section 01039.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01600.

B. Accept masonry units on site. Inspect for damage.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

B. Hot Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Hot Weather Masonry Construction.

1.11 COORDINATION

A. Coordinate work under provisions of Section 01039.

B. Coordinate the masonry work with installation of anchors and reinforcing.

1.12 EXTRA MATERIALS

A. Submit under provisions of Section 01700.

B. Provide 10 of each size, color, and type of masonry units.

PART 2 PRODUCTS

2.1 MANUFACTURERS - CONCRETE MASONRY UNITS

A. Westbrook Concrete Block Co. Inc.
439 Spencer Plain Road
Westbrook, CT. 06498
Phone: (860) 399-6201

B. Anchor Concrete Products, Inc.
975 Burnt Taven Road
Bricktown, NJ. 08724
Phone: (732) 458-9440

C. Substitutions: Under provisions of Section 01600.

2.2 EXTERIOR CONCRETE MASONRY WALL CONSTRUCTION (Cavity Wall System)

A. Concrete Masonry Units:

1. Veneer Concrete Masonry Units: Lightweight ASTM C145 and ASTM C90, 7 5/8" by 15 5/8" by 5 5/8" thickness. The minimum compressive strength of the units shall be 2000 psi. All exterior masonry units shall be fabricated with "Dry Block" Admixture as manufactured by Grace Construction Products. The specified compressive strength of the exterior veneer masonry shall be f'm = 1500 psi.

B. Face Brick: ANSI/ASTM C216. Brick type 2 modular to match existing face brick.

1. Building Brick: ASTM C62, solid units.

2. Brick Masonry Units: Standard modular actual size of 3 5/8” x 2 ¼” x 7 5/8”

C. Joint reinforcement shall be ladder type, steel wire, hot dip galvanized 9 gage, adjustable eye and pintle type.

D. Veneer Ties: Formed steel wire, 9 gage, adjustable, eye and pintle type, hot dip galvanized. Length as required for wall construction thickness.

E. Reinforcing Steel; ASTM A615, 60 ksi yield grade, deformed billet bars. Reinforcing steel which is to be welded may be ASTM A-706.

F. Mortar: As specified in Section 04100. Veneer concrete masonry units shall be laid up with full mortar beds. Non-shear wall, concrete masonry units for backup of exterior veneer concrete masonry units shall be laid up with face shell mortar beds. Shear wall, concrete masonry units for backup of exterior veneer concrete masonry units shall be laid up with full mortar beds.

G. Grout: As specified in Section 04100.

H. INSULATION Inserts: Korfil block insulation inserts meeting ASTM C 578 Type X, typical density of 1.3 Lbs./cu.ft. and R value of 5.

2.3 FLASHINGS

A. Flash against water penetration with perm-a-barrier wall flashings by the W.R. Grace & Co. Inc. Flashing shall be continuous through wall as detailed on the drawings.

B. Lap Sealant: type as required by flashing manufacturer.

2.4 ACCESSORIES

A. Weep Vents: Provide mortar type weep vents at weep locations. Weep vent shall be constructed of 200 Dernier 100% recycled polyester measuring 2.25" x 3.5" x 0.5". Similar to product manufactured by: Mortar Net USA, Ltd., Highland IN.

B. Mortar Netting: Provide mortar netting at base of cavity wall system. Mortar net shall be constructed of high density polyethylene, Nylon and 100% recycled polyester measuring 1" x

16" x 5'-0". Similar to product manufactured by: Mortar Net USA, Ltd. Highland, IN.

C. Cleaning Solutions: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Verify items provided by other sections of work are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of anchors. Provide anchors and ties at 16" o.c. vertically and horizontally unless otherwise indicated on drawings.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

C. Concrete masonry construction shall comply with the requirements or “Specification for concrete masonry construction” ACI 531.1.

3.3 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:

1. Bond: Running.

2. Coursing: One unit and one mortar joint to equal 8 inches.

3. Mortar Joints: Concave.

3.4 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Lay hollow masonry units of interior non-load bearing walls with face shell bedding on head and bed joints. Lay exterior wall units with full bed of mortar.

C. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.

D. Remove excess mortar as Work progresses.

E. Interlock intersections and external corners.

F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

H. Cut mortar joints flush where wall tile is scheduled and resilient base is scheduled.

I. Isolate masonry partitions from vertical structural framing members with a control joint.

J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

K. Head joints shall be full. No slushing of head joints is allowed.

3.5 WEEP AND VENTS

A. Install weep holes in veneer at 32 inches on center horizontally above through-wall flashing above shelf angles and at bottom of walls.

3.6 CAVITY WALL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep holes.

B. Build inner wythe ahead of outer wythe to receive cavity insulation air/vapor barrier adhesive.

3.7 REINFORCEMENT AND ANCHORAGE

A. Install horizontal joint reinforcement 16 inches oc.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place joint reinforcement continuous in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

E. Support and secure reinforcing bars from displacement. Maintain position within ½ inch of dimensioned position.

3.8 MASONRY FLASHINGS

A. Extend flashings horizontally at foundation walls, above ledge or shelf angles and lintels, under parapet caps, and at bottom of walls, at all weep hole locations, window openings, exterior wall openings and door openings.

B. Turn flashing up minimum 8 inches bed into mortar joint of masonry back-up.

C. Lap end joints minimum 6 inches and seal watertight.

D. Turn flashing, fold, and seal at corners, bends, and interruptions.

3.9 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control joints.

B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

C. Size control joint in accordance with Section 07900 for sealant performance.

D. Form expansion joint as detailed.

3.10 TOLERANCES

A. Maximum Variation From Alignment of Columns and Pilasters: 1/4inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/32 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and ½ inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch (6 mm) per story non-cumulative; ½ inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; ½ inch in 30 ft.

F. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

3.11 CUTTING AND FITTING

A. Cut and fit for chases pipes conduit sleeves and grounds. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 CLEANING

A. Clean work under provisions of 01700.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.13 SEALANTS

A. Prepare exterior surfaces and apply sealants as per Section 07175 - Exterior Coatings.

3.14 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01500.

B. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

SECTION 07 20 70

FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fireproof firestopping and firesafing materials and accessories.

1.2 RELATED SECTIONS

A. Division 22 - Plumbing: Plumbing work requiring fireproofing.

B. Division 23 – Mechanical: Mechanical work requiring firestopping.

C. Division 26 - Electrical: Electrical work requiring firestopping.

1.3 REFERENCES

A. ASTM E84 - Test Method for Surface Burning Characteristics of Building Materials.

B. ASTM E119 - Method for Fire Tests of Building Construction and Materials.

C. ASTM E814 - Test Method of Fire Tests of Through Penetration Firestops.

D. FM (Factory Mutual) _ Fire Hazard Classifications.

E. UL _ Fire Hazard Classifications.

F. UL 263 - Fire Tests of Building Construction and Materials.

G. UL 723 - Test for Surface Burning Characteristics of Building Materials.

H. UL 1479 - Fire Tests of Through-Penetration Firestops.

I. WH (Warnock Hersey) - Certification Listings.

1.4 DEFINITION

A. Firestopping: A sealing or stuffing material or assembly placed in spaces between building materials to arrest the movement of smoke, heat, gases, or fire through wall or floor openings.

1.5 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119 ASTM E814 UL 1479 to achieve a fire rating of 1 hour.

1.6 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Provide data on product characteristics, performance and limitation criteria, and ratings.

C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

B. Applicator: Company specializing in performing the work of this section with minimum three years experience and approved by manufacturer.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable code and UL for fire resistance ratings and surface burning characteristics.

B. Provide certificate of compliance from authority having jurisdiction Orange Fire Marshal indicating approval of materials used.

1.9 MOCKUP

A. Provide mockups of applied firestopping assemblies under provisions of Section 01 45 00.

B. Apply 1 linear ft to a representative substrate surface.

C. Apply firestop material to a representative penetrated masonry, concrete, substrate surface.

D. If accepted, mockup will demonstrate minimum standard for the Work.

E. Mockup may remain as part of the Work.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for 3 days after installation of materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Firstopping materials shall be products manufactured by Electrical Products Division/3M, St. Paul, MN 55114 or approved equal.

B. Hilti Construction Chemical.

C. International Protective Coatings Corp.

2.2 FIRSTOPPING MATERIALS

A. Firestopping materials/constructions shall constitute one or more of the following products:

1. 3M Brand Caulk CP-25.
2. 3M Brand Putty 303.
3. 3M Brand Wrap/Strip FS-195.
4. 3M Brand Composite Sheet CS-195.
5. 3M Brand Penetraing Sealing Systems 7900 Series.
6. Those products compatible with the above materials as certified by 3M in their published data.
7. Hilti Firestop Joist Spray.
8. IPC, KBS Seal Bags.

B. Firestopping materials shall be asbestos-free and capable of maintaining an effective barrier against flame, smoke and gases in compliance with the requirements of ASTM E814, and UL 1479.

C. Materials shall be suitable for the firestopping of penetrations made by steel, glass, plastic and insulated pipe.

D. On insulated pipe, the fire-rating classification must not require removal of the insulation.

E. The rating of the firestops shall be 1 hour, but in no case less than the rating of the time-rated floor or wall assembly.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to be in contact with firestopping materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting or the required fire resistance.

3.2 INSTALLATION

A. Install firestopping materials as indicated, in accordance with manufacturer's instructions.

B. Seal all holes or voids made by penetrations to ensure an effective smoke barrier.

C. Unless protected from possible loading or traffic, install firestopping materials in floors having void openings of (4) four inches or more to support the same floor load requirements.

3.3 FIELD QUALITY CONTROL

A. Examine firestopped areas to ensure proper installation prior to concealed or enclosing firestopped areas.

B. Areas of work shall remain accessible until inspection and approval by the applicable code authorities.

END OF SECTION

SECTION 07 92 00

JOINT SEALERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparing sealant substrate surfaces.

B. Sealant and backing.

1.2 RELATED SECTIONS

A. Section 04 30 30 - Masonry Cavity Wall Systems: Sealants used in conjunction with brick and concrete masonry.

1.3 REFERENCES

A. ANSI/ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.

B. ASTM C790 - Use of Latex Sealing Compounds.

C. ASTM C834 - Latex Sealing Compounds.

D. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.

E. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, solvent Release Type.

F. FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi-Component.

G. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.

H. FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.

I. SWI (Sealing and Waterproofer's Institute) - Sealant and Caulking Guide Specification.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability.

C. Submit samples under provisions of Section 01 33 00.

D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

E. Submit manufacturer's certificate under provisions of Section 01 45 00 that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. Applicator: Company specializing in applying the work of this Section with minimum three years experience.

C. Conform to Sealant and Waterproofer's Institute requirements for installation.

1.6 FIELD SAMPLES

A. Provide samples under provisions of Section 01 33 00.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install solvent curing sealants in enclosed building spaces.

B. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with all Sections referencing this Section.

1.9 WARRANTY

A. Provide three year warranty under provisions of Section 01 70 00.

B. Warranty: Include coverage of installed sealants and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MATERIALS

A. Compressible filler: closed cell polyethylene foam rod equivalent to Ethafoam sealant backer rod, manufactured by Dow Chemical Co. Minimum rod diameter: 1-1/3 x joint width. Length: as long as practical.

B. Ceramic fiber insulation for use behind compressible filler in joints in fire-rated walls: Tremco Cerablanket FS alumina-silica fiber insulation of thickness, depth, and configuration as required to maintain fire ratings of walls at joints.

C. Caulking for interior joints: Pecora AC-20 Acrylic Latex Calk manufactured by the Pecora Corporation, or approved equivalent.

D. Sealant for use in joints in masonry control joints. Pecora Dynatrol II polyurethane sealant.

E. Sealant for exterior windows and door frames shall be dynaflex polyurethane sealant.

F. Asphalt emulsion sealant: trowel grade filled emulsion equivalent to Karnak No. 86 fibrated trowel damproofing.

G. Primers for caulking and sealant: as recommended by caulking and sealant manufacturers.

H. Colors: as selected from caulking and sealant manufacturer's standard colors.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.

B. Beginning of installation means installer accepts existing substrate.

3.2 PREPARATION

A. Clean and prime joints in accordance with manufacturer's instructions.

B. Remove loose materials and foreign matter which might impair adhesion of sealant.

C. Verify that joint backing and release tapes are compatible with sealant.

D. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3 INSTALLATION

A. Install all materials in accordance with material manufacturers' installation instructions.

B. Depth of caulking and sealant: in accordance with material manufacturers' recommendation for width and location of joint.

C. Back up sealants with compressible filler, installed to provide proper sealant depth throughout joint length.

D. Install ceramic fiber insulation behind compressible filler in joints in fire rated walls. Ceramic fiber insulation: of thickness, depth, and configuration as required to maintain fire ratings of walls at joints.

E. Back up caulking with compressible filler at joints not provided with stops, ½" behind finish face.

F. Place polyethylene bond breaker tape between sealant and back-up when back-up material is not compressible filler.

G. Place caulking and sealant with pressure gun. Fill crevices and joints solidly. Tool joint surface to assure complete surface contact. Avoid use of slicking agent wherever possible.

H. Sealants in joints in floors and other locations subject to wheeled or foot traffic: self-leveling two-component urethane sealant.

I. Sealants in exterior finish system: Pecora Dynatrol II.

J. Control joints in exterior foundation walls below grade: compressible filler, one-component polyurethane sealant, and 4 mil thick polyethylene bond breaker tape. Bond breaker tape shall span complete width of joint and be adhered to wall faces 1" beyond edges of joint before installation of bituminous damproofing.

K. All other joints exposed to exterior, and interior joints where sealant is specifically indicated: one-component polyurethane sealant.

L. Other interior joints: acrylic latex caulking.

3.4 SCHEDULE

A. Joint Sealants

1. Brick masonry control joints-dynatrol II.

END OF SECTION

SECTION 09 65 19

RESILENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Resilient tile flooring

1.2 RELATED SECTIONS

A. Section 03 30 00 - C.I.P; Concrete Floor and Stair substrate surface.

1.3 REFERENCES

A. ASTM E84 - Surface Burning Characteristics of Building Materials.

B. FS SS-T-312 - Sheet, Tile, Floor Treads and Risers: Rubber, Vinyl, Vinyl Composition.

C. FS SS-W-40 - Wall Base: Rubber and/or Vinyl.

1.4 SUBMITTALS

A. Submit product data under provisions of Section 01 33 00.

B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, and color availability.

C. Submit samples under provisions of Section 01 33 00.

D. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

E. Submit manufacturer's certificate under provisions of Section 01 45 00 that products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years experience.

B. Applicator: Company specializing in applying the work of this Section with minimum three years experience.

C. Conform to Sealant and Waterproofer's Institute requirements for installation.

1.6 FIELD SAMPLES

A. Provide samples under provisions of Section 01 33 00.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Store materials for three days prior to installation in area of installation to achieve temperature stability.

B. Maintain ambient temperature required by adhesive manufacturer three days prior to, during, and 24 hours after installation of materials.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with all Sections referencing this Section.

1.9 WARRANTY

A. Provide three year warranty under provisions of Section 01 70 00.

B. Warranty: Include coverage of installed sealants and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MANUFACTURERS - FLOORING MATERIALS

A. Armstrong

B. Toli International

C. Flexco

2.2 TILE FLOORING MATERIALS

A. Vinyl Composition Tile: FS SS-T-312 B (1) Type IV; 12 x 12 inch size, 1/8 inch thick; Armstrong Standard Excelon, "Imperial" texture design.

2.3 ACCESSORIES

A. Sub floor Filler: type recommended by flooring material manufacturer.

B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

C. Accessories: #44 fillet strip 3/4" radius; #46 square cove cap, #50 tile/carpet joiner.

D. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/8 inch in 10 ft, and are ready to receive Work.

B. Verify concrete floors are dry to a maximum moisture content of 7 percent, and exhibit negative alkalinity, carbonization, or dusting.

C. Beginning of installation means acceptance of existing substrate and site conditions.

3.2 PREPARATION

A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.

B. Apply, trowel, and float filler to leave a smooth, flat, hard surface.

C. Prohibit traffic from area until filler is cured.

D. Vacuum clean substrate.

E. Apply primer to surfaces as recommended by manufacturer.

3.3 INSTALLATION

A. Install in accordance with manufacturers' instructions.

B. Mix tile from container to ensure shade variations are consistent.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Set flooring in place, press with heavy roller to attain full adhesion.

E. Install tile with pattern grain alternating with adjacent unit to produce basket weave pattern. Allow minimum ½ full size tile width at room or area perimeter.

F. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.

G. Install reducer strips at unprotected or exposed edges, and where flooring terminates.

H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

I. Install flooring in pan type floor access covers. Maintain floor pattern.

3.4 PROTECTION

A. Prohibit traffic on floor finish for 48 hours after installation.

3.5 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

B. Clean, seal, and wax floor and base surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 91 23

INTERIOR PAINTING

1.1 DESCRIPTION

A. Work included: Items to be painted are limited to all surfaces that have not been factory finished.

1.2 RELATED SECTIONS

A. Priming, or priming and finishing of certain surfaces are specified to be factory-performed or installer-performed under pertinent other Sections.

1.3 WORK NOT INCLUDED:

A. Do not include painting which is specified in other Sections of these Specifications;

B. Unless otherwise indicated, painting is not required on surfaces in concealed areas and inaccessible areas such as furred spaces, foundation spaces, utility tunnels, pipe spaces, and duct shafts;

C. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require painting except as may be otherwise specified in this Section;

D. Do not paint any moving parts of operating units, mechanical or electrical parts such as valve operators, linkages, sensing devices, and motor shafts, unless otherwise indicated;

E. Do not paint over any required labels or equipment identification, performance rating, name or nomenclature plates;

1.4 DEFINITIONS

A. The term "paint", as used in the Specifications means all coating system materials including primers, emulsions, epoxy, enamels, sealers, fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.5 QUALITY ASSURANCE

A. Qualification of manufacturers: Products used for the Work described in this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production acceptable to the Architect.

B. Qualification of workers:

1. Provide at least one (1) person who shall be present at all times during execution of the Work described in this Section, who shall be thoroughly familiar with specified requirements and the materials and methods needed for their execution, and who shall direct all Work performed described in this Section.

2. Provide adequate numbers of workers skilled in the necessary crafts and properly informed of the methods and materials to be used.

3. When accepting or rejecting the Work described in this Section, the Architect will make no allowance for lack of skill on the part of the workers.

C. Paint coordination:

1. Provide finish coats which are compatible with the prime coats used.

2. Review other Sections of these Specifications and verify compatibility of the total coating system.

3. Upon request, furnish information on the characteristics of the specific finish materials to ensure that compatible prime coats are used.

4. Provide barrier coats over non-compatible primers, or remove the primer and reprime as required for compatibility.

5. Notify the Architect in writing, of anticipated problems with using the specified coating systems over prime-coating described in other Sections. Do not proceed until such problems have been fully resolved.

1.6 SUBMITTALS

A. Submit samples under provisions of Section 01 33 00.

B. Manufacturer's data: Within sixty (60) calendar days after award of the Contract, submit:

1. Complete materials list of all items proposed to be furnished and installed under this Section.

2. Manufacturer's Specifications and other data required to demonstrate compliance with the specified requirements.

3. Two (2) copies of the manufacturer's specifications, including paint label analysis and application instructions for each material proposed. Indicate by transmittal that a copy of each manufacturer's instructions has been distributed to the applicator.

C. Samples: Following the selection of colors and glosses by the Architect as described in Paragraph 2.1.4 below, submit Samples for the Architect's review:

1. Provide two (2) Samples of each color and each gloss for each material on which the finish is specified to be applied;

2. Except as otherwise directed by the Architect, Samples shall be manufacturer's prepared samples approximately 2" square;

3. Samples during progress of the Work of this Section, in the form of actual application of the approved materials.

1.7 PRODUCT HANDLING.

A. Delivery of materials: Deliver all materials to the job site in original, new, and unopened containers bearing the manufacturer's name and label showing the following information:

1. Name or title of material.

2. Fed. Spec. No. if applicable.

3. Manufacturer's stock number.

4. Manufacturer's name.

5. Contents by volume for major constituents.

6. Thinning instructions.

7. Application instructions

B. Storage of materials: Provide proper storage to prevent damage to, and deterioration of, paint materials as recommended by the manufacturer. Do not use paints which have exceeded their shelf life.

C. Protection: Use all means necessary to protect the materials described in this Section, before, during, and after installation and to protect the Work and materials of all other trades.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.8 JOB CONDITIONS

A. Surface temperature: Do not apply solvent-thinned paints when the temperature of surfaces to be painted and the surrounding air temperatures are below 45 degrees F., unless otherwise permitted by the manufacturer's printed instructions, and accepted by the Architect.

B. Weather conditions: Do not apply paint in snow, rain, fog, or mist, or when the relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by the manufacturer's printed instructions accepted by the Architect. Applications may be continued during inclement weather within the temperature limits specified by the paint manufacturer.

1.9 EXTRA STOCK

A. Amount: Upon completion of the Work described in this Section, deliver to the Owner an extra stock equaling 5 (five) gallon of each color, type, and gloss of paint used for the Work.

B. Packaging: Each container shall be tightly sealed, previously unopened, and clearly labeled with the contents and location of use.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Devoe - ICI

B. Glidden Co.

C. Sherman Williams.

D. Substitutions: Under provisions of Section 01600.

2.2 PAINT MATERIALS

A. Design is based on use of paint products manufactured by Devoe/ICI. Colors shown on the Drawings are /Devoe/ICI names and numbers, unless otherwise noted.

B. General: Provide the best quality grade of the various types of coatings as regularly manufactured by paint materials' manufacturers accepted by the Architect. Materials not displaying the manufacturer's identification as a standard best grade product will not be accepted.

C. Durability: Provide paints of durable and washable quality. Do not use paint materials which will not withstand normal washing as required to remove pencil marks, ink, ordinary soil, and similar material, without showing discoloration, loss of gloss, staining, or other damage.

D. Colors and glosses: The Architect will select colors to be used in the various types of paint specified and will be the sole judge of acceptability of the various glosses obtained from materials proposed to be used by the Contractor.

E. Undercoats and thinners: Provide undercoat paint produced by the same manufacturer as the finish coat. Use only the thinners recommended by the paint manufacturer, and use only to the recommended limits. Insofar as practicable, use undercoat, finish coat, and thinner materials as parts of a unified system of paint finish.

F. Standards: Paint materials shall meet or exceed the standards listed for each application in the Painting Schedule in Part Three of this Section.

2.3 APPLICATION EQUIPMENT

A. General: For application, use only equipment recommended for application of the particular paint by its manufacturer, and as accepted by the Architect.

B. Compatibility: Prior to actual use of application equipment, use all means necessary to verify that the proposed equipment is actually compatible with the materials to be applied and that the integrity of the finish will not be jeopardized by use of the proposed equipment.

C. Spray application: Take extreme care anytime spray, wet or dry, applications are made. Cleaning, replacement, or repair of finished work by over-spray shall be done to the satisfaction of the Architect and at no expense to the Owner.

2.4 OTHER MATERIALS

A. All other materials, not specifically described but required for a complete and proper installation of the Work described in this Section, shall be new, first-quality of their respective kinds, and as selected by the Contractor, subject to the approval of the Architect.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection: Prior to installation of the Work described in this Section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence. Verify that painting may be completed in strict accordance with the original design and with the manufacturer's recommendations as approved by the Architect.

B. Discrepancies: Do not proceed in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 MATERIALS PREPARATION

A. Mix and prepare painting materials in strict accordance with the manufacturer's recommendations as approved by the Architect.

B. Store materials not in use in tightly covered containers.

C. Maintain containers used for storing, mixing, and applying paint in a clean condition, free from foreign materials and residue.

D. Stirring: Stir all materials before application and as required during application to produce a mixture of uniform density. Do not stir into the material any film which may form on the surface. Remove the film and, if necessary, strain the material before using.

3.3 SURFACE PREPARATION

A. Perform all preparation and cleaning procedures in strict accordance with the paint manufacturer's recommendations as approved by the Architect.

B. Remove all removable items which are in place and are not scheduled to receive paint finish, or provide surface-applied protection prior to surface preparation and painting operations.

C. Following completion of painting in each space or area, reinstall the removed items by using workers skilled in the necessary trades.

D. Clean each surface to be painted prior to applying paint or surface treatment.

E. Remove oil and grease with clean cloths and cleaning solvents of low toxicity and a flash point in excess of 100 degrees F., (38 degrees C.), prior to start of mechanical cleaning.

F. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall onto wet, newly painted surfaces.

G. Preparation of wood surfaces:

1. Clean all wood surfaces until they are free from dirt, oil, and all other foreign substances.

2. Smooth all finished wood surfaces exposed to view, using varying degrees of coarseness in sandpaper to produce a uniformly smooth and unmarred wood surface.

3. Unless specifically approved by the Architect, do not proceed with painting of wood surfaces until the moisture content of the wood is 12% or less, as measured by a moisture-meter accepted by the Architect.

H. Preparation of metal surfaces:

1. Thoroughly clean all surfaces until they are completely free from dirt, oil, and grease.

2. On galvanized surfaces, use solvent for the initial cleaning and then treat the surface thoroughly with phosphoric acid etch. Remove all etching solution before proceeding and allow surfaces to dry thoroughly before application of paint.

3.4 PAINT APPLICATION

A. General:

1. Slightly vary the color of succeeding coats. Do not apply additional coats until the complete coat has been inspected and approved by the Architect and/or the Owner. Only the inspected and approved coats of paint will be considered when determining the number of coats applied.

2. Sand and dust between coats to remove all defects visible to the unaided eye from a distance of five feet.

3. On all removable panels and all hinged panels, paint the back sides to match the exposed sides.

4. Unless otherwise noted, provide one prime coat and two finish coats on all surfaces.

B. Drying: Allow sufficient drying time between coats; modify as recommended by the material manufacturer to suit adverse weather conditions. Oil-base and oleoresinous solvent-type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the applications of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

C. Brush application: Brush-out and work all brush coats onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, and other surface imperfections will not be accepted.

D. Spray application: Confine spray application to metal framework and similar surfaces where handbrush Work would be inferior. Wherever spray application is used, apply each coat to provide the equivalent thickness of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of two coats in one pass.

E. Completed Work shall match the approved samples for color, texture, and coverage. Remove, refinish, or repaint all areas where coatings do comply with specified requirements.

3.5 PAINTING SCHEDULE

A. General: Paint types required for Work described in this Section are is indicated below. Colors will be selected by the Architect from the full range at available colors.

B. Interior Paint Systems

1. Drywall
Primer: 1 coat Devoe 1030-1200 Prep & Prime PVA Wall Interior Based Primer 1 mil.
Finish: 2 coats Devoe/ICI 1412 Ultra Hide Latex Eggshell Interior wall and trim enamel, or Devoe/ICI Latex Semi Gloss 1.3 mils per coat.

2. Drywall, Toilet Rooms above ceramic tile
Primer: 1 coat Devoe/ICI 3210-1200Prep & Prime Gripper Multi-Purpose Interior/Exterior Water-Based Primer Sealer 1.8 mils.
Finish: 2 coats Devoe/ICI Tru-Glaze-WB 4406 Waterborne Epoxy Semi-Gloss 2.3 mils per coat.

3. Concrete Block
Primer: SP206 High Solids Block Filler. Master Coating Technologies
Second Coat: SP203 Acrylic Drywall Primer. Master Coating Technologies.
Third Coat: Polomyx. Master Coating Technologies

4. Wood for Opaque Finish
Primer: 1 coat Devoe/ICI 1120-1200Ultra Hide Oil/Alkyd interior wood under coat 2 mils.
Finish: Devoe/ICI 1516 Utra Hide alkyd semi-gloss interior wall and trim enamel 1.7 mils per coat.

5. Wood for Transparent Finish
Stain: Devoe/ICI 1700 Wood Pride interior Oil wood finish stain.
Finish: 2 coats Devoe 1902-0000 Wood Pride Interior Polyurethane varnish satin varnish 1.2 mils per coat.

6. Non-Ferrous Metals
Primer: 1 coat Devoe/ICI 3210-1200 Prep & Prime Gripper Multi-Purpose Interior/Exterior Water Based Primer Sealer 1.8 Mils.
Finish: 2 coats Devoe/ICI 1416 Ultra Hide Alkyd semi gloss interior wall and trim enamel 1.4 mils per coat.

7. Ferrous Metal
   Primer: 1 coat Devoe 4020 DTM Flat Int/Ext Waterborne Primer & Finish 2.0 mils.
   Finish: 2 coats Devoe/ICI 1416 Ultra Hide Alkyd semi gloss interior wall and trim enamel 1.4 mils per coat.

   * Primer not required if shop primed.
   ** Semi Gloss for Laundry, Kitchens and Toilets.

E. Paint not specifically described for a particular surface may be selected by the Contractor as recommended by the manufacturer of paint products, but is subject to acceptance by the Architect.

3.6 CLEANING

A. In addition to complying with Section 01700, remove all paint from finish surfaces of materials installed by other trades.

3.7 SCHEDULE

A. Patch prepare and paint all walls in Boiler Room, prepare and paint interior of doors and frames to Boiler Room, Patch, prepare and paint ceiling of Boiler Room. Patch prepare and paint wall areas behind unit replaced ventilators and relocated cabinets.

END OF SECTION

SECTION 22 11 00

PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 SECTION INCLUDES

A. Pipe and pipe fittings.

B. Valves

C. Storm water piping system.

D. Natural gas piping

1.3 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Division 2: Placement of pipe sleeves.

1.4 RELATED SECTIONS

A. Section 22 12 00 – Plumbing Specialties.

B. Section 23 00 00 - General Mechanical Requirements.

C. Section 23 05 29 - Hangers and Supports.

D. Section 23 05 48 - Sound and Vibration Isolation.

E. Section 23 05 53 - Mechanical Identification.

F. Section 23 07 19 - Piping Insulation.

1.5 REFERENCES

A. ANSI B31.1 - Power Piping.

B. ANSI B31.2 - Fuel Gas Piping.

C. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.

D. ANSI B31.9 - Building Service Piping.

E. ASME - Boiler and Pressure Vessel Code.

F. ASME Sec. 9 - Welding and Brazing Qualifications.

G. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

H. ASME B16.3 - Malleable Iron Threaded Fittings.

I. ASME B16.4 - Cast Iron Threaded Fittings Class 125 and 250.

J. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.

K. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

L. ASME B16.23 - Cast Copper Alloy Solder-Joint Drainage Fittings - DWV.

M. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.

N. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.

O. ASME B16.32 - Cast Copper Alloy Solder-Joint Fittings for Solvent Drainage Systems.

P. ASTM A47 - Ferritic Malleable Iron Castings.

Q. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

R. ASTM A74 - Cast Iron Soil Pipe and Fittings.

S. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized), Welded and Seamless, for Ordinary Uses.

T. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

U. ASTM B32 - Solder Metal.

V. ASTM B42 - Seamless Copper Pipe.

W. ASTM B43 - Seamless Red Brass Pipe.

X. ASTM B75 - Seamless Copper Tube.

Y. ASTM B88 - Seamless Copper Water Tube.

Z. ASTM B251 - Wrought Seamless Copper and Copper-Alloy Tube.

AA. ASTM B302 - Threadless Copper Pipe (TP).

AB. ASTM B306 - Copper Drainage Tube (DWV).

AC. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

AD. ASTM C425 - Compression Joints for Vitrified Clay Pipe and Fittings.

AE. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

AF. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

AG. ASTM C700 - Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.

AH. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

AI. ASTM D2235 - Solvent Cement for Acrylonitrile - Butadiene - Styrene (ABS) Plastic Pipe and Fittings.

AJ. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).

AK. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

AL. ASTM D2513 - Thermoplastic Gas Pressure Pipe, Tubing and Fittings.

AM. ASTM D2564 - Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

AN. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) Composite-Sewer Piping.

AO. ASTM D2683 - Socket-Type Polyethylene Fillings for Outside Diameter-Controlled Polyethylene Pipe.

AP. ASTM D2729 - Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

AQ. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

AR. ASTM D2846 - Chlorinated Polyvinyl Chloride (CPVC) Pipe, Fittings, Solvent Cements and Adhesives for Potable Hot Water Systems.

AS. ASTM D2855 - Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

AT. ASTM D3033 - Type PSP Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

AU. ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

AV. ASTM D3309 - Polybutylene (PB) Plastic Hot Water Distribution System.

AW. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

AX. ASTM F493 - Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

AY. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Pipe.

AZ. AWS A5.8 - Brazing Filler Metal.

BA. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

BB. AWWA C110 - Ductile - Iron and Gray - Iron Fittings 3 in.through 48 in., for Water and Other Liquids.

BC. AWWA C111- Rubber-Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings.

BD. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

BE. AWWA C651 - Disinfecting Water Mains.

BF. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

BG. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.

BH. CAN-3 B281 - Aluminum Drain, Waste, and Vent Pipe and Components.

BI. NCPWB - Procedure Specifications for Pipe Welding.

BJ. Connecticut Gas Equipment and Piping Code, approved under Connecticut General Statues, Section 29-329.

1.6 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual locations of valves.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welders Certification: In accordance with ASME Sec 9 and NCPWB Standard Procedure Specifications.

D. Maintain one copy of each document on site.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing the work of this section with minimum five years documented experience.

1.11 REGULATORY REQUIREMENTS

A. Perform Work in accordance with the 2003 International Plumbing Code and 2009 Connecticut Amendments to the State Building and Fire Codes.

B. Conform to Connecticut Health Code and other applicable codes and regulations for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.13 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.14 EXTRA MATERIALS

A. Furnish under provisions of Division 1.

B. Provide two repacking kits for each size valve.

PART 2 PRODUCTS

2.1 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.
1. Fittings: ASME B16.18, cast bronze, or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, Grade 95TA.

2.2 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 service weight.
1. Fittings: Cast iron.
2. Joints: ASTM C564, neoprene gasket system or lead and oakum.

2.3 NATURAL GAS PIPING, ABOVE GRADE

A. Steel pipe: ASTM A53 OR A120, Schedule 40 black.
1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
2. NFPA 54, threaded or welded to ANSI B31.1 and ASME Sec.1.

2.4 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under:
1. Ferrous pipe: 150 psig malleable iron threaded unions.
2. Copper tube and pipe: 150 psig bronze unions with soldered joints.

B. Pipe Size Over 2 Inches:
1. Ferrous pipe: 150 psig forged steel slip-on flanges; 1/16 inch (1.6 mm) thick preformed neoprene gaskets.
2. Copper tube and pipe: 150 psig slip-on bronze flanges; 1/16 inch thick preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings:
1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder
end, water impervious isolation barrier.

2.5 GATE VALVES

A. Up to and including 2 Inches: Bronze body, bronze trim, rising stem, handwheel, inside screw, single wedge or disc, solder or threaded ends.

B. Over 2 Inches: Iron body, bronze trim, rising stem, handwheel, OS&Y, single wedge,

flanged or grooved ends.

2.6 BALL VALVES

A. Up to and including 2 Inches: Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle and balancing stops, solder[or threaded ends with union.

B. Over 2 Inches: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.7 WATER PRESSURE REDUCING VALVES

A. Up to 2 Inches: Bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded and double union ends.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify excavations under provisions of Division 1.

B. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 8.

I. Establish elevations of buried piping outside the building to ensure not less than 4ft of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 9.

M. Excavate in accordance with Division 2.

N. Backfill in accordance with Division 2.

O. Install bell and spigot pipe with bell end upstream.

P. Install valves with stems upright or horizontal, not inverted.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

C. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

D. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.5 ERECTION TOLERANCES

A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.

B. Slope water piping and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

END OF SECTION 22 11 00

SECTION 23 00 00

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS:

A. General Conditions: Refer to the General Conditions, the Supplementary General Conditions and the Special Conditions, all provisions of which apply to work under this Section as if written in full herein.

B. The scope of work described in these Specifications and/or indicated on the drawings shall include (except where otherwise noted) the furnishing of all materials, equipment, appurtenances, accessories, connections, labor, etc. required and/or necessary to completely install, clean, inspect, adjust, test, balance and leave in safe and proper operating condition all mechanical systems. All mechanical work shall be accomplished by workmen skilled in the various trades involved.

1.2 ORDINANCES AND PERMITS:

A. All mechanical work shall conform to all ordinances and regulations of the City, County, State and/or other authorities having jurisdiction.

B. If code or other requirements exceed the provisions shown on the contract documents, the Engineer shall be notified in writing. Where requirements of the contract documents exceed code requirements, work shall be furnished and installed in accordance with the contract documents. Any work done contrary to these requirements shall be removed and replaced at the Contractor's expense.

C. Contractor shall obtain all permits and inspections required for the installation of this work and pay all charges incident thereto. He shall deliver to the Architect all certificates of said inspection.

1.3 EQUIPMENT, MATERIALS, BID BASIS:

A. Manufacturers' names, model numbers, etc. as specified on the drawings and herein are for the purpose of describing type, capacity, function and quality of equipment and materials required.

B. Unless "approved equal" is specifically stated, bids shall be based on equipment named in specifications or on drawings as "base" products.

C. "Equal product" and "approved equal" items listed shall conform to specified base items and shall be substantially equal in size, weight, construction and capacities. The alternate equipment and materials shall be submitted as full equivalent to the equipment and materials specified, with-sufficient supportive documentation and technical literature to demonstrate quality, performance, and workmanship without doubt or question. The Engineer shall consider the use of the alternate equipment based on the supportive documentation available to him, and shall approve or disapprove any proposed alternates. The decision of the Engineer shall in all cases be final.

D. The contractor shall coordinate the installation of all mechanical equipment proposed for use in this project with all building trades (architectural, structural and electrical). Coordination shall be accomplished prior to, and shall be reflected in, the submittal of shop drawings for approval Any modifications or revisions required by other trades as a result of the use of equipment other than the basis of design shall be made at no additional cost.

1.4 EXAMINATION OF PREMISES:

A. Prior to the ordering or purchasing of any equipment or materials or the layout or installation of any work, the Contractor shall examine the premises and verify any and all of the conditions under which he will be obliged to operate, or that will in any manner affect the work under this contract. No allowance will be made subsequently in this connection in behalf of the Contractor.

1.5 INSTRUCTIONS & DIAGRAMS:

A. Contractor shall prepare three (3) instruction manuals describing installation, operation and maintenance of all mechanical equipment. Manuals shall include copies of control schematics and sequences involved in these operations and indicate the function and operations of all components, as well as the Contractor's name, address, and telephone number. Manuals shall also contain one copy of all manufacturers' drawings, pamphlets, data, parts lists, instructions and manuals of equipment. One copy shall be delivered to the Owner, one copy shall be placed in Instruction Box. The pamphlets and drawings are to be neatly bound in a plastic binder.

B. Also upon completion of the work, the Contractor shall conduct operation and training sessions) for the Owner's key operating personnel. These sessions shall be of sufficient length and duration to adequately explain the design intent and proper operating and maintenance techniques for all mechanical equipment and systems. After these sessions are
completed, the Contractor shall provide a copy of a signed statement by the Owner that his personnel are thoroughly familiar with and capable of operating all mechanical equipment and systems.

1.6 SHOP DRAWINGS:

A. The Contractor shall prepare, submit, and obtain Engineer's approval of manufacturers' shop drawings on the following equipment and systems prior to ordering, purchasing, or installing any equipment or materials:

1. All equipment scheduled on the drawings.
2. Valves.
3. Control equipment, systems and diagrams.
4. Insulation and lining.
5. Ductwork drawings drawn to not less than 1/8 scale, double line, showing all fittings, offsets, etc. required for the installation.
6. Flexible ductwork.
7. Grilles, registers and diffusers.
8. Dampers.
9. Piping drawings drawn to not less than 1/8" scale (or larger if shown on the contract drawings) showing all fittings, valves, offsets, etc. required for the installation.
10. Pipe and piping accessories (gauges, hangers, thermometers,etc.)

11. Roof curbs.
12. Expansion of the existing Energy management system (EMS).

B. All shop drawing approvals required by any code or enforcement authority, insurance underwriter, etc. shall be obtained prior to being submitted to the Engineer.

. C. Review of shop drawings by the Engineer does not relieve the Contractor from responsibility for complying with all requirements of the Contract Documents. Furthermore, it shall be the responsibility of the Contractor to coordinate the requirements (roof openings, wall openings, curbs, electrical, etc.) of all approved equipment with the other trades and disciplines at no additional cost.

D. All shop drawings shall be identified by the equipment mark or tag identification numbers shown on the contract drawings.

E. All shop drawings shall clearly state that the electrical characteristics of all equipment has been coordinated with the electrical contract documents and the electrical contractor.

1.7 PAINTING:

A. Painting, except as otherwise specified, will be done under another SECTION of the specifications, but Contractor shall leave all surfaces of work free of rust, dirt and grease.

B. Contractor shall touch-up to match original finish any equipment scratched in shipment or installation.

A. Any visible ductwork through grilles, registers and diffusers shall be painted flat black. Provide one coat of rust preventive primer on all new structural steel supports and new ferrous surfaces not galvanized.

1.8 RECORD DRAWINGS:

A. The Contractor shall maintain a record of all changes in the work from that shown in the contract documents. After all work is completed, the Contractor shall prepare a set of "as-built" reproducible drawings of similar type and quality as the contract drawings that r eflect all changes and that accurately show actual final construction, and deliver these drawings to the Engineer, provide (3) sets of vellum drawings and one record set on Autocadd 2004 Format.

1.9 TRANSPORTATION, DELIVERY, STORAGE AND PROTECTION:

A. As part of the mechanical. work, the Contractor shall provide and pay for all transportation, delivery, and storage required for all equipment and materials. Upon receipt of all equipment and materials, they shall be properly stored to protect them from vandalism, theft, the elements, and other harm or damage. Any equipment or materials received in a damaged condition, or damaged after receipt, shall not be installed. Only new undamaged equipment in first-class operating condition shall be installed.

B. All equipment, piping and ductwork shall be protected to prevent entrance of foreign matter and debris by covering exposed openings during construction.

C. The mechanical contractor shall closely coordinate the ordering and delivery of all mechanical equipment with other trades to assure that equipment will be delivered in time

to be installed in the building without requiring special or temporary access or building modifications. Certain equipment may have to be installed prior to the erection of the building walls or roofs.

1.10 GUARANTY:

A. All mechanical work described in the contract documents shall be guaranteed for a period of one year from the date of final acceptance or Owner occupancy, whichever comes first. This guaranty shall apply to all equipment, materials and workmanship. During the guaranty period, all defects in mechanical systems shall be corrected in an acceptable manner, consistent with the quality of materials and workmanship of original construction, at no expense to the Owner.

B. All air conditioning compressors shall have an additional 5 year parts warranty.

PART 2 - PRODUCTS

2.1 GENERAL:

A. All equipment, materials, accessories, etc. used as part of the mechanical work shall be new, of the best grade and quality and 'Of current production, unless specified otherwise. Equipment not specified in the contract documents shall be suitable for the intended use and shall be subject to approval by the Engineer.

B. All equipment, products and materials shall be free of defects and shall be constructed to operate in a safe manner without excessive noise, vibration, leakage, or wear.

C. Electric motors need to conform to the minimum efficiency requirements of ASHRAE 90.1 – 2007 Table 10.8 in order to comply with LEED.

D. All filters shall be U.L. Class 1.

E. All penetrations through rated floors and walls shall be fire stopped with “Thomas and Betts” - Flamesafe FST firestop compound or approved equal, conforming to ASME E814/UL1479.

2.2 ELECTRICAL WORK:

A. Except as otherwise specified or noted, electrical equipment shall be as specified herein.

B. Motor controls, system controls, starters, pilot lights, push buttons, etc. shall be furnished by the Contractor complete as a part of the motor or apparatus which it operates. Electrical equipment shall be wired for the voltage, as shown on the Electrical Drawings.

C. Motors shall be standard NEMA continuous duty type. Each motor shall have ample capacity to drive the equipment to which it is connected at its full load capacity without loading the motor beyond its nameplate ratings, and shall have overload protection. Starters shall be Allen-Bradley as specified herein. Starters for motors 1/3 HP and smaller shall be manual AB Bulletin 600; for 1-1/2 HP and larger, magnetic, AB Bulletin 709. Starters for motors with remote or automatic control shall be magnetic. Relays, interlocks and auxiliary contacts shall be provided as specified and required.

D. Motor controls shall be either "Hand-Off -Auto" switches AB Bulletin 800 or "On-Off" push buttons with one indicating light, AB Bulletin 800. "Hand-Off-Auto" switches shall be provided for automatically controlled apparatus.

E. Motor starters not an integral part of equipment shall be installed under the Electrical Specifications. Provided by this contractor.

F. Electrical power wiring to disconnects, starters, motors and similar devices shall be provided under the Electrical Section.

G. Contractor shall provide all system controls, line and low voltage control and interlock wiring in conduits in accordance with materials and installation requirements of Electrical Section. All starters shall be labeled on face of starter.

H. All starters, control devices (other than those located in the Electrical Closets and Storage Rooms) shall be flush-mounted types.

I. All starters for three-phase equipment shall have overload devices in all three (3) phases.

J. Wiring diagrams shall be furnished by this Contractor.

K. Equal products of Westinghouse, General Electric, Square D, Cutler-Hammer, Furnas or Clark will be acceptable.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL:

A. All equipment and materials shall be completely installed and adjusted, complete with all accessories and connections.

B. Equipment, piping, ductwork, etc. shall fit into the spaces provided in the building and shall be installed at such times and in such a manner as to avoid damage to the building and as required by the job progress. Contractor shall coordinate work with other trades and locate work described herein to avoid interferences with structural, electrical and architectural work. Equipment, accessories and similar items requiring normal servicing or maintenance shall be easily accessible.

C. Contractor shall coordinate work so that structural work is properly installed to accommodate work under these Sections.

D. Installation shall be in accordance with ASHRAE Guide and manufacturers' recommendations.

E. The Architect/Project Engineer reserves the right to direct the removal of any item which, in his opinion, does not present an orderly and reasonably neat or workmanlike appearance. Such removal and replacement shall be done when directed by the Architect, at the Contractor's expense, and without additional cost to the Owner.

3.2 DEMOLITION WORK

A. Furnish all necessary labor and equipment to remove and safely dispose of all equipment,

materials, etc., shown, indicated, implied or required by this project.

B. All removal and demolition work shall comform with the national and state codes and regulations which may apply and nothing in these specifications shall be interpreted as an infringement of such codes and regulations.

C. Submit for review a schedule of all demolition work and proposed method for disposal.

D. Relocate existing devices, piping, condiuits, etc., conflicting with new equipment, devices, ductwork, piping, etc.

E. All existing abandoned or disused mechanical work within contract area shall be removed completely back to the last active devicve, regardless of the location of said device.

F. All active items within the contract area which service the contract area and beyond the contract area shall be maintained in service.

G. Remove and relocate all existing mechanical work as necessary for coordination with the work of other trades.

H. All existing unused piping and accessories shall be completely removed including hanger, fittings, etc. Disused piping embedded in the building's structure shall be stubbed off as close to the structure as practicable.

I. All removed equipment shall become the Contractor's property unless otherwise noted and/or specified, and shall be removed from the premised in entirety and safely disposed of in accordance with all local, state and federal regulations.

J. This Contractor shall pay for all disposal costs incurred in conjunction with the work.

3.3 EQUIPMENT SUPPORTS:

A. Major equipment supports (framed structural openings, etc.) shall be furnished and installed
by others as shown on the drawings. The mechanical work shall include, however, the furnishings and installation of all miscellaneous equipment supports, structural members, rods, clamps and hangers required to provide adequate support of all mechanical equipment.

B. Unless otherwise shown on the drawings, all mechanical equipment, piping, and accessories shall be installed level, square, and plumb.

C. Hangers shall not be attached to the bottom chord of any joists.

3.4 PIPE AND DUCTWORK PENETRATIONS:

A. Sleeves shall be installed in all masonry or concrete walls, floors, roofs, etc. for pipe and ductwork penetrations. Sleeves for pipe shall be schedule 40 black steel. Sleeves for ductwork shall be 20 gauge galvanized steel. Sleeves shall be sized to provide a minimum of 1/4" clearance between the sleeve and pipe or duct. For insulated pipes or ducts, the clearance shall be between the sleeve and the insulation.

B. As far as possible, all pipe and ductwork penetrations shall be provided for at the time of

masonry or concrete construction. Where drilling is required, only core drills shall be used.
Star drills shall not be used.

C. All pipes penetrating walls or floors of any construction shall be installed with escutcheon plates on both sides of the penetration securely fastened to the wall or floor. In exposed areas, escutcheon plates shall be chrome plated. All escutcheon plates shall be sized to completely conceal the penetration.

D. Ductwork penetrating walls or floors of any material shall be installed with closure plates on both sides of the penetration. Penetrations through exterior walls shall be sealed weathertight.

3.5 CUTTING AND PATCHING:

A. The mechanical work shall include all cutting, patching, masonry and carpentry work required as part of the equipment installation when not provided by other SECTIONs of these specifications.

B. All work shall be performed as specified under Architectural specification SECTION for cutting and patching.

3.6 TRENCHING AND BACKFILLING:

A. Trenching and backfilling required for the routing of piping shall be a part of the mechanical work and shall be performed as described in other SECTIONs of these specifications.

3.6 CLEANING:

A. At all times, the premises shall be kept reasonably clean and free of undue amounts of waste, trash and debris by periodic cleaning and removal. After completion, al1 foreign material , trash and other debris shall be removed from the job site.

B. After all equipment has been installed, but prior to testing and balancing, all equipment, piping, ductwork, etc. shall be thoroughly cleaned both inside and out.

C. Filters shall then be installed where required, and all systems shall be tested and balanced.

D. After testing and balancing and just prior to Owner review and acceptance, all systems shall be finally cleaned and shall be left ready for use.

E. All water piping shall be cleaned and disinfected as required by Code.

3.7 PAINTING AND COATING:

A. Unless otherwise specified herein or shown on the drawings, general painting of mechanical equipment shall be by others.

B. Touch-up painting of mechanical equipment shall be part of the mechanical work. All equipment and materials that are painted or coated by the manufacturer shall be touched-up prior to completion to conceal any and all scratches or other finish irregularities and to maintain the integrity of the paint or coating. All painting and coating shall match the

original and shall conform to the requirements detailed in other SECTIONs of these specifications.

3.8 FLASHING:

A. All piping and ductwork penetrating roofs shall be flashed in an approved manner, shall be watertight, and shall conform to the requirements detailed in other SECTIONs of these specifications.

B. Flashing for piping shall be sheet lead of not less than 6 pounds per square foot, shall have a base not less than two (2) square feet, and shall extend up over and into the open end of the pipe. All flashing shall be properly caulked and sealed.

3.9 TESTING, BALANCING AND ADJUSTING:

A. Air systems shall be balanced and tested in accordance with the procedures and methods outlined in "National Standards for Field Measurement and Instrumentation", prepared by the Associated Air Balance Council'. 2146 Sunset Blvd., Los Angeles, CA. Independent Test and Balance shall be used and they shall be a member of AABC.

B. Final air quantities dictate the final settings of fan speed and damper settings. Final performance of the installed equipment is the Contractor's responsibility and complete test data shall be submitted. for approval prior to the final inspection. Final results shall be typed and three copies submitted. All control functions shall be checked for compliance with specifications.

C. Unless otherwise specified herein, all mechanical piping shall be tested as required by Code to 1-1/2 times the rated system pressure or 100 psig, whichever is greater. Care shall be taken to isolate all equipment not suitable for this test pressure by installing pipe caps or blank flanges at the equipment connections. All valves and fittings shall be tested under pressure.

D. System balancing shall be performed only by qualified personnel skilled and experienced in this area of work. All instruments and instrument test openings shall. be provided as part of the work.

E. Balancing and adjusting shall be performed under all modes of operating conditions to simulate actual seasonal building conditions.

F. Air systems shall be balanced and adjusted to obtain the temperatures and flow rates scheduled on the drawings. Balancing shall be accomplished with minimum pressure differentials across all balance points.

G. After testing and balancing is complete, six copies of the Contractor's Test and Balance Report shall be completed and delivered to the Engineer for review.

END OF SECTION 23 00 00

SECTION 23 05 16

EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install flexible pipe connectors, expansion joints (compensating), pipe loops, offsets and swing joints.

1.2 RELATED SECTIONS

A. Section 22 11 00: Plumbing Piping.

B. Section 23 11 16: Hydronic Piping.

1.3 REFERENCES

A. Expansion Joint Manufacturers' Association.

1.4 SYSTEM DESCRIPTION

A. Base expansion calculations on 50 degrees F installation temperature to 350 degrees F for refrigeration gas, 210 degrees F for hot water heating, 140 degrees F for domestic hot water, plus 30 percent safety factor.

1.5 SUBMITTALS

A. Include maximum allowable temperature and pressure rating, overall face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure, total number of wires in braid in flexible pipe connector, and maximum expansion compensation in expansion joint.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Adsco.

B. Badger.

C. Flexonics.

D. Keflex.

E. Triflex.

2.2 FLEXIBLE PIPE CONNECTIONS

A. For steel piping construct with stainless steel inner hose and braided exterior sleeve.

B. For copper piping construct with bronze inner hose and braided exterior sleeve.

C. Construct spool pieces to exact size for insertion of flexible connection.

2.3 EXPANSION JOINTS

A. Steel Piping 3 Inch and Under: Provide stainless steel bellows type with anti-torque device, limit stops, and internal guide.

B. Steel Piping over 3 Inch: Provide external ring controlled type with hydraulically formed stainless steel bellows.

C. Copper Piping: Provide all bronze type with two-ply bronze bellows, anti-torque device limit stops, internal guides, and solder joint end.

2.4 CONNECTIONS

A. Provide flexible pipe connections and expansion joints suitable to connect to adjoining piping as specified for pipe joints. Use pipe sized units.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine piping layout and notify A/E of additional anchors required to adequately protect system.

B. Provide inspection services by flexible pipe manufacturer's representative for final installing and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

3.2 INSTALLATION

A. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation.

B. Accomplish structural work and provide equipment required to control expansion and contraction of piping, loops, pipe offsets, and swing joints, and provide corrugated bellows type expansion joints where required.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end.

D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so that movement takes place along axis of pipe only.

END OF SECTION 23 05 16

SECTION 23 05 29

HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Related Documents: The general provisions of the Contract, including Bidding Requirements, General and Other Conditions, and Specific Requirements, apply to all work of this Section.

B. Work Included in This Section:
1. Clamps, hangers and inserts for piping supports.
2. Hangers and supports for ductwork.
3. Equipment bases and supports.
4. Seismic bracing.

C. Related Work Specified in Other Sections:
1. Section 22 11 00 - Plumbing Piping.
2. Section 23 11 13 - Natural Gas and Fuel Oil Piping and Specialties.
3. Section 23 11 16 - Hydronic Piping.
4. Section 23 11 19 - Hydronic Specialties
5. Section 23 00 00 - General Mechanical Requirements.
6. Section 23 07 19 - Piping Insulation.
7. Section 23 31 00 - Ductwork.

1.2 QUALITY ASSURANCE

A. Applicable Standards:
1. 2005 State Building and Fire Safety Codes with 2009 Amendments.
2. ANSI: American National Standard Institute, Inc.
3. Automatic Sprinkler Pipe Supports: NFPA No. 13, Standard for the Installation of Sprinkler System.
4. SMACNA Duct Manual.

B. Hangers and supports shall be provided as per manufacturer's recommendations and as necessary to meet the performance requirements of the design.

1.3 SUBMITTALS

A. Submit the following in accordance with the requirements of the General Conditions.

B. Shop Drawings: Submit details of hangers, supports, inserts, support methods and part loadings.

C. Certification: Certificate from manufacturers stating that materials meet specified requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. The suspension system for ductwork, piping, and equipment shall be designed by a Professional Engineer registered in the State of Connecticut and under the employment of the contractor. The design shall conform to the rules and regulations of the Seismic Code. The maximum allowable single point load to slab shall be 200 pounds. Any load above 200 pounds shall be with supplementary steel members. The connecting members must be designed with a factor of safety of four (4).

2.2 CLAMPS

A. For risers, stacks and other vertical piping, use concealed black galvanized or cadmium plated wrought iron riser clamps, Fee & Mason Fig. 241 or Fig 238 at each floor.

2.2 HANGERS

A. For hot and cold water supply, return and drainage lines of brass, copper or galvanized steel, use split ring vertical or adjustment, Fee & Mason Fig. 199 or Fig. 115, for pipe sizes up to and including 4 inches. For sizes 6 inches and larger, use a clevis type hanger, Fee & Mason Fig. 239.

B. For support of copper tubing, use a split ring hanger with provision for vertical adjustment of cast brass, copper plated malleable iron, Fee & Mason Fig. 361.

C. Provide hangers of heavy construction suitable for the size of pipe to be supported. All materials to be of steel, except rollers of wrought or malleable iron. Hangers for pipes up to and including 4 inches to be swivel ring, split ring, wrought pipe clamp or adjustable wrought clevis type. Hangers for pipes 6 inches and above to have 2 rods and cross-rod with cast iron pipe roll complete with adjustable sockets and nuts.

D. Approved Manufacturers: Grinnel, Piping Technology & Products, Inc., Elcen, Tube-Turn, F&S, Pipe Shields, Inc.

2.3 INSERTS

A. Inserts shall be BS&A approved. Use Phillips Drill Company BS&A No. 481-64-SM. For stud anchors and for self-drilling inserts, BS&A No. 390-58-SM.

2.4 DUCT HANGERS AND SUPPORTS

A. For Horizontal Rectangular Ductwork:
   1. Support horizontal rectangular ductwork and associated equipment by structural steel channels and angles. For overhead ductwork suspend the shelf angle from two steel rods threaded at the ends.
   2. Where the specification provides for the use of strap hangers as an alternate or required method of support, fabricate the straps of the same material as the duct.

3. Use bolted or welded structural angle iron frames to support rectangular ductwork and associated equipment from floors or roof.
4. Hangers and supports for ductwork shall conform to the requirements of SMACNA Duct Construction Standards, latest edition except as otherwise noted.

B. For Vertical Rectangular Ductwork:
1. Support vertical rectangular ducts at intervals of not more than 12 feet and at each story by structural angles bolted or spot welded to a minimum of two larger sides of the duct where the minimum side dimension is 24 inches or greater.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND BRACKETS

A. Support all Horizontal Copper and Steel piping in accordance with the following schedule unless otherwise indicated on Drawings:

Pipe Size	Maximum Hanger Spacing	Rod Size
1" and smaller	6'-0"	3/8"
1-1/4" to 2"	9'-0"	3/8"
2-1/2" to 3"	10'-0"	1/2"
4" to 5"	12'-0"	5/8"
6"	12'-0"	3/4"
8" to 12"	12'-0"	7/8"
PVC (All Sizes)	6'-0"	3/8"

B. Provide hangers at each change in direction and both sides of each valve.

C. Support hangers from concrete inserts or beam clamps. Furnish, locate and set such inserts and make sure that such inserts are in place when the concrete is poured for new construction. Construct inserts of malleable iron or pressed steel with space for rods of all sizes. Install all inserts for pipes 3" and larger in size with a reinforcing rod 5/8" in diameter run through a slot in the insert specifically provided for this purpose.

D. If any pipe is to be hung in a space where no inserts have been provided, drill holes in the slab (subject to Engineer prior approval in writing) and provide rods and hanger attached to an approved fishplate or connected by a 2" x 2" angle, from which the hanger rod is to be suspended. For pipe size 2" and under use single No. 7000 shields by the hanger spacing designed hereinbefore to be reduced to 5'-0". The carrying capacity and size of each shield to be calculated on the basis of the spacing indicated above by the minimum size to be 3/8”. Install additional shields of the same size so that the number of hangers are of adequate size to support the loads which they carry.

E. Regardless of the type of construction (i.e., concrete, concrete-deck-steel or other variations) take particular care to support all main lines and all large and heavy pipes in an approved manner, including the furnishing and installation of supplementary steel.

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. Set all inserts for all pipes in ample time to allow concrete work to be performed on scheduled time.

G. Hangers shall be directly bolted or welded to steel beams of building construction, where they occur. Smaller pipes may be suspended from cross-pieces of pipe or steel angles, which in turn, are to be securely fastened to building beams or hung from building concrete construction by means of rods and inserts. The intention is to provide supports which, in each case, shall be amply strong and rigid for the load, but which will not weaken or unduly stress the building construction. This contractor shall provide all supplementary steel framing to adequately support the pipes.

H. Provide approved roller support, floor stands, wall brackets, etc., for all 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 to a higher level than the pipe.

I. Do not hang piping from other piping. Support of hangers by means of vertical expansion bolts is not permitted.

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 required to localize expansion or to prevent undue strain on piping and branches. All anchor designs, when submitted for approval, to include piping reactions which respective anchors are capable of supporting. Provide all indicated or required expansion loops.

L. Support all lines of copper tubing individually by approved type hangers not more than 6' apart, or as shown on the drawings. Hangers for uncovered lines: especially designed for copper tubing and of exact outside diameter of tubing. Hangers for covered tubing: broad straps fitting outside of covering.

M. Hangers for cold piping to support the pipe without piercing the insulation. Use insulation shields to protect the insulation on cold pipes. Shields shall be half round galvanized 14 gauge steel saddles not less than 12 inches long. Weld insulation protection saddles to insulated hot pipes at roller supports. Wherever fibrous glass pipe insulation is installed, install calcium silicate of equal thickness, in lieu thereof, wherever hangers and insulation shields shall bear only on a insulation material which is of such density that it will not compress, crush or deform.

N. For piping 4" and larger, support the elbows of the piping adjacent to the pumps with steel supports from the floor, or from the inertia base where pump is on such a base to prevent

loading heavy weights of piping on pump casing.

O. Attachments to Deck:

1. Attachments to deck slab for the purpose of supporting piping shall not be permitted. Heavy loads to be supported by supplementary structural steel connected to structural beams. Provide all required supplementary steel.
2. Furnish and locate sleeves, cut holes through deck, reinforce deck and set sleeves. Coordinate sleeve locations with deck sub- contractor and electrical distribution. Submit drawings showing location of holes and proposed reinforcing for approval before proceeding with installation.

P. Install all hangers straight and true, and in perfect alignment. Locate no hangers near couplings, fittings or bends in piping without making provision for expansion.

Q. In general, hangers shall be of the split ring or clevis type, of black galvanized wrought iron, with vertical adjustment. Where several lines of piping run as a common group, they shall be supported on a common hanger bar of black galvanized steel pipe or of black galvanized steel channel SECTION.

R. After adjusting hangers in place, trim, cut or file hanger rods, so that the ends do not extend more than 1/2 inch below the hanger bolts.

S. Furnish and install factory assembled supports complete with all saddles, cross bars, rollers and other accessories, as manufactured by Uni-Strut, Power Strut or other approved manufacturer. The support assembly shall include space for pipe and conduit of other trades.

T. For all buried piping encased in insulating conduit, furnish and install non-ferrous, non-corrosive supports of brick, concrete, or approved equal.

U. All hangers and brackets shall be degreased and wire brushed and dipped in a yellow zinc chromate paint equivalent for shop prime coat, prior to delivery.

3.2 DUCTWORK

A. Provide hangers and supports to support the weight of ducts and associated equipment such as heating coils, cooling coils, filters, fire dampers, volume dampers within the duct run. Fasten hangers and supports to steel structure by beam clamps or by steel clips welded to the lower flanges of beams and girders and to concrete structure by inserts or expansion anchors. Fasten strap hangers to steel structure by welding and to concrete structure by inserts or expansion anchors. Provide fastening adequate to insure permanent stability and to effectively resist all applied loads and strains.

B. Where ducts require support between beams, provide supplementary steel angles or channels.

C. One duct shall not act as support for another, but common hangers may be employed for two horizontal ducts in the same vertical plane.

D. Extend the strap hangers along the bottom of the duct and fasten to the bottom of the duct by bolts or rivets and to the side of the duct by bolts or rivets spaced so that one is provided for each foot or fraction thereof of duct height.

3.3 EQUIPMENT BASES AND SUPPORTS

A. Floor Mounted Equipment:
1. Provide for major equipment reinforced concrete housekeeping bases poured directly on structural floor slab 4 inches thick minimum, extended 6 inches minimum beyond machinery bedplates. Provide templates, anchor bolts and accessories required for mounting and anchoring equipment.
2. Construct supports of structural members on steel pipe and fittings. Brace and fasten with flanges bolted to structure.
3. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.

B. Suspended Equipment:
1. Each suspended equipment and air handling apparatus including fans, heating and ventilating units, shall be rigidly supported from the slab, roof or wall adjoining it by means of welded structural steel platform rigidly secured to the structure. The minimum structural member for support shall be 2-1/2" x 2-1/2" x 1/4" angles with at least four suspending angles for each unit. Plates used in forming platform support shall be 1/4 inch thick minimum. The suspended platform shall be designed so there is a factor of safety of 4 In. design stress below maximum permissible working stress for each structural steel member.
2. Provide angle bracings, brackets and struts to prevent the platform structure from swaying in any direction for any significant deflection.
3. Vibration isolation for suspended units shall be between the bases of the air handling apparatus and the structural platform that supports the suspended apparatus. Structural platforms shall be suitably reinforced to support the bases of the vibration isolation specified.
4. Suspending air handling apparatus by means of unbraced rods and channels or other unbraced trapezes is not acceptable. SMACNA details shall not be used for suspended equipment unless reinforced to give equal rigidity to an all welded structural platform.

END OF SECTION 23 05 29

SECTION 23 05 48

SOUND AND VIBRATION ISOLATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Related Documents: The general provisions of the Contract including Bidding Requirements, General and Other Conditions, and Specific Requirements, apply to all work of this Section.

B. Work Included in This Section:
1. Vibration isolation elements for piping and equipment.
2. Equipment isolation bases.
3. Piping flexible connections.

C. Related Work Specified in other Sections:
1. Section 22 11 00 - Plumbing Piping.
2. Section 23 11 13 - Natural Gas and Fuel Oil Piping and Specialties.
3. Section 23 11 16 - Hydronic Piping
4. Section 23 31 00 - Ductwork.
5. Section 23 34 00 - Fans.
6. Section 23 52 23 - Cast-Iron Boilers.
7. Section 23 77 00 - Packaged Rooftop Equipment.
8. Section 23 82 19 - Unit Ventilators

1.2 QUALITY ASSURANCE

A. It is the objective of this Specification to provide the necessary design for the control of excessive noise and vibration in the Buildings due to the operation of machinery or equipment, and/or due to interconnected piping, ductwork or conduit. The installation of all vibration isolation units, and associated hangers and bases, shall be under the direct supervision of the vibration isolation manufacturer's representative.
1. 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.
2. 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.
3. 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%.
4. All neoprene mountings shall have a Shore hardness of 30 to 60 ±5, after minimum aging of 20 days or corresponding oven-aging.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. All vibration isolation devices shall be the product of a single manufacturer. Products of other manufacturers are acceptable provided their systems strictly comply with the design intent, performance, deflection and structural design of the base manufacturer.

B. Seismic Restraints: Seismic restraints shall be capable of safely accepting one-half "G" external forces without failure, or one "G" for life safety equipment. It shall maintain equipment, piping, duct in a captive position. It shall not short circuit vibration isolation systems or transmit objectionable vibration or noise. It shall be provided on all equipment as scheduled on equipment schedules on drawings. Calculations by registered Civil or Structural Engineer or Contractor Consultant shall be submitted to verify snubber capacities for each isolated piece of equipment.

1. Spring Seismic Restraint Type I: Shall comply with general characteristics of spring isolators having a minimum O.D. to O.H. of 0.8 to 1 and minimum runout of 50% to solid. It shall incorporate snubbing restraint in all directions. It shall be capable of supporting equipment at a fixed elevation during equipment erection. Cast or aluminum housings unless ductile iron are not acceptable. System shall be field bolted or welded to deck with 1G acceleration capability.
   a. Mason Type SSLFH, or approved equal
2. Seismic Restraint Type II: Each corner or side shall incorporate a seismic restraint having a minimum 5/8" thick resilient pad limit stops working in all directions. Restraints shall be made of plate, structural members or square metal tubing concentric within a welded assembly incorporated resilient pads. Angle bumpers are not acceptable. System shall be field bolted or welded to deck with 1G acceleration capability.
   a. Mason Type Z-1011 and Z-1225, or approved equal
3. Seismic Restraint Type III: Metal cable type with approved end fastening devices to equipment and structure. See details on drawings. System shall be field bolted to deck or overhead structural members using two sided beam clamps to steel or appropriately designed insert for concrete. All parts of system including cables, clamps, excluding fastenings shall be single vendor furnished to assure seismic compliance.
   a. Mason Type SCB Seismic Restraining System
4. Seismic Restrainer Type IV: Shall be double deflection neoprene isolator encased in ductile iron or steel casing minimum 0.30 static deflection. System shall be field bolted or welded to deck with 1G acceleration capacity.
5. Seismic Restraint Type V: Non-isolated equipment shall be field bolted or welded (powder shots not acceptable) to resist seismic forces unless under 100# shear force.

C. Vibration Isolator Types:

1. Type A: Spring isolators shall incorporate the following:
   a. Minimum diameter of 0.8 of the loaded operating height.
   b. Corrosion resistance where exposed to corrosive environment with:
      (1) Springs cadmium plated or electrogalvanized.
      (2) Hardware cadmium plated.
      (3) All other metal parts hot-dip galvanized.
   c. Reserve deflection (from loaded to solid height) of 50% of rated deflection.

d. Minimum ¼" thick neoprene acoustical base pad on underside, unless designated otherwise.
e. Designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.
f. Non-resonant with equipment forcing frequencies or support structure natural frequencies.
g. Install accompanied with seismic restraint Type II.
h. Spring isolators to be Mason Type SLF, or as approved.

2. Type B: Spring isolators shall be same as Type A, except:
   a. Provide built-in vertical limit stops with minimum 1/4" clearance under normal operation.
   b. Tapped holes in top plate for bolting to equipment when subject to wind load.
   c. Capable of supporting equipment at a fixed elevation during equipment erection. Installed and operating heights shall be identical.
   d. Adjustable and removable spring pack with separate neoprene pad isolation.
   e. Design of housing to meet 1G acceleration.
   f. Field bolted or welded onto deck.
   g. Mason Type SLR, or as approved.
3. Type C: Spring hanger rod isolators shall incorporate the following:
   a. Spring element seated on a steel washer within a neoprene cup incorporation a rod isolation bushing.
   b. Steel retainer box encasing the spring and neoprene cup.
   c. Install accompanied with seismic restraint Type III.
   d. Mason Type HS, or as approved.
4. Type D: Elastomer Mounting Types - Elastomer Isolators shall incorporate the following:
   a. Bolt holes for bolting to equipment base.
   b. Bottom steel plates for bolting to sub-base as required.
   c. Unit type design molded in oil-resistant neoprene.
   d. Minimum static deflection of 0.35".
   e. Mason Type ND, or as approved.
5. Type E: Elastomer hanger rod isolators shall incorporate the following:
   a. Molded unit type neoprene element with projecting bushing lining rod clearance hole.
   b. Neoprene element to be minimum 1-3/4" thick.
   c. Steel retainer box encasing neoprene mounting.
   d. Clearance between mounting hanger rod and neoprene bushing shall be minimum of 1/8".
   e. Minimum static deflection of 0.35".
   f. Install accompanied with seismic restraint Type III.
   g. Mason Type HD, or as approved.
6. Type F: Combination spring/elastomer hanger rod isolators to incorporate the following:
   a. Spring neoprene isolator elements in a steel box retainer. Neoprene of double deflection type. Single deflection is unacceptable. Spring seated in a neoprene cup with extended rod bushing.
   b. Characteristics of spring and neoprene as described in Type A and Type E isolators.
   c. Install accompanied with seismic restraint Type III.

d. Mason Type DNHS, or as approved.

7. Type G: Pad type elastomer mountings to incorporate the following:
   a. 0.750" minimum thickness.
   b. 50 psi maximum loading.
   c. Ribbed or waffled design.
   d. 0.10" deflection per pad thickness.
   e. 1/16" galvanized steel plate between multiple layers or pad thickness.
   f. Suitable bearing plate to distribute load.
   g. Mason Type Super W, or as approved.
8. Type H: Pad type elastomer mountings to incorporate the following:
   a. Laminate canvas duck and neoprene.
   b. Maximum loading 1000 psi.
   c. Suitable bearing plate to distribute load.
   d. Minimum thickness ½".
   e. Mason Type HL, or as approved.
9. Type I: Isolated Clevis:
   a. Vibration isolation manufacturer shall provide an isolated clevis hanger for pipe support that combines a unit clevis or rod roller hanger and a Type (C, E or F) isolation hanger into one assembly. System shall be precompressed to allow for rod insertion and standard leveling. Deflection and type shall be as listed under PART 3 - EXECUTION.
   b. Install accompanied with seismic restraint Type III.
   c. Mason Type CIH.
10. Type J: Rail type spring isolators:
   a. Rail type spring isolators shall provide steel members of sufficient strength to prevent flexure with equipment operation.
   b. Springs shall be the same as Type A.
   c. Install accompanied with seismic restraint Type I, II or IV.
   d. Mason Type ICS, or equal.
11. Type K: Pipe anchors:
   a. Vibration isolator manufacturer shall provide an all directional acoustical pipe anchor, consisting of telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or neoprene isolation material. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. Allowable loads in the isolation material shall not exceed 500 psi and the design shall be balanced for equal resistance in any direction.
   b. Mason Type ADA, or as approved.
12. Type L: Spring type hangers:
   a. Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger to swing thru a 30° arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include a scale drawing of the hanger showing the 30° capability.
   b. Install accompanied with seismic restraint Type III.
   c. Mason Industries, Inc. type 30N, or as approved.
13. Type M: Horizontal thrust restraints:

a. Air handling equipment shall be protected against excessive displacement which might result from high air thrust in relation the equipment weight. The horizontal thrust restraint shall consist of a spring element in series with a neoprene pad, as described under Type A, with the same deflection as specified for hangers. The spring element shall be contained within a steel frame and designed so it can be preset for thrust at the factory and adjusted in the field to allow for a maximum of 1/4" movement at start and stop. The assembly shall be furnished with one rod and angle brackets for attachment to both the equipment and ductwork or the equipment and the structure. Horizontal restraints shall be attached at the centerline of thrust and symmetrically on either side of the unit.

b. Mason Industries, Inc. type WB, or as approved.

2.2 EQUIPMENT BASES

A. Curb Mounted Base, Type B-3:

1. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that directly sit on roof construction and are flashed and waterproofed into roof's membrane waterproofing system. Manufacturer's curb shall not be used.
2. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal.
3. Curbs shall be sound attenuating type which will utilize standard 2" roof insulation for sound attenuation or will require 2" of interior lining.
4. All spring mounts shall be as Isolator Type A.
5. Curbs shall be P-6000 having 3" of static deflection.
6. Curbs shall be rated for 1 G of acceleration and shall be wind restrained for 110 mph wind loads.
7. Options shall include sound barrier package, SBC-3. Two layers of waterproof sheetrock shall be supplied and installed by general contractor.
8. Curb shall be field bolted or welded onto deck.

B. Roof Isolation Rail System, Type B-4:

1. Specification R: Rooftop fans, condensing units, exterior ducted air handling units etc, shall be installed on continuous equipment support piers which shall combine a regular equipment support and an isolation system into one assembly. The system shall be designed with 2" or 3" static deflection steel springs which are both adjustable, removable and interchangeable after equipment has been installed. The system shall maintain the same operating and installed height both with and without the equipment load and shall be fully restrained during wind load conditions allowing no more than ¼" motion in any direction. The isolation pier shall be designed to accept the membrane waterproofing. The entire assembly shall be dry galvanized or plastic coated. System design permits minimum 1G of acceleration. The isolation rail pier system shall be model R-7000 as manufactured by Mason Industries or approved equal.

C. Isolated Rail Base, Type B-5:

1. Rails shall be constructed from structural steel angles as required to prevent flexure and misalignment under load.
2. Each rail shall be the full length of the supported equipment and be welded to a series of vertically restrained spring isolators as Type B described above.

3. Angles shall have bolt together ties at the ends and center to form one rigid base platform.
4. System shall be designed for minimum 1 G of acceleration. Mason Type TRSLR, or as approved.

D. Non-Isolated Curb, Type B-6:
1. Curb mounted rooftop equipment shall be mounted on structural curbs that meet 1G acceleration criteria. Curbs shall accept standard 2" roof insulation and be water-proofed in accordance to NRCA standard.
2. Curbs shall be sound attenuating type which shall utilize standard 2" roof insulation or 2" interior lining for sound attenuation.
3. Curb shall be field bolted or welded onto deck.
4. Curbs shall be Mason B-6000 or approved equal.

2.3 FLEXIBLE C0NNECTORS

A. Elastomer, Type FC-1:
1. Manufactured of nylon tire cord and EPDM, both molded and cured with hydraulic presses.
2. Straight connectors to have two spheres reinforced with a molded-in external ductile iron ring between spheres.
3. Elbow shall be long radius reducing type.
4. Rated 250 psi at 170°F. Dropping in a straight line to 170 psi at 250°F for sizes 1½" to 12" elbows. Elbows shall be rated no less than 90% of straight connections.
5. Sizes 10" and 12" to employ control cables with neoprene end fittings isolated from anchor plates by means of ½" bridge bearing neoprene bushings.
6. Minimum safety factor, 4 to 1 at maximum pressure ratings.
7. Systems bolted to victaulic type couplings or gate, butterfly or check valves to have a minimum 5/8" flange spacer installed between connector and coupling on flange.
8. Submittals to include test reports.
9. Mason Type MFTNC Superflex or approved equal.

B. Flexible Stainless Hose, Type FC-2:
1. Braided flexible metal hose.
2. 2" pipe size and smaller with male nipple fittings.
3. 2½" and larger pipe size with fixed steel flanges.
4. Suitable for operating pressure with 4:1 minimum safety factor.
5. Length as shown on drawings.
6. Mason Type BSS, or as approved.

C. Unbraided Exhaust Hose, Type FC-3:
1. Low pressure stainless steel annularly corrugated.
2. Fitted with flanged ends.
3. Maximum temperature 1500°F.
4. Mason Type SDL-RF, or as approved.

PART 3 - EXECUTION

3.1 GENERAL

A. Install in accordance with manufacturer's written instructions. Vibration isolators must not cause any change of position of equipment or piping resulting in piping stresses or misalignment.

B. Mechanical equipment shall be isolated from the building structure by means of noise and vibration isolators as specified herein.

C. Isolate all piping 2" and over located in mechanical equipment rooms and all duct runs from connected equipment for 50 feet with Type F hanger.

D. All piping and vertical risers shall be isolated from the building structure by means of noise and vibration isolation quides and supports.

E. All piping and ductwork to be isolated shall freely pass through walls and floors without rigid connections. Penetration points shall be sleeved or otherwise formed to allow passage of piping or ductwork, and maintain 3/4" to 1¼" clearance around the outside surfaces. This clearance space shall be tightly packed with fiberglass, and caulked airtight after installation of piping of ductwork.

F. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified.

G. Electrical circuit connections to isolated equipment shall be looped to allow free motion of isolated equipment.

H. The Contractor shall not install any equipment, piping or conduit which makes rigid contact with the "building" unless permitted in this Specification. Building includes, but it is not limited to, slabs, beams, columns, studs and walls.

I. Coordinate work with other trades to avoid rigid contact with the building. Inform other trades following work, such as plastering or electrical, to avoid any contact which would reduce the vibration isolation.

J. Bring to the Engineer'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 shall be at the responsible contractor's expense.

K. Bring to the Engineer's attention any discrepancies between the specifications and field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the contractor's expense.

L. Obtain inspection and approval of any installation to be covered or enclosed, prior to such closure.

M. Diagonal thrust restraint shall be as described for Type C Hanger with the same deflection as

specified for the spring mountings. The spring element shall be designed so it can be preset for thrust and adjusted to allow for a maximum of ¼" movement at start and stop. Diagonal restraints shall be attached at the centerline of thrust. Restraint shall be Mason Type WB, or as approved.

N. Correct, at an additional cost, all installations which are deemed defective in workmanship or materials.

3.2 PREPARATION

A. For vibration isolation equipment installed indoors, all metal parts, including rails and bases, shall be painted at the factory with one coat of red oxide paint and one coat of aluminum paint.
Other means or rust resisting painting may be accepted, subject to prior approval.

B. Vibration isolation equipment installed outdoors shall have all steel parts hot dipped galvanized, all bolts cadmium plated, and all springs cadmium plated and neoprene coated.

3.3 SEISMIC REQUIREMENTS

A. All equipment whether isolated or not shall be bolted to structure to allow for minimum 1/2 G of acceleration. Bolt points and diameter of inserts shall be submitted and verified as part of the contractors submission for each piece of equipment and certified by a licensed civil or structural engineer.

B. All structurally suspended overhead equipment isolated or non-isolated shall be four point independently braced with Type III seismic restraining system.

C. Install seismic restraining system Type III: Taught for overhead suspended non-isolated equipment, piping or ductwork and slack with 1/2" cable deflection for isolated systems.

D. Seismically restrain all piping and ductwork with Type III restraining system in accordance with guideline as outlined below.
1. Piping, schedule 10, 20, or 40 weld or victaulic braced at 40 foot intervals and at turns of more than 4 feet. Lateral bracing 80 intervals. No hub piping to be braced at 20 feet intervals or 40 feet using 1/2 G acceleration rated couplings.
2. Ductwork to be braced every 30 feet and at every turn and duct run ends. Lateral bracing every 60 feet.
3. Piping to be restrained as per detail on drawing.
4. Ductwork to be restrained as per detail on drawing.

E. If equipment is mounted on housekeeping pads, pads to be properly doweled or expansion shielded to deck to meet acceleration criteria.

F. Seismic restraints are not required for the following:
1. Gas piping less than 1" I.D.
2. Piping in boiler and MER rooms less than 1-1/4" I.D.
3. Other piping less than 2-1/2" I.D.
4. All rectangular ducts less than 6 sq. ft. in cross SECTIONal area.
5. All round ducts less than 28" in diameter.

6. All clevis piping suspended by individual hangers 12" in length or less from the top of the pipe support to the bottom of the support for the hanger.
7. All top supported ducts suspended by hangers 12" or less in length from the top of the duct support to the bottom of the support for the hanger.

G. Chimneys and stacks passing through floors are to be bolted at each floor level or secured above and below each floor with riser clamps.

H. Chimneys and stacks running horizontally to be braced every 30 feet with Type III restraining system.

I. Where base anchoring is insufficient to resist seismic forces supplementary restraining such as seismic restraint system Type III shall be used above systems center of gravity to suitably resist this additional restraint.

J. For overhead supported equipment, overstress of the building structure must not occur. Bracing can occur from:
1. Flanges of structural beams
2. Upper or lower truss chords in bar joist construction at the panel points
3. Cast in place inserts or drilled and shielded inserts in concrete structures

K. Pipe risers through cored shafts require no further seismic bracing. (Core diameter to be maximum 2" larger than pipe O.D.)

3.4 EQUIPMENT INSTALLATION

A. Mount floor mounted equipment on 4" concrete housekeeping pads over complete floor area of equipment. Mount vibration isolating devices and related inertia blocks on concrete pad.

B. Each fan and motor assembly shall be supported on a single structural steel frame. Flexible duct connections shall be provided at inlet and discharge ducts.

C. Additional Requirements
1. The minimum operation clearance between the equipment frame or rigid steel base frame and the housekeeping pad or floor shall be 1". Minimum operating clearance between concrete inertia and base and housekeeping pad or floor shall be 2".
2. The equipment structural steel or concrete inertia base shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the machine or isolators.
3. The isolators shall be installed without raising the machine and frame assembly.
4. After the entire installation in complete and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. When all isolators are properly adjusted, the blocks or shims shall be barely free and shall be removed.
5. Isolation mounting deflection shall be (minimum) as specified.
6. Install equipment with flexibility in wiring connection.
7. Verify that all installed isolator and mounting systems permit equipment motion in all directions. Adjust of provide additional resilient restraints to flexibly limit start-up equipment lateral motion to ¼".

8. Prior to start-up, clean out all foreign matter between bases and equipment. Verify that there are not isolation short circuits in the base, isolators or seismic restraints.

3.4 PIPING INSTALLATION

A. All piping are included under this Section.

B. Installation:
1. Isolate piping outside the shafts as follows:
   a. All water piping in machine rooms.
   b. Piping where exposed on roof.
   c. Water piping and boiler breeching within 50 feet (or 100 diameters if greater than 50 feet) from connected rotating equipment and pressure reducing stations.
2. The isolators shall be installed with the isolator hanger box attached to, or hung as close as possible to, the structure.
3. The isolators shall be suspended from substantial structural members, not from slab diaphragm unless specifically permitted.
4. Hanger rods shall be aligned to clear the hanger box.
5. Horizontal suspended pipe 2" and smaller and all steam piping shall be suspended by Type E isolator with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type F isolator with minimum 1" or same static deflection as isolated equipment to which pipe connects, whichever is greater. Type CIH Hanger can substitute for the above.
6. Horizontal pipe floor supported at slab shall be supported via Type A, with a minimum static deflection of 1" of same deflection an isolated equipment to which pipe connects, whichever is greater.
7. Vertical riser pipe supports shall utilize Type H.
8. Vertical riser guides, if required, shall avoid direct contact of piping with building.
9. Pipe anchors, where required, shall utilize resilient pipe anchors, Mason Industries Type ADA, or equivalent, to avoid direct contact of piping with building.
10. Pipe sway braces, where required, shall utilize two (2) neoprene elements (Type G or H to accommodate tension and compression forces).
11. Pipe extension and alignment connectors:
    Provide connectors at riser takeoffs, cooling and
    heating coils, and elsewhere as required, to accommodate thermal expansion and misalignment.
12. Provide drainpan over electrical equipment.

C. Isolator Position:
1. Close to building structure.
2. Between building structure and supplementary steel if required.
3. Suspend isolators from rigid and massive support points.
4. Supplementary steel to be sized for a maximum deflection of 0.08 inches at center span.
5. Support water piping in shafts and floor supports entering shaft with Type G isolators or Type H pad to prevent direct contact of piping with building structure.
6. Guide and anchor piping in shafts, as required, with approved mounting designs incorporating Type H pad to prevent direct contact of piping with building structure.

3.5 INSPECTION

A. On completion of installation of all vibration isolation devices herein specified, the local representatives of the isolation materials manufacturer shall inspect the completed system

and report in writing any installation error, improperly elected isolation devices, or other faults in the system that could affect the performance of the system. Contractor shall submit a report on the Engineer including the manufacturer's representatives final report, indicating all isolation reported as properly installed or requiring correction, and include a report by the Contractor on steps taken to properly complete the isolation work.

3.6 SEISMIC ISOLATION SCHEDULE

Type of Equipment	Type	Equipment Below Grade Deflect	Type	Equipment Above Grade Deflect
Condensing unit (self-contained)	D	0.4"	A or B	1.0"
Boiler	D	0.4"	B	1.0"
Pump (to 15hp)	D-J	0.4"	A-J	1.0"
Pump (above 15hp)	A-(B-2)	1."	A-(B-2)	2.0"
AHU factory assembled A (above 600rpm)		1."	A	2.0"
AHU factory assembled (below 600rpm)			A-(B-2)	2.5"

Type of Equipment	Type	Equipment Below Grade Deflect	Type	Equipment Above Grade Deflect
AHU factory assembled F suspended (above 600rpm)		.5"	F	2.0"
Fan, class I arrange 1 & 3 indoor (above 600rpm)			A-(B-1)	2.0"
Fan, class I arrange 1 & 3 indoor (above 600rpm)	A-(B-1)	1."	A-(B-1)	3.0"

Fan, class I arrange 1 & 3 indoor (below 600rpm)	A-(B-1)	1."	A-(B-1)	4.0"
Fan, class II & III indoor (below 600rpm)	A-(B-2)	1."	A-(B-2)	2.0"
Fan, class II &III indoor (below 600rpm)			A-(B-2)	3.0"
Fan, class I &III arrange 9 indoor	A	1."	A	2.0"
Piping in MER			I	
Ductwork in MER			F	
Flex connection for suction & discharge of pumps & chillers			(FC-1)	
Emergency generator			B	2.0"

3.7 SEISMIC SELECTION FOR NON-ISOLATED EQUIPMENT

A. Equipment:
1. All ceiling suspended piping and ductwork not excluded by diameter or distance requirement from support.
   a. Seismic Restraint Type III
2. All ceiling mounted equipment including but not limited to fans, AHU's, tanks, stacks, VAV boxes, and unit heaters.
   If VAV box is rigidly attached to ductwork (no flex) it is considered part of the ductwork. All diffusers mounted in ATC ceilings to be four point independently cable braced to deck unless ATC ceiling meets Seismic Zone II requirements. If this is met, earthquake clips shall secure fixture to T-bar structure.
   a. Seismic Restraint Type III
3. All floor mounted equipment
   a. Seismic Restraint Type V

B. Piping:
1. All ceiling suspended piping not excluded by diameter or distance requirement from support.
   a. Seismic Restraint Type III
2. All ceiling mounted equipment
   a. Seismic Restraint Type III
3. All floor mounted equipment, including but not limited to tanks, stacks, boilers, domestic water heaters, etc.

END OF SECTION 23 05 48

SECTION 23 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install materials for identification of mechanical products installed under Sections 22, 23 & 25.

1.2 RELATED SECTIONS

A. Division 9 - Painting.

1.3 REFERENCES

A. ANSI A13.1 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

A. Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. W. H. Brady Company.

B. Craftsmark.

C. Markem Corporation.

D. Seton Name Plate Company.

2.2 MATERIALS

A. Color: Meet requirements of ANSI A13.1, unless specified otherwise.

B. Plastic Nameplates: Laminated three-layer plastic with engraved white letters on a black background; minimum size 3 inches long and 1 inch high. Minimum lettering height for numbers and names is 1/4-inch and other data is 1/8-inch.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.

D. Stencils: With clean cut symbols and letters 2-1/2-inch high for ductwork and equipment.

E. Stencil Paint: Semi-gloss, high build epoxy esther or alkyd paint.

F. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and fluid being conveyed.

G. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Plastic Nameplates: Secure nameplates to equipment fronts using corrosive resistant screws and rivets. Install nameplates parallel to equipment lines.

B. Metal Tags: Install with corrosive-resistant chain and "j-hook."

C. Stencil Painting: Apply single coat sufficient to cover background completely with minimum 4 mils dry film thickness.

D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

E. Plastic Tape Pipe Markers: Install completely around pipe in accordance with manufacturer's instructions.

F. Equipment: Identify mechanical equipment scheduled on Drawings with nameplates, except for air devices, sprinkler heads, plumbing fixtures, and plumbing shock absorbers. Identify name, number, function, capacity, and other pertinent information of air handling units, heat transfer equipment, with plastic nameplates.

G. Controls: Identify control panels and major control components outside panels with plastic nameplates.

H. Valves: Identify valves in main and branch piping with metal tags.

I. Piping: Paint exposed piping in colors to meet ANSI standards. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet on straight runs, including risers and drops, adjacent to each valve and tee at each side of penetration of structure or enclosure and at each obstruction. Provide a flow arrow at each identification marker.

J. Ductwork: Identify ductwork with stenciled painting. Identify as to air handling unit number, and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure and at each obstruction.

K. Use identification of equipment on the "Record Drawings" for nameplate designations.

L. Attach identification for items such as special switches, etc., located in finished areas, on or in the immediate vicinity of the item.

3.3 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location as directed by Owner.

3.4 COLOR CODE FOR MARKING PIPE

MATERIAL	BAND	LETTERS AND FLOW ARROWS	LEGEND
Cold water (potable) WATER	Green	White	POTABLE-CW
Fire protection water WATER	Red	White	FIRE PR.
Condensate	Yellow	Black	COND.
Hot water (potable)	Green	Red	Potable-HW
Hot Water (Recirculation)	Green	Black	Recirculate-HW-potable
Refrigeration pipng	Blue	White	REFRIG.
Natural gas piping	Red	White	GAS
Fuel oil piping	Red	White	OIL

3.5 COLOR CODE MARKING SIZES

OUTSIDE DIAMETER OF PIPE COVERING (INCHES)	LENGTH OF COLOR BAND (INCHES)	ARROW LENGTH BY WIDTH (INCHES)	SIZE OF LEGEND LETTERS AND NUMERALS (INCHES)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4

END OF SECTION 23 05 53

SECTION 23 07 19

PIPING INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 22 11 00 - Plumbing Piping: Placement of hangers and hanger inserts.

B. Section 23 11 16 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 RELATED SECTIONS

A. Section 22 11 00 - Plumbing Piping.

B. Section 23 00 00 - General Mechanical Requirements

C. Section 23 05 29 - Hangers and Supports.

D. Section 23 05 53 - Mechanical Identification.

E. Section 23 11 16 - Hydronic Piping.

F. Section 23 11 19 - Hydronic Specialties.

G. Section 23 52 23 – Cast-Iron Boilers.

1.04 REFERENCES

A. ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.

B. ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.

C. ASTM C518 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

D. ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

E. ASTM C547 - Mineral Fiber Preformed Pipe Insulation.

F. ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes

of Pipe and Tubing (NPS System).

G. ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.

H. ASTM D2842 - Water Absorption of Rigid Cellular Plastics.

I. ASTM E84 - Surface Burning Characteristics of Building Materials.

J. ASTM E96 - Water Vapor Transmission of Materials.

K. NFPA 255 - Surface Burning Characteristics of Building Materials.

L. UL 723 - Surface Burning Characteristics of Building Materials.

M. 2009 International Energy Conservation Code (IECC)

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide product description, list of materials and thickness for each service, and locations.

C. Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.06 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 ASTM E84 and NFPA 255.

1.07 QUALIFICATIONS

A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 1..

B. Deliver materials to site in original factory packaging, labeled with manufacturer's Identification, including product density and thickness.

C. Store insulation in original wrapping and protect from weather and construction traffic.

D. Protect insulation against dirt, water, chemical, and mechanical damage.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.01 GLASS FIBER

A. Insulation: ASTM C547; rigid molded, noncombustible.
1. 'K' ('ksi') value : ASTM C335, 0.24 at 75 degrees F.
2. Minimum Service Temperature: -20 degrees F.
3. Maximum Service Temperature: 300 degrees F.
4. Maximum Moisture Absorption: 0.2 percent by volume.

B. Vapor Barrier Jacket
1. ASTM C921, White kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Transmission: ASTM E96; 0.02 perm inches.
3. Secure with self sealing longitudinal laps and butt strips.
4. Secure with outward clinch expanding staples and vapor barrier mastic.

C. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.

D. Vapor Barrier Lap Adhesive
1. Compatible with insulation.

2.02 CLOSED CELL OR “ARMAFLEX” insulation

A. To be used for refrigeration piping only.

2.03 JACKETS

A. PVC Plastic
1. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color.
a) Minimum Service Temperature: -40 degrees F.
b) Maximum Service Temperature: 150 degrees F.
c) Moisture Vapor Transmission: ASTM E96; 0.002 perm inches.
d) Maximum Flame Spread: ASTM E84; 25.
e) Maximum Smoke Developed: ASTM E84; 50.
f) Thickness: 15 mil.
g) Connections: Pressure sensitive color matching vinyl tape.

2. Covering Adhesive Mastic
a) Compatible with insulation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. On exposed piping, locate insulation and cover seams in least visible locations.

C. For insulated pipes conveying fluids above and below ambient temperature:
1. Provide standard jackets, with vapor barrier, field applied.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
3. Finish with glass cloth and adhesive.
4. PVC fitting covers will be used.
5. For hot water heating piping conveying fluids over 140 degrees F, insulate also flanges and unions at equipment.

D. Insulate all new piping, as hot water supply & return, cold water, condensate drain, and refrigeration suction piping, as indicated on drawings. This Contractor shall be responsible to avoid crushing of the refrigeration piping insulation or insulation failure due to vibration, by allowing adequate expansion and contraction of piping held clams..

E. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert Material: ASTM C640 cork or other heavy density insulating material suitable for the planned temperature range.

F. Finish insulation at supports, protrusions, and interruptions.

3.03 TOLERANCE

A. Substituted insulation materials shall provide thermal resistance within 10 percent at normal conditions, as materials indicated.

3.04 GLASS FIBER INSULATION SCHEDULE

PIPING SYSTEMS	PIPE SIZE Inch	THICKNESS Inch
A. Plumbing Systems		
Domestic Cold & Hot Water		
	Up to 1-1/2	1
	Over 1-1/2	1-1/2

Rain Leaders	2

B. Heating Systems

Heating Hot Water	
Up to 1-1/2	1-1/2
Over 1-1/2	2
Air Separators	2

C. Refrigeration Piping Systems

Refrigeration gas (RG) and Refrigeration Discharge Gas (RDG)	
Up to 1-1/2	1
Over 1-1/2	1-1/2

END OF SECTION 23 07 19

SECTION 23 08 00

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

1.02 RELATED SECTIONS

A. Division 1 - Starting of Systems.

B. Section 23 11 19 - Hydronic Specialties.

C. Section 23 31 00 - Ductwork.

D. Section 23 33 00 - Ductwork Accessories.

E. Section 23 34 00 - Fans.

F. Section 23 52 23 - Cast-Iron Boilers.

G. Section 23 77 00 - Packaged Rooftop Equipment.

H. Section 23 82 19 - Unit Ventilators.

I. Section 23 09 13 - Microprocessor Control Systems.

1.03 ALLOWANCES

A. Refer to Division 1 - Inspection and Testing and Allowances for the Cash Allowance Sum applicable to this Section of the Work.

B. This allowance includes adjusting and balancing of systems. Installation is included in this Section
and is part of the Contract Sum.

1.04 REFERENCES

A. AABC - National Standards for Field Measurement and Instrumentation, Total System Balance.

B. ASHRAE - 1984 Systems Handbook: Chapter 37, Testing, Adjusting and Balancing.

C. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.05 SUBMITTALS

A. Submit name of adjusting and balancing agency for approval within 30 days after award of

Contract.

B. Submit test reports as a submittal under provisions of Division 1.

C. Submit test reports under provisions of Division 1.

D. Prior to commencing work, submit draft reports indicating adjusting, balancing, and equipment data required.

E. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect/Project Engineer and for inclusion in operating and maintenance manuals.

F. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

G. Include detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty prior to commencing system balance.

1.06 REPORT FORMS

A. Submit reports on AABC National Standards for Total System Balance or NEBB forms.

B. Forms shall include the following information:

1. Title Page:
    a. Company name
    b. Company address
    c. Company telephone number
    d. Project name
    e. Project location
    f. Project Architect
    g. Project Engineer
    h. Project Contractor
    i. Project altitude

2. Instrument List:
    a. Instrument
    b. Manufacturer
    c. Model
    d. Serial number
    e. Range
    f. Calibration date

3. Air Moving Equipment:
    a. Location
    b. Manufacturer
    c. Model
    d. Air flow, specified and actual
    e. Return air flow, specified and actual
    f. Outside air flow, specified and actual

g. Total static pressure (total external), specified and actual
h. Inlet pressure
i. Discharge pressure
j. Fan RPM

4. Exhaust Fan Data:
   a. Location
   b. Manufacturer
   c. Model
   d. Air flow, specified and actual
   e. Total static pressure (total external), specified and actual
   f. Inlet pressure
   g. Discharge pressure
   h. Fan RPM

5. Return Air/Outside Air Data:
   a. Identification/location
   b. Design air flow
   c. Actual air flow
   d. Design return air flow
   e. Actual return air flow
   f. Design outside air flow
   g. Actual outside air flow
   h. Return air temperature
   i. Outside air temperature
   j. Required mixed air temperature
   k. Actual mixed air temperature
   l. Design outside/return air ratio
   m. Actual outside/return air ratio

6. Electric Motors:
   a. Manufacturer
   b. HP/BHP
   c. Phase, voltage, amperage; nameplate, actual, no load.
   d. RPM
   e. Service factor
   f. Starter size, rating, heater elements

7. V-Belt Drive:
   a. Identification/location
   b. Required driven RPM
   c. Driven sheave, diameter and RPM
   d. Belt, size and quantity
   e. Motor sheave, diameter and RPM
   f. Center to center distance, maximum, minimum, and actual

8. Duct Traverse:
   a. System zone/branch

b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

9. Air Distribution Test Sheet:
   a. Air terminal number
   b. Room number/location
   c. Terminal type
   d. Terminal size
   e. Area factor
   f. Design velocity
   g. Design air flow
   h. Test (final) velocity
   i. Test (final) air flow
   j. Percent of design air flow

10. Duct Leak Test:
    a. Description of ductwork under test
    b. Duct design operating pressure
    c. Duct design test static pressure
    d. Duct capacity, air flow
    e. Maximum allowable leakage duct capacity times leak factor
    f. Test apparatus
       1) Blower
       2) Orifice, tube size
       3) Orifice size
       4) Calibrated
    g. Test static pressure
    h. Test orifice differential pressure
    i. Leakage

1.07 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 1.

B. Accurately record actual locations of air diffusion devices, balancing valves and rough settings.

1.08 QUALITY ASSURANCE

A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum five years documented experience. Certified by AABC. Perform Work under supervision of AABC Certified Test and Balance Engineer.

B. Total system balance shall be performed in accordance with AABC National Standards for Field

Measurement and Instrumentation, Total System Balance. ASHRAE - 1984 Systems Handbook.

1.09 SEQUENCING AND SCHEDULING

A. Sequence work under the provisions of Division 1.

B. Schedule work under the provisions of Division 1.

C. Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.10 PRE-INSTALLATION CONFERENCE

A. Convene a conference one week prior to commencing work of this Section, under provisions of Division 1.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before commencing work, verify that systems are complete and operable. Ensure the following:

1. Equipment is operable and in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Correct fan rotation.
7. Fire and volume dampers are in place and open.
8. Coil fins have been cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage has been minimized.
12. Hydronic systems have been flushed, filled, and vented.
13. Correct pump rotation.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Report any defects or deficiencies noted during performance of services to Architect/Engineer.

C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.

D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

E. Beginning of work means acceptance of existing conditions.

3.02 PREPARATION

A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

B. Provide additional balancing devices as required.

3.03 INSTALLATION TOLERANCES

A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10 percent for return and exhaust systems from figures indicated.

B. Adjust hydronic systems to plus or minus 10 percent of design conditions indicated.

3.04 ADJUSTING

A. Adjust work under provisions of Division 1.

B. Recorded data shall represent actually measured, or observed condition.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.05 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. 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.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

3.06 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gages to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings.
Do not use service or shut-off valves for balancing unless indexed for balance point.

END OF SECTION 23 08 00

SECTION 23 09 13

CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Thermostats/temperature sensors.

B. Automatic dampers and operators.

C. Control valves and operators.

D. Carbon monoxide detector.

E. Local control panels.

F. Miscellaneous accessories.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 33 00 - Ductwork Accessories: Installation of automatic dampers.

1.03 RELATED SECTIONS

A. Section 23 05 29 - Hangers and Supports..

B. Section 23 05 48 - Sound and Vibration Isolation.

C. Section 23 09 93 - Sequences of Operation.

D. Section 25 00 00 – Expansion of the existing Energy Management System (EMS)

E. Division 26 - Equipment Wiring Systems.

1.04 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.

C. ANSI/ASTM B32 - Solder Metal.

D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

E. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

F. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

H. FS-GG-G-76 - Gages, Pressure and Vacuum, Dial Indicating for Air, Steam, Oil, Water, Ammonia, Chloro-Fluorohydrocarbon Gases, and Compressed Gases).

I. FS-QQ-S-571 - Solder, Tin Alloy; Tin-Lead Alloy; and Lead Alloy.

J. MIL-F-18280 - Fittings, Flareless Tube, Fluid Connection.

K. MIL-S-29175 - Switch, Thermostatic, Low Voltage, Non-(Setback/Setup) and Setback/Setup, Limiting: Heating, Cooling and Heating-Cooling.

L. NEMA DC 3 - Low-Voltage Room Thermostats.

1.05 SYSTEM DESCRIPTION

A. Provide control systems consisting of thermostats, control dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.

B. Provide electric/electronic automatic temperature control systems with electric accessories.

1.06 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.

C. Product Data: Include description and engineering data for each control system component. Include sizing as requested.

D. Submit manufacturer's certificate under provision of Division 1 that meet or exceed specified requirements.

E. Submittals of automatic control systems components which are not the product of the control system manufacturer shall bear evidence of his approval.

F. Submit manufacturer's installation instructions under provisions of Division 1.

G. Submit manufacturer's field reports under provisions of Division 1.

H. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.

1.07 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Division 1.

B. Accurately record actual location of control components, including dampers, thermostats, and sensors.

C. Revise shop drawings to reflect actual installation and operating sequences.

1.08 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include systems descriptions, set points, and controls settings and adjustments.

C. Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.09 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum five years documented experience.

B. Installer: Company specializing in installing the work of this Section with minimum five years documented experience and approved by manufacturer.

1.10 SEQUENCING AND SCHEDULING

A. Refer to drawings.

B. Coordinate installation of system components with installation of mechanical systems equipment.

1.11 WARRANTY

A. Provide five year warranty under provisions of Division 1.

1.12 MAINTENANCE SERVICE

A. Furnish service and maintenance of automatic controls system for one year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 THERMOSTATS/TEMPERATURE SENSORS

A. Electric/Electronic Type: NEMA DC 3, Low voltage type with setback/setup temperature control Conform to MIL-S-29175.

B. Room Thermostat Accessories:
1. Thermostat Covers: Clear lockable type.

2.02 CONTROL VALVES

A. Electric/Electronic: NEMA DC 3, Low voltage, Type: 2-way or 3-way type, 2 –position or modulating type, as indicated or required.

2.03 MOTORIZED DAMPERS

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel carbon steel, welded or riveted with corner reinforcement.

C. Blades: [Galvanized steel, attached to minimum 1/2 inch shafts with set screws.

D. Blade Seals: Neoprene, mechanically attached, field replaceable.

E. Jamb Seals: Stainless steel.

F. Shaft Bearings: Lubricant free, stainless steel, single row, unground, flanged, radial, antifriction type with extended inner race.

G. Linkage Bearings: Oil impregnated sintered bronze or graphite impregnated nylon.

H. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.

I. Maximum Pressure Differential: 6 inches wg .

J. Temperature Limits: -40 to 200 degrees F.

2.04 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.

B. Electric Operators: Split phase type with oil immersed gear train.

C. Number: Sufficient to achieve unrestricted movement throughout damper range.

2.05 CARBON MONOXIDE DETECTORS

A. General: Electro-chemical sensing technology system-monitored type, 12/24 VDC, 4-wire supervised with trouble relay, UL 2034 and 2075, installed in strict accordance with 2012 NFPA-720.

B. Refer to drawings for specifications and sequence of operation.

2.06 LOCAL CONTROL PANELS

A. Control panels with suitable brackets for wall mounting, for each piece of specified equipment, UL
listed. Locate adjacent to the systems served.

2.07 DUCT MOUNTED SMOKE DETECTORS

A. Ionization UL listed type furnished key type remote test station, as indicated and required.

2.08 SYSTEMS ACCESSORIES

A. Relays: 24VAC.

B. Switches: With indicating plates, accessible adjustment, calibrated and marked.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that systems are ready to receive work.

B. Beginning of installation means installer accepts existing conditions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats/temperature sensors and other exposed control sensors with plans and room details before installation.

C. Provide conduit and electrical wiring where required. Refer to Division 26.

D. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 1.

3.04 DEMONSTRATION

A. Provide systems demonstration under provisions of Division 1.

B. Demonstrate complete operation of systems, including sequence of operation after Date of Substantial Completion.

END OF SECTION 23 09 13

SECTION 23 09 33

MOTORS AND CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install electric motors required for equipment furnished under this Section; include:
   1. Motors factory mounted on equipment.
   2. Motor controllers provided as an integral part of a piece of equipment.
   3. Motor controllers will be furnished and installed under Section 26 unless motor controller is integral part of piece of equipment and/or specifically required to be furnished under this Section.

1.2 REFERENCES

A. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.

1.3 SUBMITTALS

A. Include product data on motor starters and combination motor starters, relays, pilot devices and switching and overcurrent protective devices. Include trip ratings, size and UL listing.

B. Electrical motors need to conform to the minimum efficiency requirements of ASHARE 90.1.-2007 Table 10.8 in order to comply with LEED.

C. Where similar items of equipment are utilized, include separate data sheet for each item, individually identified as to function.

D. Provide operation and maintenance manual.

1.4 QUALITY ASSURANCE

A. Provide motor starters under this SECTION by same manufacturer where possible.

PART 2 - PRODUCTS

1.5 MANUFACTURERS

A. Motors
   1. Century/Gould.
   2. General Electric.
   3. Louis-Allis.
   4. Reliance.
   5. Siemans-Allis, Inc.
   6. U.S. Motors.
   7. Westinghouse.

B. Motor Starters
1. Allen-Bradley.
2. General Electric.
3. Square D.
4. Westinghouse.

1.6 MOTORS

A. Provide motor voltages as follows unless specified or indicated otherwise:
1. 3/4 hp and Larger: three phase, 60 hertz.
2. Smaller than 3/4 hp: single phase, 60 hertz.

B. Unless otherwise specified, provide motors that are single speed, 1750 rpm with standard drip-proof enclosure.

C. Provide motors exposed to the weather that are totally enclosed fan-cooled or totally enclosed air-over types.

D. Provide all three-phase motors with at least 1.15 service factor.

E. Select motors to operate at design conditions without exceeding nameplate ratings if 1.00 service factor is assumed.

F. Provide motors with sealed or field-lubricated type ball bearings unless otherwise noted. Provide grease fittings for field-lubricated motors.

G. Provide motors with copper windings.

H. Select motors for low starting current, designed for continuous duty to provide the running torque and pull-in torque required to send the load.

I. Select motors for quiet operation. Provide totally enclosed fan cooled (TEFC) Gould E+ energy efficient design for all motors 5 hp and above.

J. Provide capacitor start type single-phase motors with starting, pull-in and running characteristics to match the load. Limit temperature rise to 60 degrees C.

K. Refer to various Sections of this Section for special requirements for specific items of equipment requiring motors. Select motors for variable speed operation (i.e., for air handling units) specifically for quiet operation.

1.7 MOTOR STARTERS

A. Manual Motor Starters
1. Fractional Horsepower Manual Starter: NEMA ICS 2; AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, pilot light and toggle operator.
2. Motor Starting Switch: NEMA ICS 2; AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors,

without thermal overload unit, red pilot light, NO auxiliary contact, and toggle operator.

3. Enclosure: NEMA ICS 6; Type 1.

B. Magnetic Motor Starters

a. Magnetic Motor Starters: NEMA ICS 2; AC general-purpose, Class A magnetic controller for induction motors rated in horsepower as indicated.
b. Provide accessible terminals for wiring directly from the front of the starter.
c. Contacts: Provide silver, cadmium oxide alloy, double break, non-welding contacts which will not require filing, dressing or cleaning throughout the life of the control equipment.
d Provide starter types as required.:
e. Full Voltage Starting: Non-reversing type.
f. Two Speed Starting: Two speed, two winding, variable torque type. Include integral time delay transition between FAST and SLOW speeds.
g. Coils: Pressure molded, 120 volts, 60 hertz. Provide integral control transformer.
h. Overload and Phase Protection Relay: Provide solid state voltage and overload sensing in all three phases for three-phase full voltage starters, in ungrounded phases for single-phase full voltage starters and in all six legs for two-speed full voltage starters. Overload relay shall be self powered solid state type with selectable Class 10 or 20 overload, phase loss and phase current unbalance protection, ±2% repeatability, thermal memory, trip test and indication, and FLA adjustment without the use of heaters. The overload relay shall be insensitive to ambient temperature with a range of -20 to 70 degrees Celsius. Non adjustable phase failure relay shall be integral with overload relay and have an under voltage trip point set at 80% for dropout and 90% for pickup. Relay shall also operate at 6% phase unbalance and 6% phase voltage loss. A single reset button on the door shall permit external reset.
i. Enclosure: NEMA ICS 6; Type 1.
j. Auxiliary Contacts: Provide each starter with the required auxiliary contacts for the control functions Indicated and required, including the holding interlock and pilot light interlocks, plus two additional contacts, field convertible to normally open or normally closed, NEMA ICS 2 controls. Provide capability to add auxiliary contacts without removing existing wiring or removing the controller from its enclosure.

11. Push Buttons: NEMA ICS 2; START/STOP or HAND/OFF/AUTO in front cover as required by temperature controls.
12. Indicating Lights: NEMA ICS 2; RUN; red pilot light (push to test type) in front cover. Operate pilot lights from separate interlock not placed across the holding coil.
13. Control Power Transformers: Provide integral 120-volt secondary control transformer with both primary and secondary control power fuses.

i. Combination Motor Starter

1. Combine starter with disconnect in common enclosure as scheduled.
   a. Molded Case Thermal-Magnetic Circuit Breakers: NEMA AB 1; circuit breakers with integral thermal and instantaneous magnetic trip in each pole.
   b. Motor Circuit Protector: NEMA AB 1; circuit breakers with integral instantaneous magnetic trip in each pole.
2. Provide combination starters with an IER of at least 65,000 A (RMS).

PART 3 - EXECUTION

1.1 INSTALLATION

a. Install motor control equipment in accordance with manufacturers' instructions.
b. Select and install overload elements in motor starters to match installed motor characteristics.
c. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor and voltage/phase rating. Provide phenolic nameplate on cover exterior to indicate motor served.
d. Mount motor package according to manufacturers recommendations.
e. Mount in accessible location to allow sufficient room for maintenance on itself and adjacent items.

END OF SECTION 23 09 33

SECTION 23 09 93

SEQUENCES OF OPERATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Sequence of operation is hereby defined as the manner and method by which controls function. Requirements for each type of control system operation are specified in this Section.

1.2 SUBMITTALS

A. Shop Drawings

1. Submit shop drawings for each system automatically controlled, containing the following information:
   Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, wiring, installation details, control devices and sequence of operation.
2. Submittals shall be clearly referenced to the specifications Section and paragraphs indicating compliance with, or where deviation is proposed, to clearly demonstrate that the proposed system, subject to the approval of the Engineer, satisfies the intent of the specifications.
3. Submittals for control and interlock wiring shall be complete, indicating all power requirements, wire size, ampacity, and control and interlock wiring diagrams. Diagrams shall indicate contact points or devices required for proper interface with manufacturers of equipment specified to be monitored or controlled. Partial submittals will not be considered for approval.
4. Submittals shall clearly indicate location of control panels and indicate required methods for routing, attachment or support. In addition to a riser diagram, submit floor plans indicating the general routing of the communication lines, which shall be in conduit.
5. Provide data inputting and all programming.

B. Maintenance Data

1. Include copy of shop drawings in each maintenance manual in accordance with the requirements of the General Conditions.

PART 2 - PRODUCTS

2.1 General

A. Provide a complete control systems including all system components and wiring. Provide all input/output devices, relays, panels, control and interlock wiring, transmitters, transducers, switches, as indicated on drawings, including instrumentation and controls, as dictated by the sequence of operation, input/output control points to existing expanded Energy Management System (EMS), and control diagrams.

2.2 ELECTRICAL WIRING AND MATERIALS

A. Install, connect and wire the items included under this Section. This work includes providing required conduit, wire, fittings, and related wiring accessories.

B. Provide wiring between thermostats, aquastats, switches and unit heater motors, all control and alarm wiring for all control and alarm devices for all Sections of this Contract.

C. Obtain from nearest available emergency power panel and provide 120 volt, single phase, 60 hertz power to every transmission power supplies, annunciator modules, modems, intercom modules, printers and to other devices as required. Coordinate available circuits with the Electrical Contractor.

1. The power supplies are to be extended in conduit and wire from available spare circuits in emergency panel boards.
2. It is the intent that the entire central automation system and all peripheral devices, alarms, etc., shall be operative under emergency power conditions in the building.

D. Provide status function conduit and wiring for equipment covered under this Section..

E. Provide conduit and signal wiring between motor starters and high and/or low temperature relay contacts and remote relays in control panels located in the vicinity of the equipment.

F. Provide conduit and wiring between the central processing unit, electrical panels, metering instrumentation, indicating devices, miscellaneous alarm points, remotely operated contractors, and control panels, as shown on the drawings or as specified.

G. All control power and control wiring shall be mounted in conduits.

H. All wiring shall be in compliance with the Local/State Electrical Code.

I. Coordinate electrical work under this contract with work of the Electrical Contract.

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION

A. Refer to Sequences of Operation on drawings.

END OF SECTION 23 09 93

SECTION 23 11 13

NATURAL GAS AND FUEL OIL PIPING AND SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe and pipe fittings.

B. Valves.

C. Accessories.

1.02 RELATED SECTIONS

A. Division 9 - Painting.

B. Section 23 05 29 - Hangers and Supports.

C. Section 23 05 53 - Mechanical Identification.

D. Section 23 52 23 - Cast Iron Boilers.

1.03 REFERENCES

A. ASME B16.18 - Cast Bronze Solder-Joint Pressure Fittings.

B. ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings

C. ASME B16.26 - Cast Bronze Fittings for Flared Copper Tubes.

D. ASTM B88 - Seamless Copper Water Tube.

E. NFPA 30 - Flammable and Combustible Liquids Code.

F. NFPA 31 - Installation of Oil Burning Equipment.

G. ANSI B31.1 - Power Piping.

H. ANSI B31.2 - Fuel Gas Piping.

I. ANSI B31.4 - Liquid Petroleum Transportation Piping Systems.

J. ANSI B31.9 - Building Service Piping.

K. ASME B16.3 - Malleable Iron Threaded Fittings.

L. NFPA 54 - National Fuel Gas Code.

M. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

N. ASTM A234 - Pipe Fittings or Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

1.04 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include installation instructions, spare parts lists.

1.06 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing the work of this section with minimum five years experience.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable EPA Regulations for installation of fuel oil system and NFPA 54 for installation of natural gas piping, fittings, valves and accessories.

B. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of fuel oil system.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation is performed.

1.10 EXTRA MATERIALS

A. Furnish under provisions of Division 1.

B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.01 FUEL OIL PIPING

A. Copper Tubing: ASTM B88, Type K annealed.
1. Fittings: ASME B16.26, cast bronze.
2. Joints: Flared.

B. Stainless steel flexible hose, suitable for fuel oil # 2, for final connection.

2.02 NATURAL GAS PIPING

A. Steel Pipe: ASTM A53 or A120, Schedule 40, black.
1. Fittings: ASME B16.3, malleable iron.
2. Joints: NFPA 54, threaded or welded (over 2”)..

B. Stainless steel flexible hose, suitable for natural gas for final connection.

2.03 UNIONS, AND COUPLINGS

A. Pipe Size 2 Inches and Under:
1. Ferrous pipe: 150 psig malleable iron threaded unions.
2. Copper tube: 150 psig bronze unions with brazed joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.04 GATE VALVES

A. Bronze body, bronze trim, non-rising stem, handwheel, inside screw, single wedge or disc, threaded ends.

2.05 SWING CHECK VALVES

A. Bronze body, bronze swing disc, threaded ends.

2.06 FUSOMATIC VALVES

A. Globe valve, bronze body with spring and replaceable fusible element rated for 165 F, threaded ends. Provide three (3) spare fusible elements for each valve. Fusomatic valves shall be equal to

"Preferred Utilities".

2.07 PLUG VALVES

A. Bronze body, bronze tapered plug, non-lubricated, teflon packing, threaded ends or welded over 2".

2.08 GAUGES

A. Dial type with satin black steel case and shatterproof, heat resistant polycarbonate lense, 0-30 inches mercury vacuum range for vacuum gauges and 0-60 psi for pressure gauges. Gauges shall be equivalent to "Preferred Utilities", Bulletin 20.23.

2.09 STRAINERS

A. Threaded brass rated for 175 psig working pressure, Y pattern with 1/32" stainless steel perforated screen.

2.10 STRAINER - FILTERS

A. Cast iron body, rated for 150 psig working pressure, screwed connections with stainless steel perforated 40 mesh strainer. Strainers shall be equivalent to "Preferred Utilities", model # 72. Provide one (1) spare basket for each strainer.

PART 3 - EXECUTION

3.01 PIPING PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with unions.

3.02 PIPING AND ACCESSORIES INSTALLATION

A. Install in accordance with manufacturers' instructions.

B. Extend existing copper fuel oil lines as required for new burners installation. Final connections will be made with stainless steel hoses, to allow access for door swing to boilers.

C. Extend existing black steel gas piping as required for new burners installation. Final connections will be made with stainless steel hoses, to allow access for door swing to boiler.

D. Install a 3/4" fusomatic valve on each suction line.

E. Install a manual strainer, a gate valve, a vacuum gauge, a strainer-filter, and a vacuum gage on each suction line and a pressure gauge on each discharge line.

F. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Install as per the manufacturer's instructions.

G. Route piping in orderly manner and maintain gradient.

H. Install piping to conserve building space and not interfere with use of space.

I. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Division 9.

J. Identify piping systems, refer to Section 23 05 53.

K. Install valves with stems upright or horizontal, not inverted.

L. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

END OF SECTION 23 11 13

SECTION 23 11 16

HYDRONIC PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pipe and pipe fittings for:
   1. Heating water piping system.
   2. Equipment drains and overflows.

B. Valves:
   1. Gate valves.
   2. Ball valves.

1.02 RELATED SECTIONS

A. Division 8 - Access Doors.

B. Division 9 - Painting.

C. Section 23 05 16 - Expansion Compensation.

D. Section 23 05 53 - Mechanical Identification.

E. Section 23 05 48 - Sound and Vibration Isolation.

F. Section 23 07 19 - Piping Insulation.

G. Section 23 11 19 - Hydronic Specialties.

H. Section 23 52 23 - Cast Iron Boilers.

I. Section 23 82 19 - Unit Ventilators.

1.03 REFERENCES

A. ASME - Boiler and Pressure Vessel Codes, SEC 9 - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brasing Operators.

B. ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

E. ASME B31.5 - Refrigeration Piping.

F. ASME B31.9 - Building Services Piping.

G. ASTM A53 - Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

H. ASTM A234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.

I. ASTM B32 - Solder Metal.

J. ASTM B88 - Seamless Copper Water Tube.

K. ASTM D1785 - Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

L. ASTM D2235 - Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

M. ASTM D2241 - Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR-Series).

N. ASTM D2310 - Machine-Made Reinforced Thermosetting Resin Pipe.

O. ASTM D2466 - Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

P. ASTM D2467 - Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

Q. ASTM D2680 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite- Sewer Piping.

R. ASTM D2683 - Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.

S. ASTM D2751 - Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.

T. ASTM D2855 - Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.

U. ASTM D3309 - Polybutylene (PB) Plastic Hot-and Cold-Water Distribution Systems.

V. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

W. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

X. ASTM F845 - Plastic Insert Fittings for Polybutylene (PB) Tubing.

Y. ASTM F876 - Crosslinked Polyethylene (PEX) Tubing.

Z. ASTM F877 - Crosslinked Polyethylene (PEX) Plastic Hot - and Cold - Water Distribution Systems.

AA. AWS A5.8 - Brazing Filler Metal.

BB. AWS D1.1 - Structural Welding Code.

CC. AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.

DD. AWWA C110 - Ductile - Iron and Grey -Iron Fittings 3 in through 48 in., for Water and Other

Liquids.

EE. AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.

FF. AWWA C151 - Ductile-Iron Pipe,Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.

GG. MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.

HH. MSS SP69 - Pipe Hangers and Supports - Selection and Application.

II. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.04 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Use grooved mechanical couplings and fasteners in accessible locations.

C. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

D. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

E. Provide pipe hangers and supports in accordance with MSS SP69 unless indicated otherwise.

F. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

G. Use 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Record actual locations of valves.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years [documented] experience.

B. Installer: Company specializing in performing the work of this section with minimum three years experience.

1.09 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 code for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME SEC 9 and applicable state labor regulations.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 HEATING WATER PIPING, ABOVE GROUND

A. Copper Tubing: ASTM B88, Type L, hard drawn.
1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
3. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
4. Use for piping up to and equal with 1-1/2 in.

B. Steel Pipe: ASTM A53, Schedule 40, black.
1. Fittings: ASTM B16.3, malleable iron or ASTM A 234 forged steel welding type fittings.
2. Joints: Threaded up to 2-1/2 in and welded AWS D1.1 over 2-1/2 in.

2.02 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A 53, Schedule 40, galvanized.

1. Fittings: Galvanized cast iron, or ASTM B16.3 malleable iron.
2. Joints: Threaded up to 2-1/2 in, or grooved mechanical couplings over 2-1/2 in.

A. PVC Pipe: ASTM D1785, Schedule 40.
1. Fittings: ASTM D2466 or D2467, PVC.
2. Joints: ASTM D2855, solvent weld.
3. Use for rooftop units on roof with P-traps.

2.03 PIPE HANGERS AND SUPPORTS

A. Conform to ASME B31.9 AND MSS SP89.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

D. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

E. Vertical Support: Steel riser clamp.

F. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

G. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

H. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

I. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

J. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.04 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 Inches and Under:
1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05 GATE VALVES

A. Up To and Including 2 Inches: Bronze, non-rising stem, hand wheel, inside screw, solid wedge disc, solder ends.

B. Over 2 inches shall be iron body, bronze trim, bolted bonnet, non-rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends.

2.06 BALL VALVES

A. Up To and Including 2 Inches: Bronze, two piece body, stainless steel] ball, Teflon seats and stuffing box ring, lever handle with balancing stops, solder ends.

2.07 BUTTERFLY VALVES

A. Cast or ductile iron body with resilient replaceable EPDM seat, wafer or lug ends, extended neck. Disc shall be stainless steel. Operator shall be infinite position lever handle with memory stop, flanged or grooved ends..

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water and condensate drain piping.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Slope piping and arrange to drain at low points.

H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

I. Inserts:
1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

J. Pipe Hangers and Supports:

1. Install in accordance with ASTM B31.9 and MSS SP89.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Division. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

L. Provide access where valves and fittings are not exposed.

M. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.

O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Division 9.

P. Install valves with stems upright or horizontal, not inverted.

3.03 SCHEDULES

A. Pipe Hanger Spacing.

PIPE SIZE Inches	MAX. HANGER SPACING Feet	HANGER ROD DIAMETER Inches
1/2 to 1-1/4	6.5	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2
4 to 6	10	5/8
Over 6	12	7/8
PVC (All Sizes)	6	3/8

END OF SECTION 23 11 16

SECTION 23 11 19

HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air Separators.

D. Strainers.

E Flow indicators.

F. Relief valves.

1.02 RELATED SECTIONS

A. Section 23 11 16 - Hydronic Piping.

B. Section 23 25 00 – Chemical Water Treatment

1.03 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

1.04 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1.

B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

C. Provide temporary protective coating on cast iron and steel valves.

D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.01 EXPANSION TANKS

A. Diaphragm-type, welded steel construction, tested and stamped in accordance with ASME SEC. 8-D, supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible butyl or EPDM diaphragm sealed into tank, and steel support stand. Accessories shall include pressure gauge and air charging fitting, tank drain, pre-charged to 12 psig and automatic cold water fill assembly. Refer to drawings for make, model and size.

2.02 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type: Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.03 AIR SEPARATORS

A. In-line type air separators, cast iron for sizes 1-1/2 inches and smaller and steel for 2 inches and larger, tested and stamped in accordance with ASME SEC 8-D for 125 psig operating pressure.

B. Combination air separators/strainers shall be steel, tested and stamped in accordance with ASME SEC 8-D for 1225 psig operating pressure with integral bronze strainer, tangential inlet and outlet connections and internal stainless steel air collector tube.

2.04 STRAINERS

A. Sizes 2 inches and under shall be screwed brass or iron body rated or 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

B. Sizes 2-1/2 inches and larger shall be flanged iron body rated for 175 psig working pressure, Y pattern with 3/64 inch perforated screen.

2.05 FLOW CONTROLS

A. Brass or bronze body construction with union on inlet and outlet, temperature and pressure test plug on inlet and outlet. Calibration: Control flow within 5 percent of selected rating over operating range of 10 times minimum pressure required for control. Control Mechanism:

Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring. Accessories: In-line strainer on inlet and ball valve on outlet.

2.06 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank. Support air separators in a seismic manner, as required.

F. Pipe relief valves outlets full size to 6” above finished floor or nearest floor drains if available.

END OF SECTION 23 11 19

SECTION 23 21 23

HVAC PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. In line pumps.

1.02 RELATED SECTIONS

A. Section 23 21 23 - General Mechanical Requirements

B. Section 23 05 29 - Hangers and Supports.

C. Section 23 11 16 - Hydronic Piping.

D. Section 23 11 19 - Hydronic Specialties.

E. Section 25 00 00 – Expansion of the Energy Management System (EMS).

F. Division 26 - Equipment Wiring Systems: Electrical characteristics and wiring connections.

1.03 REFERENCES

A. UL 778 - Motor Operated Water Pumps.

B. NFPA 70 - National Electrical Code.

1.04 PERFORMANCE REQUIREMENTS

A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

1.05 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 15.

B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacture, assembly, and field performance of pumps with minimum five documented years experience.

B. Alignment: Base mounted pumps shall be aligned by qualified millwright.

1.08 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

1.09 EXTRA MATERIALS

A. Furnish under provisions of Division 1.

B. Provide one set of mechanical seals for each pump.

PART 2 - PRODUCTS

2.01 IN-LINE PUMPS

A. Type: Horizontal shaft, single stage, direct connected, radially or horizontally split casing, for 125 psig maximum working pressure.

B. Casing: Cast iron or bronze, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Bearings: Permanently lubricated roller or ball bearings.

E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

F. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.

G. Drive: Flexible coupling with coupling guard.

H. Base plate: Cast iron or fabricated steel with integral drain rim.

I. Performance: As indicated on drawings

J. Electrical Characteristics:
1. Pump HP as indicated on drawings.

2. As indicated on drawings.
3. Refer to Division 26.
4. Motor: Premium efficiency, 1750 rpm unless specified otherwise.
5. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

PART 3 - EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, recommendations and warranty..

B. Provide access space around pumps for service. Provide no less than minimum as recommended by manufacturer. Seismically anchor pumps to structural elements, as required.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump.

D. Provide line sized shut-off valve, strainer and pump suction fitting on pump suction, and line sized combination pump discharge valve on pump discharge.

F. Lubricate pumps before start-up.

G. Install across pump with flow from pump discharge to pump suction from pump tappings.

END OF SECTION 23 21 23

SECTION 23 25 00

CHEMICAL WATER TREATMENT

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Cleaning of boilers and distribution piping system as well as continuing treatment for the hot water system.

1.01 RELATED SECTION

A. Section 23 52 23 – Cast Iron Boilers: Boilers cleaning.

1.02 SUMBITTALS

A. Submit under provisions of Division 1

B. Shop Drawings: Indicate equipment characteristics and connection requirement.

C. Product Data: Provide chemical treatment materials, chemicals.

D. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration, and connection requirements.

E. Submit certificate of compliance from authority having jurisdiction indicating approval of chemicals and their proposed disposal.

1.03 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

1.04 QUALIFICATIONS

A. Manufacturer: Jamestown Technologies, A Division of Azure Water Services, LLC of West Haven, CT, or an equal company specializing in manufacturing the products specified in this section with a minimum ten (10) years experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by manufacturer.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems, which is a septic sewage system

1.06 MAINTENANCE MATERIALS

CHEMICAL WATER TREATMENT

A. Provide maintenance materials under provision of Division 1.

B. Provide sufficient chemicals for treatment and testing for one (1) year after start-up with quarterly service calls.

PART 2 – PRODUCTS

1.01 MATERIALS

A. System Cleaner:

1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products (sodium tripoly phosphate).

B. Hot Water Heating System Treatment:

1. Sequestering agent to reduce deposits and adjust pH.
2. Corrosion inhibitors; sodium nitrite and borax, sodium tolyltriazole, low molecular weight polymers, sodium molybdate.

2.02 TEST EQUIPMENT

A. Provide white enamel test cabinet with local and fluorescent light similar to AquaPhoenix's Senior Metal Cabinet.

B. Provide the following test kits & maintain the following limits:

1. Alkalinity test kit (P-Alkalinity 100 – 500 ppm)
2. Conductivity/pH meter (pH 8.5 – 10.5)
3. Molybdate test kit (100 – 150 ppm as MoO_4
4. Iron Test Kit (2.0 ppm maximum)

PART 3 – EXECUTION

3.01 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning. Provide a by-pass feeder for cleaning operation which can be used for continuing treatment after the cleaning process.

3.02 CLEANING SEQUENCE

A. Concentration:

1. As recommended by manufacturer.
2. One pound per 100 gallons of water contained in the system
3. One pound per 100 gallons of water for the hot water systems.

B. Hot Water Heating Systems

1. Apply heat while circulating, slowly raising temperature to 160 degrees F. and maintain for 12 hours minimum.
2. Remove heat and circulate to 100 degrees F. or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.

C. Use neutralizer agents if needed on recommendation of system cleaner supplier and approval of Architect/Engineer.

D. Remove, clean, and replace strainer screens.

E. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.04 HOT WATER SYSTEM TREATMENT

A. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through the by-pass filter feeder when required or indicated by test. The by-pass filter feeders should be a Neptune FTF-5DB or similar with 20 micron and 5 micron filter bags (4 of each size).

C. Provide ¾ inch water black iron coupon rack around circulating pumps with space for 2 test specimens (1 mild steel and 1 copper). Coupons should be changed every 90 days with analysis by an independent laboratory. Coupon rack to be installed before by-pass filter feeder.

SECTION 23 31 00

DUCTWORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. Related Documents: The general provisions of the Contract, including Bidding Requirements, General and Other Conditions, and Specific Requirements, apply to all work of this Section.

B. Work Included in this Section:
1. Ductwork and plenums.
2. Air conditioning and ventilation supply, return and exhaust ductwork.
3. Flexible connections.

C. Related Work Specified in Other Sections:
1. Section 23 00 00: General Mechanical Requirements.
2. Section 23 05 29: Hangers and Supports.
3. Section 23 05 48: Sound and Vibration Isolation.
4. Section 23 05 53: Mechanical Identification.
5. Section 23 07 00: Ductwork Insulation.
6. Section 23 08 00: Testing, Adjusting and Balancing.
7. Section 23 33 00: Ductwork Accessories.

1.2 QUALITY ASSURANCE

A. Applicable Standards:
1. Air Moving and Control Association (AMCA).
2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Guide, "Fundamentals", "Applications", "Systems" and "Equipment", and all applicable codes and standards listed therein.
3. National Fire Protection Association (NFPA) Standard 90A.
4. Sheet Metal and Air Conditioning Contractor National Association, Inc. (SMACNA).
5. American Insurance Association (AIA).
6. Underwriters' Laboratories, Inc. (UL).

B. Ductwork shall be provided in accordance with the reference standards listed above and as necessary to meet the performance requirements of the design.

1.3 SUBMITTALS

A. Submit the following in accordance with the requirements of the General Conditions.

B. Shop Drawings:
1. Submit for approval complete 3/8" scale dimensioned drawings of sheet metal work showing all equipment and accessories. Detail all clearances. All ducts shall be marked to show elevation of bottom of duct, including all insulation.

Include cross SECTIONs at all tight areas. Show intended ceiling elevations and construction type for coordination with ductwork.

2. Integrated drawings showing relationship with work of other trades.

C. Prior to start of work submit particulars including gauge sizes, duct construction details, welds and configuration.

PART 2 - PRODUCTS

2.1 LOW PRESSURE - GALVANIZED STEEL - TYPE LG DUCTWORK

A. Ductwork material shall be galvanized steel, coating class 1.25.

B. Construct low velocity ductwork in accordance with the recommendations of the ASHRAE Guide. Low pressure ductwork shall include all ductwork operating at or less than 2 inches water gauge pressure with air velocities below 2000 feet per minute.

C. Make longitudinal seams of the Pittsburgh type seams. Locate longitudinal seams at the corners.

D. Secure bracing and joint angles to ducts and casings by riveting or tack welding at corners and along the angles at intervals of not more than 6 inches.

E. Seal transverse joints with screws or rivets at corners and along the joints at intervals of not more than 6 inches.

F. For ductwork exposed to view and not externally insulated, locate the longitudinal seam above the horizontal center line of the duct.

G. The Following Shall be Type 'LG':

1. Air conditioning supply and return ductwork.
2. Ventilation supply and exhaust ductwork.

H. Ducts shall be pitched to drain back to room inlet, no low points will be permitted in these exhaust ducts.

2.2 FLEXIBLE INSULATED DUCTWORK

A. Provide approved type flexible insulated ductwork for the final connections to the the air diffusion devise. The maximum length of the flexible insulated ductwork at anyone location is 5 (five) feet.

PART 3 - EXECUTION

3.1 DUCTWORK

A. Install ducts, casings and hangers plumb and level, with joints square and devoid of sharp edges.

B. Route ductwork to minimize directional changes and abrupt transitions.

C. Provide adequate space around ducts to assure proper support and to allow the

installation of the insulation specified.

D. Install diverting vanes, Tuttle & Bailey "Vectrol" or approved equal, at branches connected into the main duct without a neck.

E. Provide fairing where pipes or structures must penetrate ducts. When fairing is longer than two feet maintain the original velocity. When fairing is shorter than two feet the velocity shall be increased by not more than 10%.

F. Furnish test wells made up of a 1-1/2 inch diameter brass nipple, 3 inches long, brazed into the duct or casing and a cap on the downstream side of each coil and fan for insertion of a pitot tube. Ventfab factory fabricated test wells or approved equal are acceptable.

G. Provide turning vanes in elbows whose center line radius is less than 150% of the duct width or where indicated.

H. Where hanger rods for ducts, piping or equipment must pierce ducts, provide closure plates fitted around the rod and riveted or welded to the duct used in conjunction with a silicone duct sealing compound to make an airtight seal.

I. Make connections between ductwork, including flexible connections, fittings and equipment with gradually tapered transition fittings.

J. During construction cover open ends of ductwork with one layer of heavy polyethylene sheeting secured with high pressure duct tape.

K. Remove foreign materials and clean the ducts inside and outside.

L. Clean ducts before operating fans and filters. Do not operate fans unless filters are installed. After tests, wash cleanable filters and replace renewable media.

M. Bracings and supports indicated are the minimum acceptable. Provide additional bracing or supports to eliminate any distortion or vibration when the systems are operating or under tests.

N. All ductwork shall meet the clearances required by the architectural design.

3.2 CASINGS

A. The following are Classified as Casings:
1. Ductwork between fresh air intakes and the duct distribution system including the fan plenums, housings for filters, heating and cooling coils and all other air treatment apparatus.
2. Intakes and fan plenums including those at exhaust fans.
3. Plenums and housings between fresh air intakes and package units.

B. Unless specifically shown differently or where required for clearance, construct casings with constant cross-section. Arrange air treatment equipment within casings to give the most direct air flow to the center line of the fan. Provide sheet metal filler pieces to prevent air bypass of air treatment components. Where constant cross Section casings cannot be used, maximum transitional slope for top and sides of casings shall be 30 degrees.

C. Mount fans so that the center line of the fan inlet is on the center line of the air treatment equipment both horizontally and vertically. Maximum casing transition slope angle to the axis of the fan inlet shall be 40 degrees.

D. Secure on each casing access door on the discharge side of fan 4" x 4" enameled metal sign with 2 inch white letters on red background reading "Danger".

3.3 DISSIMILAR METALS

A. Separate connections between dissimilar metals by dielectric insulation.

B. Make joints between dissimilar metal duct Sections with companion flanges separated by a compressed insulating gasket.

C. Construct nuts, bolts, screws and other hardware used in the sheet metal construction of materials identical or similar to the duct material to prevent galvanic corrosion.

3.4 FLEXIBLE EQUIPMENT CONNECTORS

A. Install air tight flexible connections where ductwork or casings connect to fans. Fasten connections securely withbolted clamps. Make the unclamped portion of the connection not less than 6 inches long crimped for flexibility.

3.5 TESTING OF DUCTWORK

A. All duct joints shall be sealed and caulked air tight and constructed in accordance with SMACNA Seal Class A for all transverse and longitudinal joints.

B. All ducts shall be pressure tested in the field in Sections in accord with SMACNA. The allowable leakage shall be 0%.

C. This Contractor shall submit a Ductwork Test Report to the Architect/Engineer and Owner’s Representative for review and comment, at completion of this work.

END OF SECTION 23 31 00

SECTION 23 33 00

DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Related Documents: The general provisions of the Contract, including Bidding Requirements, General and Other Conditions, and Specific Requirements, apply to all work of this Section.

B. Work Included in this Section:
1. Volume dampers.
2. Fire dampers.
3. Turning vanes.
4. Access doors.

C. Related Work Specified in other Sections:
1. Section 23 00 00: General Mechanical Requirements.
2. Section 23 05 29: Hangers and Supports.
3. Section 23 05 48: Sound and Vibration Isolation.
4. Section 23 05 53: Mechanical Identification.
5. Section 23 07 00: Ductwork Insulation.
6. Section 23 08 00: Testing, Adjusting and Balancing.
7. Section 23 31 00: Ductwork.

1.2 QUALITY ASSURANCE

A. Applicable Standards:
1. Air Moving and Control Association (AMCA).
2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Guide, "Fundamentals", "Applications", "Systems" and "Equipment", and all applicable codes and standards listed therein.
3. National Fire Protection Association (NFPA) Standard 90A.
4. Sheet Metal and Air Conditioning Contractor National Association, Inc. (SMACNA).
5. American Insurance Associations (AIA).
6. Underwriters' Laboratories, Inc. (UL).

B. Fire dampers shall be UL listed and constructed in accordance with UL Standard 555 Fire Dampers.

C. Fusible links on fire dampers shall be constructed to UL Standard 33, Fusible Links for Fire Protection Service.

D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Engineer.

E. Access doors shall be UL labeled.

1.3 SUBMITTALS

A. Submit the following in accordance with the requirements of the General Conditions.

B. Shop Drawings and product date for factory fabricated assemblies.

C. Certification: Certificate from manufacturers stating that materials meet specified requirements.

D. Manufacturer's printed installation and maintenance instructions.

PART 2 - PRODUCTS

2.1 LOW PRESSURE VOLUME DAMPERS

A. 16 gauge galvanized steel interlocking blades with hemmed edges and a galvanized steel frame. In ducts over 15 inches deep, use multiple opposed blade type, operated dampers with a maximum blade width of 10 inches. In smaller ducts use single bladed butterfly type. Maximum length of individual blades is 48 inches, for larger SECTIONs use multiple blade and frame SECTIONs.

B. Frame Dimensions:

Under 19" - 2" x 3/16" bar frame.

19" to 48" - 2" x 1" x 1/8" channel frame.

C. Operating Rod: Full blade length extended through the duct to externally mounted sleeve bearings. On insulated ductwork make bearings plate flush with insulation finish.

D. Operating Lever: Indicating type with locking quadrant, Duro Dyne Corporation Model IK or approved equal.

2.2 FIRE DAMPERS

A. Fire Dampers Shall Conform to the following:

1. Bear the label of the Underwriters' Laboratories, Inc. and be listed under the continuing inspection service of U.L., and shall be successfully tested for 1-1/2 hours up to 1800 degrees F.
2. In mounting conditions not in conformance with U.L. testing, units shall be built in full conformance with Standards of the American Insurance Association and also in conformance with the National Fire Protection Association (NFPA) Standard No. 90A.

B. U.L. approved dampers shall be of folding curtain, all galvanized sheet steel design and shall be "Fire/Seal" manufactured by Air Balance, Inc. or approved equal. Curtain shall be free and clear of air passageway. Other approved manufacturers are Arrow Damper & Louver, and Imperial Damper. For Low and Medium Velocity Systems use Fire Seal Type B. For high velocity systems use Fire Seal Type C.

C. Pressure drop access damper at a velocity of 2,000 FPM shall be 0.125 inches water column for Type B dampers. For Type C dampers pressure drop shall be 0.25 inches

W.C. at 3500 FPM.

2.3 TURNING VANES

A. Construct turning vanes of the same material as the ducts in which they are installed.

B. Construct turning vanes for low and medium pressure of 20 gauge galvanized steel or the equivalent thickness for other duct materials as shown in the ASHRAE Guide.

C. Turning vanes shall be double vanes as manufactured by Tuttle & Bailey or shop fabricated turning vanes constructed to the same standards. Submit samples of shop fabricated units for approval.

D. Reinforce joints to frames for turning vanes for high pressure systems by welding or brazing.

2.4 ACCESS DOORS - SHEET METAL

A. Unless otherwise indicated, access doors in casing shall be 58 inches high by 18 inches wide, and access doors in ducts shall be 16 inches x 12 inches medium.

B. Construct and install access doors of the same materials and to withstand the test pressures without deformation, vibration or leakage as the ductwork and casings in which they are provided.

C. Provide doors in insulated casings and ductwork of the double insulated reinforced panel type with a minimum of 18 gauge sheet metal on both sides of a core of 6 pound PCF density mineral fiber rigid insulation.

D. For access doors in ductwork which are less than 24 inches in height, provide two brass butt hinges and two Ventfabrics, Inc. "Ventloc" No. 100, Duro-Dyne Corporation No. SP-5 latches, or approved equal.

E. For access doors in casings and access doors 24 inches in height and over, provide two heavy bronze butt hinges and two pairs of lever type latches operable from both sides of the door, Kason Hardware Corporation Type 878 Kasonized brass, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Install items in accordance with manufacturer's printed instructions.

3.2 ACCESS DOORS - SHEET METAL

A. Provide doors in ductwork, equipment housing and connections thereto for access to all apparatus and accessories, air filters, coils, automatic dampers and damper motors, volume dampers & fire dampers, grease fittings, supply and exhaust fans, bearings and connections and all other areas and equipment requiring periodic inspection of service. Provide access doors for air handling equipment at the following locations as a minimum:
   1. Outside air or return plenums, upstream of filters.
   2. Between filters and heat exchanging coils.
   3. Between successive heat exchanging coils.

4. Between heat exchanging coils and fan inlet or discharge collars.
5. Access doors called above shall be provided for both right and left hand sides for the air handling equipment to provide two entrances into each access space.
6. Access door sills shall be within 6 inches of the bottom of the apparatus.

B. Fit doors closely. Securely attach round soft rubber gasketing to the doors by cement and countersunk rivets for a continuous air tight seal.

C. Access doors shall open against pressure of fan system in order to maintain minimum leakage. Access doors located downstream of fan discharge shall open into ductwork and against air flow. Access doors located upstream of fan suction shall open away from ductwork.

END OF SECTION 23 33 00

SECTION 23 50 00

VENTS AND BREACHINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Vents and Breechings.

1.02 RELATED SECTIONS

A. Section 15556 - Cast Iron Boilers.

1.03 REFERENCES

A. ANSI/ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

B. ANSI/ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.

C. ASHRAE - Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems."

D. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality.

F. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

G. UL 441 - Standard for Gas Vents.

H. UL 641 - Standard for Low Temperature Venting Systems.

1.04 DEFINITIONS

A. Breeching: Vent Connector.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.05 DESIGN REQUIREMENTS

A. All products furnished under this section shall conform to the requirements of NFPA-85A, B, D and NFPA-211. Products shall be listed to UL-103 and shall carry the appropriate UL listing mark or label. The vents and breechings shall be warranted by the manufacturer against defects in material and workmanship for a period of twelve (12) years from the date of the original installation. Any portion of the vents or breechings repaired under warranty shall be warranted for the remainder of the original warranty period.

1.06 SUBMITTALS

A. Submit shop drawings under provisions of Division 1.

B. Submit shop drawings indicating general construction, dimensions, weights, support and layout of vents & breechings. Where factory built units are used submit layout Drawings indicating plan view and elevations.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacture of products specified in this Section with minimum three years documented experience.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable ANSI Z223.1 code for installation of natural gas burning appliances and equipment.

PART 2 - PRODUCTS

2.01 VENTS AND BREECHINGS

A. Furnish and install new vents and breeching, as indicated on drawings. The vent and breeching shall be of insulated positive pressure double-wall design, factory built type for use with equipment burning natural gas and fuel oil # 2, as described in NFPA-211, which produce flue gases exhausted at a temperature not exceeding 1400 F continuously and 1800 F intermittently. The vents & breechings sections shall be constructed of an inner and outer wall with a 1" annular space. The outer wall shall be constructed of aluminized steel, .025" thickness. The inner wall, forming the flue-gas carrying pipe, shall be constructed of type 304 stainless steel, .035" thickness. Inner and outer walls shall be connected by means of spacer clips which maintain the concentricity of the annular space and allow unobstructed differential thermal expansion of inner and outer walls. The gas vents shall include 1 inch thick and the breechings shall include 2 inch thick high temperature resistant insulation between inner and outer walls. The manufacturer’s required clearance to combustible materials will have to be maintained at all times. All inner pipe joints shall be held together by means of tee bands and sealed with P078 Ceramic Sealant. Nuts for the inner and outer bands shall be restrained by means of a free floating cage to allow easy alignment. Screws shall be of the hex head type with shoulder stops and tapered "lead-in" threads for easy starting. Provide all required fittings, supports, auxiliary materials, etc., for a complete operational installation.

B. Provide barometric dampers with thermal spill swithes on the new gas vents.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with recommendations of ASHRAE - Handbook, Equipment Volume, Chapter "Chimney, Gas, Vent, and Fireplace Systems", and ANSI Z223.1 (NFPA 54).

C. Install vents and breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Clean breeching during installation, removing dust and debris. Sweep existing chimneys before start-up.

E. Support and anchor vents and breeching with seismic restraints, as required..

F. This Contractor shall hire the services of a certified chimney sweeper, to thoroughly clean the existing chimney flues before the start-up can take place. A Report shall be provided to the Architect/Engineer for review and comment.

END OF SECTION 23 50 00

SECTION 23 52 23

CAST-IRON BOILERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Boilers.

B. Controls and boilers trims.

C. Boilers' connections.

D. Fuels connection.

E. Collectors and chimney connection.

1.02 RELATED SECTIONS

A. Section 23 00 00 - General Mechanical Requirements.

B. Section 23 09 13 - Controls and Instrumentation.

C. Section 23 11 13 - Natural Gas and Fuel Oil Piping and Specialties.

B. Section 23 1 1 16 - Hydronic Piping.

C. Section 23 11 19 - Hydronic Specialties.

D. Section 23 25 00 - Chemical Water Treatment.

E. Section 23 50 00 - Vent and Breechings.

F. Section 25 00 00 – Expansion of the Energy Management System (EMS).

G. Division 26 - Electrical Connections to Equipment.

1.03 REFERENCES

A. AGA - Directory of Certified Appliances and Accessories.

B. ANSI/AGA Z21.13 - Gas-Fired Low-Pressure Steam and Hot Water Boilers.

C. ANSI/AGA Z223.1 - National Fuel Gas Code.

D. ANSI/ASME SEC4 - Boiler and Pressure Vessel Codes – Rules for Construction of Heating Boilers.

E. ANSI/ASME SEC6 - Recommended Rules for the Care and Operation of Heating Boilers.

F. ANSI/ASME SEC8D - Boilers and Pressure Vessel Codes – Rules for Construction of Pressure Vessels.

G. ANSI/NFPA 70 - National Electrical Code.

H. ANSI/UL 726 - Oil-Fired Boiler Assemblies.

I. HI (Hydronics Institute) - Testing and Rating Standard for Cast Iron and Steel Heating Boilers.

J. 2005 Connecticut Building and Fire Safety Codes with 2009 and 2011 Amendments..

K. National Fire Protection Association (NFPA).

L. Industrial Risk Insurers (IRI).

M. Underwriters Laboratories (UL), UL 296 & UL 795 - dated 4/1/94.

N. Gas Company Requirements.

O. America Society of Mechanical Engineers CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.

1.04 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Submit product data indicating general layout, dimensions, and size and location of connections, wiring diagrams and near boiler piping schematics.

C. Submit manufacturer's installation instructions under provisions of Division 1.

D. Submit seismic restraints drawings for anchoring boilers to concrete pads, prepared, stamped and signed by a Structural Engineer, licensed in the State of Connecticut.

1.06 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

1.07 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years of experience.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable ANSI/NFPA 70 code for internal wiring of factory wired equipment.

B. Conform to ANSI/ASME SEC4 and SEC 8D and ANSI/AGA Z21.13, ANSI/UL 726 for boiler construction.

C. Units: AGA certified & UL labeled.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1.

B. Store and protect products under provisions of Division 1.

C. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.10 WARRANTY

A. Provide ten year prorated warranty under provisions of Division 1.

B. Warranty: Include coverage for cast iron boilers sections. The manufactured boilers, equipment with cast iron/metal push nipple connectors, the boilers' manufacturer shall warrant that the cast iron sections of each boiler will be free from defects in material and workmanship under normal usage for a period of ten years from the date of original installation. The burners' manufacturer shall warrant each burner for a period of 15 months from the date of shipment.

PART 2 - PRODUCTS

2.01 GENERAL

A. It shall be understood that these documents are intended to perform as a guide and that any omission of any specific item or failure to mention any requirement specifically shall not relieve this Contractor from full and complete responsibility in furnishing a complete and satisfactory installation.

B. The winning and installing Contractor will be completely and totally responsible for the installation of all items specified or related as may be required to obtain a proper and safe boilers working room. This installing Contractor may not relieve any responsibility he/she may have, to the Owner, by subcontracting any work to other contractors.

C. All work shall be deemed as being executed by and experienced and competent Contractor with expertise in the installation of new boilers, burners, boiler/burner controls, pumps, boiler controller, chemical water treatment, and hereinafter specified equipment. All work must be properly supervised by the experienced Contractor. All work must be done in an orderly and timely fashion, after which the Contractor shall leave the jobsite broom clean. All work and

equipment must be guaranteed by this Contractor for a period of at least one (1) year from the date of acceptance by the Consulting Engineer and Owner's representative.

D. It shall also be understood that the Contractor will not be finished with the job until both the authorized Owner's representative and the Architect/ Project Engineer are completely satisfied with the work done.

E. Reference is made to the clause entitled “Buy American Act - Balance of Payments Program – Construction Materials” FAR 52.225-9. Notwithstanding a bidder’s right to offer identifiable foreign construction material in its bid pursuant to FAR 52.225-9, the awarding authority does not anticipate accepting an offer that includes foreign construction material.

F. All manufacturers to be considered shall be required to meet or exceed scheduled I=B=R capacities and ratings and will be held to strict compliance with these contract specifications. For factory assembled, packaged and fire tested boilers, the complete boilers shall be approved as a unit by Underwriters Laboratories.

G. Installing contractor shall include, as part of his contract all charges and costs for boilers and burners testing, start-up, checkout, adjusting, field and state inspections, including service contracts. Provide signed documentation to the awarding authority for completion of specified procedures.

H. Contractor shall obtain certificates of boilers inspections after boilers installation have been completed and pay all fees associated with such inspections. After the receipt of the certificates of inspections, installing contractor shall furnish suitable glass frames in which to place said certificates. Frames, with inspections certificates inserted therein, shall then be placed on or posted in a suitable location within the Boiler Room in which the new boilers have been installed.

I. Installing contractor shall obtain from the boilers’ manufacturer pertinent (O&M) operating, testing, and cleaning instructions for the boilers, burners, controls and safety devices furnished with these boilers.

J. It shall be the responsibility of the installing contractor to deliver O&M manuals, together with complete wiring and piping diagrams, to the Owner’s representative and to obtain a receipt for the instructions. The receipt shall be filed with the installation report.

K. Written notification specifying the name, address, telephone number and available service program of a third party burner service group as herein specified.

2.02 GENERAL DESCRIPTION - HOT WATER BOILERS

A. Hot water boilers shall be high efficiency, pressurized, 3-pass cast iron sectional wet base type not requiring refractory combustion chambers. It shall be suitable for forced draft and capable of achieving a minimum combustion efficiency of 88% fire with fuel oil #2 and 85% fired with natural gas. Thermal efficiency shall be a minimum of 86% with fuel oil #2 and 83% fired with natural gas. Heat transfer shall be enhanced by the addition of removable baffles.

B. Boilers shall be 3-pass cast iron sectional type design with large combustion chambers and

horizontal flue passes with cast fins. Class 25 high silicone content cast iron shall produce resistance to temperature variations and thermal stress. A high-temperature silicone-coated fiberglass rope gasket will be compressed into a cast tongue and grove connection around the perimeter of each section, providing a durable, gas tight seal.

C. Each boiler shall have return mixing tube with drilled openings in each section, allowing proportionate distribution of return water throughout the entire section assembly. Cool return water shall be pre-heated by the hot supply water as it enters the section assembly thereby reducing thermal stress on individual sections without the use of external mixing devices. Each boiler supply water temperature, measured on the supply manifold shall be no less then 130 F. Return water coming back to each boiler may be no less then 80 F. System piping shall be sized for maximum temperature difference between the supply and return water of 40 F. However, a maximum delta T of 80 F across each boiler is allowable.

D. A single supply water manifold shall be located at the rear of each boiler with eight tapings for the installation of temperature and pressure controls, gauges, probe-type low water cutoff, and electronic control sensors. A single top rear return connection shall be considered standard equipment.

E. Each boiler shall be furnished knocked down for field erection. Section shall be assembled using machined cast iron and push nipples.

F. Each cast iron burner swing door shall be lined with lightweight refractory insulation and shall have reversible hinges, allowing a minimum of 90 degree swing to the left or side of boiler, allowing unobstructed access to combustion chamber and flue passages. The flue passages and combustion chamber shall be accessible from the front of each boiler for cleaning, and from the back of each boiler to vacuum soot and combustion residue from the fireside.

G. Rear flue collector, with test tapings, shall be constructed of cast iron and shall be concealed under a highly insulated jacket.

H. Each boiler shall be equipped with a flanged mounted flame retention type burner. Input, output and combustion efficiency shall be certified to efficiency test procedures specified in I=B=R/BTS-2000. Boilers efficiencies must meet ASHRAE 90.1 and the National Energy Policy Act of 1992 requirements.

I. Boilers shall be constructed for 80 PSIG water working pressure in accordance with ASME Section IV Rules for Construction of Heating Boilers. Individual sections shall have been subjected to a hydrostatic pressure test of 200 PSIG at the factory before shipment and they shall be stamped or cast with ASME “H” symbol.

J. Each boiler shall be provided with a heavy duty 20 gauge steel jacket with modular 4-inch thick insulation and have a rust resistant powder coat finish. Each boiler jacket shall contain a concealed electrical chase way for power and limit circuit wiring within the top jacket panels, providing a clean finished look when the jacket is installed. Individual lift-off jacket side panels may be installed after system piping and allow ease of access to each boiler’s sections.

K. Boiler rim shall include: (1) 3-1/2 inch diameter combination pressure-temperature gauge, (1)

safety high limit aqua stat, (1) auxiliary safety aqua stat with manual reset,(1) low fire hold aqua stat, (10 firing rate controller, (1) dial type stack thermometer with minimum 3" dial face and ½" NPT connection, (1) ASME Section IV safety relief valve sized to exceed the gross output of each boiler set to relive pressure of 50 PSIG water pressure, (1) low water cutoff device with manual reset to comply with CSD-1 requirements, 91) probe type LWCO located above the safe permissible water level established by the boiler's manufacturer. LWCO shall be UL listed and FM approved, suitable for commercial hydronic heating service at 80 PSIG.

2.03 BURNERS - GENERAL REQUIREMENTS

A. It shall be understood that all burners shall be supplied via the local burner representative and "NOT" as additional equipment through the boiler's manufacturer. This shall be for the best service and response to the Owner in the future. The burner shall conform to applicable codes, as listed in previously reference standards.

B. The burners shall be of the flame retention design, with high efficiency and good performance under either natural or forced-draft venting condition. The burner motor shall use 208 Volts/3 Phase and control circuit shall be 115 Volts/1 Phase.

C. The burners fuel system shall conform to the already previously stated requirement and to the State and Local applicable codes and with the requirements of GE/IRI. The burners shall be dual-fired with natural gas with a BTU content of 1,000 Btu/cuft at an available gas pressure of 7.0" W.C. and fuel oil # 2 with a BTU content of 139,600 Btu/gal.

2.04 STANDARD GAS/OIL BURNERS – GE/IRI CODE

A. Refer to drawings for the burners' makes, models and sizes required to be provided under this project.

B. Each burner shall be provided with a pre-wired electronic control panel which will incorporate a UL listed primary flame safeguard control. The panel will conform to NEMA-1A standards with dust rubber gasket and lock & key. Burner shall be provided with an electronic with pre and post purge type flame safeguard with diagnostic annunciator display. The flame safeguard will be "Fireye", model E110. The burner will also have these additional items provided:

1. - Control circuit fuse.
2. - Alarm bell with red lights and reset switch to indicate low gas pressure, high gas pressure, low water, low fuel oil pressure and flame failure.
3. - Additional lights to be: Power ON (Amber), Main Fuel (Blue), Call for Heat (Green), and all alarm functions as mentioned in above item # 2.
4. - Natural gas for pilot ignition of gas and direct spark ignition for fuel oil firing (Note: all other components shall comply with GE/IRI code).
5. - Control circuit transformer from 208 Volts/ 3 Phase to 115 Volts/1 Phase.
6. - Combustion Air Damper (CAD) relay. A such relay shall be furnished and installed in each boiler's burner.
7. - Swing away burner's housing for ease of maintenance.
8. - Low oil pressure switch.
9 - GE/ IRI gas trains to be supplied at time of installation, each furnished with at least the following: gas regulator rated for maximum of 1 psi main motorized valves, normally

open valve, high & low gas pressure switches, gas strainer, and two (2) gas test cocks. Pilot train shall also contain a gas strainer, "Maxitrol", model #325 pilot regulator, main pilot valve and auxiliary solenoid valves.

2.05 GAS TRAINS ASSEMBLIES

A. The GE/IRI gas trains assembly will be supplied at the time of installation and will consist of all exact items as required. The gas train assembly will be installed in accordance with all State and local Codes having jurisdiction and with the requirements of IRI. Gas pressure regulators, high and low gas pressure, and normally open vent valves shall be vented directly outside, in strict accordance with the requirements of Codes having jurisdiction, gas company, and UL.

2.06 BOILERS' CONTROL PANELS

A. Supply a boiler control system to provide safety interlocks and water temperature control for each boiler. The control system shall be fully integrated into the burner control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of up to eight (8) fully modulating boilers and boilers pumps. The control system shall simply boiler's modulation and on/off outputs based upon the boiler's water supply temperature and an operator- adjusted set point. However, using parameter menu selections, the control system shall allow the boiler to respond to remote system water temperature and outside air temperature, warm weather shut down (WWSD) or EMS firing rate demand, remote set point or remote start/stop commands.

B. Using PID (proportional-integral-derivative) base control, the remote system water temperature shall be compared with a set point to establish a target boiler firing rate. If the secondary loop GPM is greater than the primary loop GPM, firing rate is increased in response to the decrease in secondary loop temperature. When the remote system temperature is near the boiler high limit temperature, the boiler supply sensor shall limit the maximum boiler supply temperature to prevent boiler high limit trips. Alternately, using parameter menu selections, the control system shall allow the boiler to respond directly to the boiler supply temperature and set point to establish a target boiler firing rate while remote system water temperature is used for display purpose only. All the automated logic required to ensure that pre-purged, post-purge, light-off, and burner modulation shall be provided.

C. When the controller is in the local control mode, the control system shall establish the set point based on outside air temperature and a reset function curve, or be manually adjusted by the operator. When enabled, the set point shall be adjusted above a preset minimum set point upon sensing a domestic hot water demand contact input. When in remote mode, the control system shall accept a Modbus or 4-20mAdc remote set point or firing signal from an external Energy Management System (EMS).

D. Multiple boilers shall be modulated in "unison" (all at the same firing rate). The control system shall utilize both water temperature and boiler firing rate percent to start and stop the boilers and shall minimize the total number of boilers in operation. The control system shall start and stop boilers when the water temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize the temperature deviations, the control system shall start and stop the next boiler when the "lead" boiler is at an adjustable firing rate limit for longer

than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. When rotation is enabled the lead boiler shall automatically rotate every 1 to 168 hours. The boiler shall be run at low fire for warm-up for a preset low fire hold time. When enabled, warm weather shut down control logic shall prevent boiler operation.

E. User Interface shall be provide via a front-panel English language, two line, sixteen characters LCD message display, to provide display numeric data, startup and shutdown sequence status, alarm, system diagnostics, first-out messages and boiler's historical information. Historical information shall include the last ten lockout and alarm conditions, number of boiler cycles, boiler hours and the last ten low boiler return temperature events. When boiler return water temperature is below a minimum set point a low temperature event shall be stored with time, date, "low temperature event" and "duration below set point" data. A panel mounted red alarm light shall annunciate alarm messages. Alarm conditions requiring a manual reset shall be annunciated by a flashing red light. At a minimum, the boiler system shall display the following:

1. Numeric Display with Engineering Units:
   a. Boiler Supply Water Temperature
   b. Boiler Return Water Temperature.
   c. Remote System Temperature.
   d. Outdoor Air Temperature.
   e. Firing Rate %.
   f. Boiler Temperature Set Point.
2. Status, Startup And Shutdown Sequence English language Messages:
   a. Boiler disabled.
   b. Warm Weather Shutdown,
   c. Lockout.
   d. Pump Purge.
   e. Limit Hold.
   f. Purge/Pilot Ignition.
   g. Low Fire/Pilot Ignition.
   h. Main burner Ignition.
   i. Boiler Running.
   j. Fan Post Purge.
   k. Pump Cooldown.
   l. Standby.

3. Alarm, System Diagnostics, First-Out English Messages:
   a. Low Water Level.
   b. Low Water Flow.
   c. Fuel Limit (gas pressure or oil temperature).
   d. High Boiler Supply Temperature Limit.
   e. Low Air Flow.
   g. Flame Safeguard Internal Fault.
   h. High Supply Temperature.
   i. Supply Temperature Sensor Fault.
   j. Return Temperature Sensor Fault.

k. Outside Air Temperature Fault.
l. Remote System Temperature Sensor Fault.
m. Remote Input Signal Fault.
n. Modbus Communication Fault.
o. Memory Fault.

F. Flame Safeguard (FSG) shall include an industrial duty microprocessor based controller and shall provide: safety interlocks, flame monitoring protection and timed sequences. Sequences shall include forced draft fan start and stop, furnace purge, burner light-off. shutdown. And post purge. FSG components shall be fully integrated for automatic sequencing of light-off and shutdown.

G. Boiler Pump Sequence shall include primary water pump control to allow boiler warm-up to the return water temperature before the boiler starts; continue water flow for an adjustable cool down period after the boiler has stopped; and ensure water is always moving past the remote system temperature sensor even after the last boiler has been stopped. The pump shall immediately stop if any trips occur during pre-purge, pilot or main flame trial for ignition.

H. Flue Gas Condensate Protection shall be provided an shall include alarms and control logic to help prevent corrosion in the boiler due to sustained flue gas condensation. These features become increasingly important as we add energy savings modulation and outdoor air reset function. Excessively low boiler return water temperature events shall be stored with boiler historical data.

I. Communication shall include an RS485modbus slave or peer-to-peer communication data highway on each boiler control system. When peer-to-peer communication is enabled the data highway shall allow the connected boilers to exchange signals as required to provide coordinated fully modulating lead/lag functions. It shall not be required to wire individual control signals between boilers. When modbus communication is enabled the data highway shall allow individual boiler limits, lockout, boiler and system temperatures and firing rate status to be readable and water set point, boiler firing rate, and start/stop command to be readable and writable. Provide all equipment capabilities specified in this paragraph even if a connecting SCADA (Supervisory Control and Data Acquisition) system, typically a desktop personal computer is not included in this project.

J. The boiler control systems shall be supplied as part of the factory assembled, tested burners control cabinets.

K. The boilers control panels shall communicate through a gateway, such as BacNet, Modbus etc.) with the present expanded building's Energy Management System (EMS).

2.07 DUAL FUEL SWITCHOVER PANEL

A. Provide a dual fuel switchover panel to enable safe switching from natural gas to fuel oil # 2 and vice versa. This panel shall be UL listed, approved by the gas company and shall include all necessary switches, relays, lights, wiring, etc., as required.

2.08 BAROMETRIC DAMPERS

A. The field installed barometric dampers, model M MG2 with thermal spill switches to shut units down, in any spillage situation, shall be installed and properly set for optimum efficiency. The height and arrangement installation shall be as per manufacturer's recommendations.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide for connection to electrical service. Refer to Division 26.

C. Pipe safety valves to nearest floor drain.

3.02 PRESSURE TESTS

A. All field tests after the boiler have been erected and connected will be limited to no more than the maximum pressure for which the boiler is intended. This Contractor shall be responsible for furnishing all equipment, piping, fittings, valves, hoses, labor, etc., as required to perform such tests.

B. A hydrostatic pressure test of 80 psig shall be conducted on each boiler for a period of not less than five (5) hours.

C. After the receipt of the Certificates of Inspection, this Contractor shall furnish suitable glass front frames in which to place said Certificates of Inspection. Frames, with certificates therein, shall be then placed in or posted in a suitable location within the Boiler Room, in which the boilers are located.

3.03 BOILERS CLEANING

A. After final assembly and connection, this boiler shall be thoroughly cleaned internally following the manner prescribed in detail within Section VI of the ASME Boiler and Pressure Vessel Code.

B. The process of cleaning shall include the use of a compound of caustic soda and tri-sodium phosphate at a rate of one pound of each chemical per each 50 gallons of total water content in each boiler. This process of cleaning shall include boiler cleanout, surface blow-off, blow-down and wash.

C. This process of cleaning shall be repeated as often as necessary and also as directed by the Project Engineer to ensure that all sludge, scale, oil, and dirt have been sufficiently eliminated from the system and to produce a condition of the boilers that are clean, stable and free from the effects of foaming or priming and until finally considered acceptable by the Project Engineer. Initially, all condensate shall be wasted to drain, in which case the system shall be operated until the condensate runs clear, and in no instance longer than three (3) days.

D. This Contractor shall be required to furnish to the Owner, for use by his operating personnel, two

(2) copies of the previously specified ASME Section VI, which shall be utilized as Standard Operating and Maintenance procedures for these boilers installation. This material shall be in addition to the usual manufacturer's directives normally furnished with the boiler.

E. All boil-out fluids must be containered and removed from site by a licensed transporter or a permit must be drawn in accordance with Section 22A-430 or 22A-430B of the Connecticut General Status to discharge such waste into the sanitary sewer system.

3.04 START-UP AND ONE (1) YEAR SERVICE

A. START-UP

1 - The local boilers/burner's representative shall provide the services of a service person who shall conduct a start-up of the boiler/burner units. The start-up shall check all limits, safety devices and controls. The units shall be set to optimum efficiency and a report shall be made to the Contractor. This Contractor shall relay this report to the Project Engineer for review and comment.

2 - The Contractor shall provide all necessary communication between the Project Engineer, authorized representative of the Owner and the local boiler/burner unit representative in order to coordinate the light-off with at least seven (7) working days notice to all parties in advance of the proposed date of initial light-off.

B. ONE (1) YEAR SERVICE

1 - The local boiler/burner unit representative shall contact the service of this installation to a reputable service group who on a 24-hour a day basis will respond to all reports of problems. The response will be within 4-hour period or less. This contract as absorbed by the reputable service group shall in no way absolve the initial installing Contractor from any and all legitimate responsibility for materials furnished in these Contract Documents.

3.05 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 1. Instruct Owner's operating personnel for a period of not less than four (4) hours.

B. Submit written report after start-up including control settings and performance chart of control system.

END OF SECTION 23 52 23

SECTION 23 81 19

UNIT VENTILATORS

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. For Operation and Maintenance of HVAC equipment refer to the manufacturer's Installation and Operations Manual for complete instructions.

1.2 REFERENCES

A. The unit ventilators shall comply and perform to the following standards:

1. Units shall be tested and certified in accordance with AHRI Standard 840.

2. Units shall be constructed and listed in accordance with ETL standards (ANSI/UL 1995-1999, second edition).

3. Units insulation and adhesive shall meet the requirements for flame spread rating of lower than 25 per ASTM E84 and smoke generation rating of lower than 50 per ASTM E84. Only closed cell insulation shall be used. The use of fiberglass insulation is not acceptable.

4. Each coil shall be factory tested for leakage at 350 psig air pressure with coil submerged in water.

1.3 SUBMITTALS

A. Before these units could be purchased and installed, they will require the approval of the Architect/Project Engineer, as outlined below.

B. Shop Drawing Review Stamp Definitions

1. "No Exceptions Taken" means that the shop drawing is correct as to performance, capacity, etc. and substantial conformance to the contract drawings and specifications. Fabrication and/or purchase may commence.

2. "Make Corrections Noted" means that the shop drawing is correct as to performance capacity, etc. and substantial conformance to the contract drawings and/or specifications, subject to and in compliance with the annotations and/or corrections indicated on the shop drawing. Fabrication and/or purchase may commence.

3. "Amend and Resubmit" means that the comments and/or correction are so extensive and important that the reviewer wants to see how the comments and/or corrections are resolved prior to release for fabrication and/or purchase. Fabrications and/or purchase may not commence.

4. "Rejected" means that the shop drawing does not comply or conform to the contract drawings and/or specifications. Fabrication and/or purchase may not commence.

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels indicating manufacturer and material.

B. Inspection: Inspect all items for transit damage or any indication of re-pack. Follow manufacturer's directions for filing freight claims.

C. Storage: Store materials in a dry, sheltered area, protected from damage and in accordance with manufacturer's instructions.

D. Handling: Handle and lift products in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of unit ventilators.

B. Coordinate locations of the outside air louvers.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of design for unit ventilators is Magic Aire (United Electric Company), located at 501 Galveston Street, Wichita Falls, TX 6301, Phone (940) 397-2100, Web site www.magicaire.com.

B. UNIT VENTILATOR

1. The unit shall be factory-assembled bolt-together unit ventilator. Contained within the unit enclosure shall be factory installed motor, wiring, blowers, coil(s), bearing, outdoor & return air motorized dampers, and optional controls. Unit shall have a draw-thru design for uniform air distribution across the coil and even discharge temperatures.

2.2 CONSTRUCTION AND COMPONENTS

2.3.1 CONSTRUCTION

A. Unit frame shall be constructed of heavy-gauge galvanized steel components that form a rigid foundation and resist corrosion.

B. Unit composed of three sub-assembled modules: Blower Module, Coil Module and Damper Module. Modules shall be removable without disassembling the unit.

C. Modules shall be externally insulated using closed cell insulation.

D. Unit back shall be insulated using closed cell insulation.

E. Exterior access panels shall be constructed of heavy gauge galvanized steel that has been cleaned and protected before painting to maximize corrosion resistance. Exterior service access panels shall be retained by tamper-resistant fasteners. Panels shall be electrostatically coated with polyester baked on textured paint.

F. The vertical units shall have a standard depth of 16-5/8 in with a 30 in tall cabinet furnished with three standard 16-gauge front panels, and with service access panels with tamper-resistant hex socket head threaded fasteners and retainer chains for safety and ease of service. Cabinet models shall have standard textured baked powder finish panels. Cabinet tops shall be charcoal bronze as standard with a steel bar-stock discharge grille. Finish textured baked power paint to match cabinet panels shall be selected by the Architect/Owner's Representative. External access panels shall be removed from outside of the unit for easy access to filters and routine maintenance. End panel corners shall be welded and ground smooth for appearance and durability. Units shall include leveling legs to compensate for floor irregularities.

2.3.2 COMPONENTS

A. Hot water coils shall be constructed of mechanically expanded cooper tubing with a minimum wall of .016 in., inside aluminum fins shall have a minimum thickness of 0.045 in. Coils shall have a factory-mounted low limit device mounted on the leaving side of the heating coil. The device shall be single-pole, double-throw and shall activate at 38 f if the capillary device senses a temperature change along any 6 in. of the device.

B. Direct expansion (DX) coils shall be furnished with a thermal expansion valve sized to accommodate the self-contained air cooled condensing unit.

C. All coils shall be pressure tested at no less than 350 psig at the factory to ensure that they are leak free.

D. Dual capillary type thermal sensing elements, one automatic reset and one manual reset shall be employed to protect the unit from overheating in the event of abnormal operation.

E. The unit shall be constructed such that troubleshooting or adjustment of the controls can be done while the unit is operating normally.

F. Pipe Tunnel: Rated for 500 to 1,500 CFM range shall have an integral pipe tunnel that can be used for piping across the unit. This tunnel shall be insulated with closed cell insulation, from the unit and accessible from each end compartments to allow maximum flexibility of crossover piping insulation.

G. Fan and motor assembly shall be direct driven. One end of drive shaft shall be mounted in a ball bearing, with other end of shaft supported by motor bearings. Fan wheels shall

be double-width, double inlet with forward-curved blades, and shall operate at low speed. Fan wheel shall be mounted on a hollow one piece steel shaft. Fan wheels shall be statically and dynamically balanced. Fan housing shall be constructed from heavy-gauge steel and mounted to a heavy-gauge galvanized steel fan deck. To prevent vibration transmission to the unit frame, motor and shaft bearing shall be resiliently mounted. The drive shaft shall be connected to motor with flexible coupling. Fan motors shall be mounted outside of air stream on a heavy-gauge steel partition and removable without removing the blower module. Standard shall be supplied with permanently split-capacitor (PSC) multi-tap transformer motors. Units that are used in high-static applications or that require higher efficiency shall be supplied with 3-speed, 120, 240 or 277 volt, single-phase, 60 Hz, electronically commutate motors (ECM). Units without controls shall be supplied with permanently split capacitor (PSC) multi-tap transformer motors. All motors shall have integral high temperature reset and shall be protected with cartridge-type fuse()s).

H. Units shall be supplied with a one piece 1 in. throwaway filter. The unit shall be capable of incorporating a 2 in. filter. For even loading, filter shall be positioned to filter mixed outdoor and return air. Filter track shall be adjustable to accept 1 in. or 2 in. permanent or renewable media replacement filters.

I. Units shall contain a single outdoor/return air damper with continuous seal the length of damper. the damper shall be constructed of extruded aluminum that has an integral curved web to afford maximum rigidity. External closed cell insulation shall be applied. The damper assembly shall include an anti-drat plate to prohibit outdoor air from penetrating the classrooms through the damper assembly.

J. Each unit shall be supplied with an outdoor air louver furnished with decorative lattice with finish in color as selected by Architect/Owner’s Representative.

K. The valves packages, controls and connections to the existing expanded Energy Management System (EMS) shall be field installed, tested and fully warrantied by the Controls Contractor. The valves package shall include electric/electronic 2-way or 3-way heating control valves to match existing, wye strainers, flow setters, P/T (Pressure/temperature ports), isolation ball valves, and piping unions at each unit, as a minimum. The valve package shall include all valves required to match the modified ASHARE II cycle controls described on Sequences of Operation shown on drawings. The controls package shall be capable of standalone operation and monitoring via EMS and shall have all necessary sensors and accessories to monitor, control and ensure complete and safe operation of the unit. Each unit shall be capable of accepting a field installed CO2 sensor with a field installed demand ventilation controller. Each space served by a unit ventilator shall include a room thermostat/temperature sensor furnished with a clear lockable cover. Refer to the input/output control points on drawings, as required to be provided for each unit to EMS.

L. Touch-up paint shall be made available to match each cabinet selection finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. This Contractor shall ensure that all areas that are required to receive the new unit ventilators are clear for work after the current old fan-coil units are disconnected,

removed and disposed in legal manner. The Owner's Representative shall ensure that there are no built-in cabinets, bookshelves, tables or other furniture blocking the installation of the new unit ventilators. This Contractor shall ensure that the current wall openings are weatherproof protected for the entire duration of this work. Note, that adjustment to the existing finned-tube radiation enclosure will be required to match each unit length and height of the pipe tunnel behind.

B. Install new unit ventilators in strict accordance with the manufacturer's instructions, recommendations and warranty. Coordinate this work with the General Contractor which shall be responsible to cut new wall openings required to receive the new outside air louvers. Coordinate this work with the Controls Contractor, as to ensure that controls are installed in a timely manner and as specified.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

D. Seal water and air tight the space between the exterior wall and outside air louver flange.

E. The existing finned-tube radiation controls shall be integrated with the new unit ventilators controls, as to prevent overheating of the current spaces.

F. Test the operation of each unit ventilator from local and remote (EMS) controls in strict accordance with the sequence of operation indicated on drawings, and provide written certification to the Architect/Engineer and Owner's Representative, prior to this project final completion. One (1) year parts and labor warranty shall start only after the written certification is deemed acceptable by the Architect/Engineer and Owner's Representative.

END OF SECTION 23 82 19

SECTION 25 00 00

EXPANSION OF THE ENERGY MANAGEMENT SYSTEM (EMS)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Expand the existing Energy Management System (EMS) to all new described work.

B. Control equipment.

C. Software.

1.02 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 11 16 - Hydronic Piping: Installation of control valves, flow switches, temperature sensor sockets, gage taps, flow meters.

B. Section 23 33 00 - Ductwork Accessories: Installation of automatic dampers, control valves, smoke detectors. Connection of damper end switches.

1.03 RELATED SECTIONS

A. Section 23 09 13 - Controls and Instrumentation.

B. Section 23 09 93 - Sequences of Operation.

C. Division 26 - Equipment Wiring Systems.

1.04 REFERENCES

A. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.

B. ASME MC85.1 - Terminology for Automatic Control.

C. NEMA EMC1 - Energy Management Systems Definitions.

1.05 DEFINITIONS

A. Ensure terminology used in submittals conforms to ASHRAE 85, ASME MC85.1, NEMA EMC1.

1.06 SYSTEM DESCRIPTION

A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units with communications to Building Management System.

B. Central and remote hardware, software, and interconnecting wire and conduit.

C. Local controls for air handling units, rooftop equipment, exhaust fans, etc., as indicated on drawings.

D. Damper Motors and Valve Operators: Electric/Electronic.

1.07 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings:
1. Trunk cable schematic showing programmable control unit locations, and trunk data conductors.
2. List of connected data points, including connected control unit and input device.
3. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
5. Descriptive data and sequence of operation of operating, user, and application software.

C. Product Data: Provide data for each system component and software module.

D. Manufacturer's Installation Instructions: Include for all manufactured components.

1.08 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual location of control components, including panels, thermostats, and sensors.

C. Revise shop drawings to reflect actual installation and operating sequences.

D. Include data specified in "Submittals" in final "Record Documents" form.

1.09 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Include interconnection wiring diagrams complete field installed system with identified and numbered, system components and devices.

C. Include keyboard illustrations and step-by-step procedures indexed for each operator function.

D. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum ten years documented experience.

B. Installer: Company specializing in applying the work of this Section with minimum five years Documented experience, approved by manufacturer.

C. Design system software under direct supervision of a Professional Engineer experienced in design of this work and licensed at the place where the Project is located in the State of Connecticut.

1.11 PRE-INSTALLATION CONFERENCE

A. Convene a conference one week prior to commencing work of this Section, under provisions of Division 1.

1.12 COORDINATION

A. Coordinate work under provisions of Division 1.

B. Ensure installation of components is complementary to installation of similar components in other systems.

C. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

D. Ensure system is completed and commissioned.

1.13 WARRANTY

A. Provide five year warranty under provisions of Division 1.

B. Warranty: Include coverage for field programmable micro-processor based units.

1.14 MAINTENANCE SERVICE

A. Furnish service and maintenance of energy management and control system for two years.

B. Provide four complete inspections per year, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

1.15 EXTRA MATERIALS

A. Submit maintenance materials under provisions of Division 1.

B. Provide two of each type of exposed sensor under provisions of Division 1.

1.16 PROTECTION OF SOFTWARE RIGHTS

A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
   1. Limiting use of software to equipment provided under these specifications.
   2. Limiting copying.
   3. Preserving confidentiality.
   4. Prohibiting transfer to a third party.

PART 2 - PRODUCTS

2.01 LOCAL OPERATOR ACCESS AND DISPLAY PANEL

A. Provide local display and adjustment panel. Panels shall be integral to programmable control unit. Panel contains a six character digital display, and a numerical keyboard. Display and adjust:
   1. Input/output point information.
   2. Controller set points.
   3. Controller tuning constants.
   4. Program execution times.
   5. High and low limit values.
   6. Limit differential.
   7. Time, date, year.

B. Provide two auxiliary keyboard pushbuttons for custom programming special functions. Provide dedicated pushbuttons for manual/auto override, system test, and enter functions.

C. Provide status lights to annunciate controller test, trouble, alarm, auto control, override, and auxiliary button operation.

2.03 OPERATOR STATION

A. Re-use existing main operator station.

2.04 CONTROL UNITS

A. Units: Modular in design and consisting of processor board with programmable RAM memory, local operator access and display panel, and integral interface equipment.

B. Battery Backup: For minimum of 100 hours for complete system including RAM without interruption, with automatic battery charger.

C. Provide the following functions:
   1. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
   2. Logic: OR, AND, compare negate.
   3. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dewpoint, relative humidity, humidity ratio, filter.
   4. Data Manipulation: Store, file and set.
   5. Display Panel: Display adjust, override, time, day, date, year, alarm scan, override scan.
   6. Control Routines: Proportional, integral, lead lag, hysteresis correction and

incremental control.

7. Energy Management: Duty cycling, load shed, optimal run time, holiday and daylight savings time correction.

D. Provide self-test procedure for checking digital display and computer. Display advisories for maintenance, performance, or software problems. Identify variables as reliable or unreliable. Variables identified as unreliable will flash when displayed and calculation will use default.

E. Indicate alarms and deviations. Alarm scan shows alarms and identification. Continue alarm indication until acknowledged and alarm condition is corrected.

F. Provide two communication interface ports permitting communication between processor, process interface equipment, other processors, and central processing unit.

2.05 DATA INTERFACE UNITS

A. Provide equipment required to connect all sensors, transducers and interface relays required to monitor and control equipment in sequence of operation.

2.06 INPUT/OUTPUT SENSORS

A. Temperature:

1. Resistance temperature detectors with resistance tolerance of plus or minus 0.1 percent at 21 degrees C, interchangeability less than plus or minus 0.2 percent C, time constant of 13 seconds maximum for fluids and 200 seconds maximum for air.
2. Measuring current maximum 5 MA with maximum self-heat of 0.017 degrees C/MW in fluids and 0.008 degrees C/MW in fluids and 0.008 degrees C/MW in air.
3. Provide 3 lead wires and shield for input bridge circuit.
4. Use insertion elements in ducts not affected by temperature stratification or smaller than one square meter. Use averaging elements where larger or prone to stratification sensor length 2.5 m or 5 m as required.
5. Insertion elements for liquids shall be with brass socket with minimum insertion length of 2-1/2 inches (60 mm).
6. Supply room sensors with locking cover matching thermostats used.
7. Provide outside air sensors with watertight inlet fitting, shielded from direct rays of sun.

B. Humidity Sensors:

1. Elements: Accurate within 5 percent full range with linear output.
2. Room Sensors: With locking cover matching thermostats used], span of 10 to 60 ercent relative humidity.
3. Duct and Outside Air Sensors: With element guard and mounting plate, range of 0 - 100 percent relative humidity.

C. Static Pressure Sensors:

1. Undirectional with ranges not exceeding 150 percent of maximum expected input.
2. Temperature compensated with typical thermal error or 0.06 percent of full

scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
3. Accuracy: One percent of full scale with repeatability 0.3 percent.
4. Output: 0 - 5 vdc with power at 12 to 28 vdc.

D. Equipment Operation Sensors:
1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg (0 to 1250 Pa).
2. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.
3. Status Inputs Where Differential Pressure Sensing is Impractical: Current sensitive relay with current transformers, adjustable and set to 175 percent of rated motor current.

E. Digital to Pneumatic Transducers: Convert continuous proportional current or voltage to 0 to 20 psi.

F. Damper Position Indication: Potentiometer mounted in handbox enclosure with adjustable crankarm assembly connected to damper to transmit 0 - 100 percent damper travel.

G. Carbon Monoxide Detectors:
1. Single or multichannel dual level detectors, using solid state sensors with three year minimum life. Sensor replacement shall take maximum 15 minutes. Suitable over temperature range of 23 to 130 degrees F (-5 to 55 degrees C).
2. Provide individual indicators and contactors for each level, initially calibrated for 50 ppm and 100 ppm.
3. Maximum response time to 100 ppm CO calibration gas shall be two minutes.

2.07 OPERATING SYSTEM SOFTWARE

A. System Format:
1. Divide points of control or monitoring by system.
2. Identify points with unique, structured point identifier reflecting "specific area" or "specific system", and "specified point".

B. Input Process:
1. Select, from menu, one of four general types of commands based upon password clearance, command points, information points, build parameters, and modify parameters. Commands not available by password clearance shall be deleted from video display.
2. Enter memory changes through keyboard.
3. Select entry modes, Aid or Direct, based on operator's degree of capability and familiarity with system.
4. Aid Mode shall prompt operator through each step indicating available options.
5. Direct Mode shall allow experienced operator to input command string directly.
6. Enter commands as alpha/numeric character strings. Where commands require data for limits, setpoint, and time, enter value in same engineering units as controlled variable.
7. Operator input shall not inhibit alarm reporting. Echo input on associated

output device, to either execute or abort.

C. Operator Access Control: Restrict any operator command through use of software password.

D. Information Access: Obtain point status information from any designated output device with access command. Point status consists of point identification, numerical value (analog points) and associated engineering units, and individual function label indicating that point is on or off or in Alarm Normal condition. Output includes date and time of execution.

E. Point Display: Video display includes status of single point or group of points with high and low limits (if applicable). Refresh display at least every 20 seconds.

F. Alarm summary includes status of points in Alarm condition.

G. Off-normal summary includes status of points in Off-Normal condition.

H. Alarm Reporting:
1. Alarm outputs contain descriptor, point identification, point data, engineering units, and date and time.
2. Print on line changeable message, up to 60 characters in length, for each alarm point specified, immediately.
3. Display alarm reports on video. Display multiple alarms in order of occurrence.
4. Inhibit reporting of associated analog and binary alarms upon HVAC system shutdown. Upon restart, inhibit alarm reporting for operator pre-determined time.
5. Operator specifies if alarm required acknowledgement.

I. Advisories:
1. Lockout summary which contains status of points in locked out condition.
2. Continuously interrogate system hardware and programmable control units for failure or tampering and report if operational or not operational.
3. Power failure detection, time and date.
4. System communication failure with operator device, field interface unit, point, programmable control unit.

J. Data Base Save/Restore:
1. Provide program which allows saving or restoring of operating data.

2.08 BASIC OPERATING FEATURES

A. Binary Capabilities:
1. Monitor binary sensors, continuously storing press contact condition in memory.
2. Indicate if point is off-normal, in alarm, or off- line.
3. Program output points for Open/Closed, Test/Reset, Start/Stop.
4. Feedback Start/Stop points. Employ point unique, feedback delay timer to temporarily suppress alarm reporting after input to allow time for response.
5. Output advisory message if response is not as commanded.

6. Hold points in present operating condition if controls power failure occurs.

B. Analog Capabilities:
1. Measure, transduce, transmit and display analog values.
2. Express analog point values in proper engineering units, displaying with up to six significant digits.
3. Have sensor to readout accuracy of plus or minus one degree F.
4. Provide for operator designated ranges either linear, series of linear approximations, split ranges, or square root extractions of exponential functions.
5. Compare analog read to high and low limits and annunciate Alarm or Off-Normal condition.
6. Output alarm, including point identification current value and associated engineering units, high or low value, and time and date.
7. Automatically disable alarm reporting upon associated system shutdown. Allow sufficient time to return to normal operating conditions before allowing alarm reporting.
8. Provide limit and differential summary.

C. Analog Point Adjust:
1. Remotely adjust controller set points or dampers. Automatically adjust points based upon preselected time or value.
2. Employ feedback so that if point fails to respond responds with wrong value, or drifts from set point value by plus or minus 2 percent, output alarm message. Employ feedback delay timer to temporarily suppress alarm reporting after input to allow time for response.
3. Hold points in present operating condition if controls power failure occurs.

D. Automatic Alarm Lockout: Automatically inhibit alarm reporting of analog and binary points upon associated system shutdown. Inhibit reporting for operator predetermined time, upon restart of HVAC systems.

2.09 LOAD CONTROL PROGRAMS

A. General:
1. Provide means to reduce electrical energy usage, using control algorithms designed for electrical energy control.
2. Apply algorithms to other energy sources, such as steam or natural gas.
3. Support S.I. Metric units of measurement.

B. Demand Limiting:
1. Monitor total power consumption per power meter and shed associated loads automatically to reduce power consumption to an operator-presettable maximum demand level.
2. Use floating window type demand determination to monitor demand and compare to target value.
3. Automatically shed loads throughout the demand interval selecting loads with independently adjustable on and off time of between one and 255 minutes.
4. Output advisory if loads are not available to satisfy required shed amount, advise shed requirements and requiring operator acknowledgement.
5. Operator commands:

a. Add/delete demand meter point.
b. Define load point.
c. Define load priority target.
d. Define control target.
e. Begin new billing period.
f. Lock/unlock program.
g. Activate/inactivate/restore load.
h. Request load control system control summary.
i. Request load control system load summary.

6. Load control system summary:
   a. Demand interval
   b. Current kW power and measured demand.
   c. Projected load limit.
   d. Total energy available from HVAC system
   e. Maximum, average, and current expendable load.
   f. Maximum, average and current deferrable load.
   g. Demand limit status, target value, and recent control action.
   h. Duty cycle status, target value, and recent control action.
   i. Covergence time.
   j. Restore band width.
7. Load summary:
   a. Load priority.
   b. Expendable/deferrable load type.
   c. Point type, ID, status.
   d. Load rating.
   e. Minimum off, maximum off, and minimum on times.

C. Duty Cycling:
1. Periodically turn selected loads off to evenly reduce power consumption to target value, selecting loads with independently adjustable on and off time of between one and 255 minutes.
2. Operator commands:
   a. Define load point.
   b. Define control target.
   c. Activate/inactivate/restore load.
   d. Request load control system load summary.

2.10 HVAC CONTROL PROGRAMS

A. General:
1. Support English units of measurement.
2. Identify each HVAC Control system.

B. Optimal Run Time:
1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.

4. Use outside air temperature to determine early shut down with ventilation override.
5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
6. Operator commands:
    a. Define time schedule.
    b. Add/delete fan status point.
    c. Add/delete outside air temperature point.
    d. Add/delete mass temperature point.
    e. Define heating/cooling parameters.
    f. Define mass sensor heating/cooling parameters.
    g. Lock/unlock program.
    h. Request optimal run time control summary.
    i. Request optimal run time mass temperature summary.
    j. Request HVAC point summary.
    k. Request HVAC saving profile summary.
7. Control summary:
    a. HVAC Control system begin/end status.
    b. Optimal run time lock/unlock control status.
    c. Heating/cooling mode status.
    d. Optimal run time time schedule.
    e. Start/stop times.
    f. Selected mass temperature point ID.
    g. Optimal run time system normal start times.
    h. Occupancy and vacancy times.
    i. Optimal run time system heating/cooling mode parameters.
8. Mass temperature summary:
    a. Mass temperature point type and ID.
    b. Desired and current mass temperature values.
    c. Calculated warm-up/cool-down time for each mass temperature.
    d. Heating/cooling season limits.
    e. Break point temperature for cooling mode analysis.
    f. Linear compensation factor for heating mode Manalysis.
9. HVAC point summary:
    a. Control system identifier and status.
    b. Fan status. point ID and status.
    c. Outside air temperature point ID and status.
    d. Mass temperature point ID and status.
    e. Calculated optimal start and stop times.
    f. Period start.

C. Supply Air Reset:
1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
    a. Raising cooling temperatures to highest possible value.
    b. Reducing heating temperatures to lowest possible level.
3. Operator commands:
    a. Add/delete fan status point.

b. Lock/unlock program.
c. Request HVAC point summary.
d. Add/Delete discharge controller point.
e. Define discharge controller parameters.
f. Add/delete air flow rate.
g. Define space load and load parameters.
h. Request space load summary.

4. Control summary:
   a. HVAC control system status (begin/end).
   b. Supply air reset system status.
   c. Optimal run time system status.
   d. Heating and cooling loop.
   e. High/low limits.
   f. Deadband.
   g. Response timer.
   h. Reset times.
5. Space load summary:
   a. HVAC system status.
   b. Optimal run time status.
   c. Heating/cooling loop status.
   d. Space load point ID.
   e. Current space load point value.
   f. Control heat/cool limited.
   g. Gain factor.
   h. Calculated reset values.
   i. Fan status point ID and status.
   j. Control discharge temperature point ID and status.
   k. Space load point ID and status.
   l. Air flow rate point ID and status.

D. Enthalpy Switchover:
1. Calculate outside and return air enthalpies using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.
2. Operator commands:
   a. Add/delete fan status point.
   b. Add/delete outside air temperature point.
   c. Add/delete discharge controller point.
   d. Define discharge controller parameters.
   e. Add/delete return air temperature point.
   f. Add/delete outside air dewpoint/humidity point.
   g. Add/delete return air dewpoint/humidity point.
   h. Add/delete damper switch.
   i. Add/delete minimum outside air.
   j. Add/delete atmospheric pressure.
   k. Add/delete heating override switch.
   l. Add/delete evaporative cooling switch.
   m. Add/delete air flow rate.
   n. Define enthalpy deadband.
   o. Lock/unlock program.
   p. Request control summary.

q. Request HVAC point summary.

3. Control summary:
    a. HVAC control system begin/end status.
    b. Enthalpy switchover optimal system status.
    c. Optimal return time system status.
    d. Current outside air enthalpy.
    e. Calculated mixed air enthalpy.
    f. Calculated cooling cool enthalpy using outside air.
    g. Calculated cooling cool enthalpy using mixed air.
    h. Calculated enthalpy difference.
    i. Enthalpy switch.over deadband.
    j. Status of damper mode switch.

2.11 PROGRAMMING APPLICATION FEATURES

A. Trend Point:
1. Sample up to 4 points, real or computed, with each point capable of collecting 4 samples at intervals specified in minutes, hours, days, or month.
2. Output trend logs as line graphs or bar graphs. Output graphic on terminal, with each point for line and bar graphs designated with a unique color, vertical scale either actual values or percent of range, and horizontal scale time base. Print trend logs up to 12 columns of one point/column.

B. Alarm Messages:
1. Allow definition of minimum of 12 messages, each having minimum length of 80 characters for each individual message.
2. Assign alarm messages to system messages including point's alarm condition, point's off-normal condition, totalized point's warning limit, hardware elements advisories.
3. Output assigned alarm with "message requiring acknowledgement".
4. Operator commands include define, modify, or delete; output summary listing current alarms and assignments; output summary defining assigned points.

C. Weekly Scheduling:
1. Automatically initiate equipment or system commands, based on preselected time schedule for points specified.
2. Provide program times for each day of week, per point, with one minute resolution.
3. Automatically generate alarm output for points not responding to command.
4. Provide for holidays, minimum of 366 consecutive holidays.
5. Operator commands:
    a. System logs and summaries.
    b. Start of stop point.
    c. Lock or unlock control or alarm input.
    d. Add, delete, or modify analog limits and differentials.
    e. Adjust point operating position.
    f. Change point operational mode.
    g. Open or close point.
    h. Enable/disable, lock/unlock, or execute interlock sequence or computation profile.
    i. Begin or end point totalization.

j. Modify totalization values and limits.
k. Access or secure point.
l. Begin or end HVAC or load control system.
m. Modify load parameter.
n. Modify demand limiting and duty cycle targets.

6. Output summary: Listing of programmed function points, associated program times, and respective day of week programmed points by software groups or time of day.

D. Interlocking:
1. Permit events to occur, based on changing condition of one or more associated master points.
2. Binary contact, high/low limit of analog point or computed point shall be capable of being utilized as master. Same master may monitor or command multiple slaves.
3. Operator commands:
a. Define single master/multiple master interlock process.
b. Define logic interlock process.
c. Lock/unlock program.
d. Enable/disable interlock process.
e. Execute terminate interlock process.
f. Request interlock type summary.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install electrical work in accordance with Division 16. Electrical material and installation shall be in accordance with appropriate requirements of Division 16.

C. Provide with 120v AC, 15 amp dedicated emergency power circuit to each programmable control unit.

3.02 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Division 1.

B. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

C. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for 3 day period.

D. Provide basic operator training for two persons on data display, alarm and status descriptors, requesting data, execution of commands and request of logs. Include a minimum of 40 hours dedicated instructor time.

3.03 DEMONSTRATION

A. Provide systems demonstration under provisions of Division 1.

B. Demonstrate complete and operating system to Owner.

END OF SECTION 25 00 00

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Date: For sleeve seals.

B. Shop Drawing Review Stamp Definitions

1. “No Exceptions Taken” means that the shop drawing is correct as to performance, capacity, etc. and substantial conformance to the contract drawings and specifications. Fabrication and/or purchase may commence.
2. “Make Corrections Noted” means that the shop drawing is correct as to performance capacity, etc. and substantial conformance to the contract drawings and/or specifications, subject to and in compliance with the annotations and/or corrections indicated on the shop drawing. Fabrication and/or purchase may commence.

3. "Amend and Resubmit" means that the comments and/or correction are so extensive and important that the reviewer wants to see how the comments and/or corrections are resolved prior to release for fabrication and/or purchase. Fabrications and/or purchase may not commence.

4. "Rejected" means that the shop drawing does not comply or conform to the contract drawings and/or specifications. Fabrication and/or purchase may not commence.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment.

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Furnish and Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames", and shall be installed by division 08 contractors.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 – PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.

b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Metraflex Co.

d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.

3. Pressure Plates: Plastic. Include two for each sealing element.

4. 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.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 – EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches above finished floor level unless otherwise noted on drawings.

G. Size pipe sleeves to provide ¼-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section “Joint Sealants.”

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section “Penetration Firestopping.”

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe 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.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section “Firestopping” Section.

END OF SECTION 26 05 00

SECTION 26 05 10

SCOPE OF WORK

PART - GENERAL

1.1 SUMMARY

A. Provide the work included in accordance with the Contract Documents.

B. Provide all labor, materials, equipment, tools, appliances, auxiliaries, services, hoisting, scaffolding, support, supervision, and Project Record Documents, and perform all operations for the furnishing and installing of the complete electrical system, including but not limited to the work described hereinafter. The work shall meet or exceed the latest codes, regulations and requirements of the general conditions to the specifications, Division 26 specifications and drawings submitted.

C. The electrical work is shown schematically on the Drawings to indicate the general system arrangement and configuration. The work of this Division shall include coordination with the work of other Divisions of the Specifications and the Contract Documents so as to provide a complete and operational system capable of being readily operated and maintained, including approved rearrangement of the systems and equipment and rerouting of distribution services to enable the complete system to fit within the confines of the allotted electrical spaces, all to the satisfaction of the Architect/Engineer or as directed by the Architect/Engineer.

D. The work includes, but is not limited to the following: Equipment supports and miscellaneous steel for electrical equipment.

1. As-built drawings on (PDF backgrounds supplied by design engineers or ACAD format.

2. Balancing loads for complete electrical system.

3. Combination starters required for project not supplied by other Divisions (Contractor shall review all divisions and shall be responsible for all work specified or implied) Review all specifications and drawings.

4. Demolition work stated or implied by all divisions

5. Distribution feeders.

6. Electrical requirements listed in Divisions 1 thru Division 28 and architectural and mechanical contract drawings.

7. Equipment supports and miscellaneous steel for electrical equipment. Contractor is responsible for reviewing complete project specifications and project drawings.

8. Fire alarm system modifications.

9. Convenience outlet systems and miscellaneous wiring devices.

10. Miscellaneous electrical equipment and systems, unless otherwise noted.

11. Motor power wiring.

12. Requirements as listed in other Sections of Division 26.

13. Sealing of sleeves and other electrical openings.

14. Seismic bracing of electrical equipment where required by specifications and the State of Connecticut. **Seismic submittal package shall be complete and submitted by Vibra-Conn, Inc., 1-800-379-9119, or equal. (See Section 26 05 48)**

15. Special mechanical system connections.

16. Testing, adjusting and calibration and requirements listed in other sections.

17. Wiring, conduit and connections between the motor controllers and motors.

18. Wiring, conduit and connections for fire alarm interface.

19. Digital photographs of all concealed work

20. Shop drawings as required by specifications and in this section.

    a. Shop drawing submittals shall consist of five (5) sets. Only originals or clean copies will be accepted. Fax copies will not be accepted. Shop drawings shall be submitted by specification section and be complete.

    b. The following shop drawings shall be submitted as a minimum. Please refer to other sections in Division 26 & Division 28 for additional shop drawing requirements.

        1. Fire alarm devices (Manufacturer Cut Sheets), Riser Diagram and Wiring Layout.

        2. Modifications to drawings supplied.

        3. Disconnect switches, circuit breakers, fuses, etc.

        4. Wiring, conduit, wiring devices and misc. fitting and boxes.

        5. Lighting fixtures & Life Safety Devices (Emergency Lights & Exit Signs).

        6. See other Sections for additional requirements.

21. Fire stopping and Smoke stopping requirements per Division 7 and Contract Documents.

a. This includes through-penetration fire stop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

   1. Floors.

   2. Walls and partitions.

   3. Roof Assemblies.

   4. Construction enclosing compartmentalized areas.

b. Related Sections include the following:

   1. Division 7 Section “Firestopping”

   2. Division 22 & 23 Sections specifying duct and piping penetrations.

   3. Division 26 Sections specifying cable and conduit penetrations.

   4. Division 28 Fire Alarm modifications.

c. Provide through-penetration fire stop systems that are produced and installed to resist spread of fire according to requirements indicated in this project. Systems shall resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

d. Shop Drawings: For each through-penetration fire stop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include fire stop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidence compliance with requirements for each condition indicated.

22. Codes and Standards

a. The Codes and Standards listed below apply to all electrical Work. Where Codes or Standards are mentioned in these Specifications, follow the latest edition or revision:

   IES - Lighting Handbook
   NEMA - Standards
   ANSI C1 - National Electrical Code (NFPA 70)
   ANSI C50 - Rotating Electrical Machinery
   ANSI C51.1 - Construction & Guide for Selection, Installation and Use of Electric Motors
   ANSI C52.1 - Motors and Generators (NEMA MG1)
   FIPS Publication #94 - Guideline on Electrical Power for ADP Installations

b. The current adopted editions of the following State or local Codes apply:

2005 National Electric Code, NFPA 70 (NEC)
International Building Code/2003 (ICC)
International Mechanical Code/2003 (ICC)
International Plumbing Code/2003 (ICC)
Connecticut Supplement/2005/State Building Code/ 2005 CSBC/2009 Amendment & 2011 Amendments.
2005 Connecticut State Fire Safety Code
Local Authorities Having Jurisdiction (AHJ)
ICC/ANSI A 117.1/2003 Accessible and Usable Buildings and Facilities
O.S.H.A. Regulations
Americans with Disabilities Act, ADA Requirements (Public Law 101-336)
International Existing Building Code/2003(ICC)
International Energy Conservation Code 2003 (ICC) and 2011 CT Amendment Adopting 2009 Edition.
State of Connecticut Department of Public Health – Public Health Code

c. The following abbreviations are used within these Specifications:

IES - Illuminating Engineering Society
NEC - National Electrical Code
ANSI - American National Standards Institute
ASTM - American Society for Testing and Materials
EPA - Environmental Protection Agency
IEEE - Institute of Electrical and Electronic Engineers
NEMA - National Electrical Manufacturers Association
NFPA - National Fire Protection Association
OSHA - Occupational Safety and Health Administration
UL - Underwriters' Laboratories

d. All materials furnished and all Work installed comply with the rules and recommendations of the NFPA, the requirements of the local utility companies, the recommendations of the fire insurance rating organization having jurisdiction and with the requirements of all Governmental departments having jurisdiction.

e. Include in the Work, without extra cost to the Owner, any labor, materials, services, apparatus and drawings in order to comply with all applicable laws, ordinances, rules and regulations whether or not shown on Drawings and/or specified.

23. The Contractor shall include in the work, without extra cost to the Owner, any labor, materials, apparatus, and drawing additions to the Contract Drawings and Documents in order to comply with all applicable Codes, Ordinances, Rules and Regulations, whether or not shown on the drawings or indicated.

24. All work shall be performed in a neat and workmanlike manner, with due regard for good practice and best finished appearance.

25. Where such acceptable substitution or deviation requires different quantity or arrangement of foundations, supports, ductwork, piping, wiring, conduit, and any other equipment or accessories normal to this equipment, furnish said changes and additions and pay all changes to the work and the work of others affected by this substitution or deviation. Deviations mean the use of any listed acceptable manufacturer other than those on which the drawings are based.
26. The checking of the shop drawings and samples and the use of the review stamp will be only for conformance with the design concept. The review stamp does not indicate acceptance of every detail of the drawings nor the work methods indicated thereon. Shop drawings will not be accepted for review unless they are stamped and signed as having been fully coordinated with all trades. The review stamp does not relieve the Contractor of the responsibility to comply with all the requirements of this Specification.

27. It is the intent of the Specifications and Drawings to call for finished work, tested and ready for operation.

28. The Contractor shall guarantee all materials, equipment and apparatus and workmanship furnished by him to be free from all defects and agrees to replace at his own expense, at any time within (2) year from the date of acceptance by the Owner, all defective parts that may be found. **At job completion, the Contractor shall submit certification of Guarantee to the Owner and Engineer on contractor's letterhead.**

29. Upon completion of all work and all tests, Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment. During this period, instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. **There shall be a minimum of 2-1 hour trainings per system.** This shall be completed and signed off by owner's maintenance staff and engineer.

30. Contractor shall furnish to the Architect/Engineer five (5) complete bound sets of typewritten or copied instructions for operating and maintaining all systems included in this contract. All manuals shall be submitted in draft, for approval, prior to final issue. Manufacturing advertising literature will not be acceptable. Only technical bulletins will be considered for the maintenance manual. All shop drawings shall be part of this manual.

31. All switches, starters, circuit breakers, panel boards and other electrical apparatus shall be permanently and neatly identified, clearly legible. All characteristics shall be in a sharply contrasting color to the background surface. All panel boards shall be provided with a neatly typed schedule at the time of final inspection. (see sample at end of this section).

32. Free-hand lettering shall not be acceptable. Engraved laminated labels with stainless steel screw mounting shall be used. All plates shall identify panel and circuit number for switches and receptacles.

33. Each piece of equipment shall be identified with the following:

    1. Name or title of equipment i.e., (LP-3).

    2. Voltage and phase of power source(s) within.

34. **All electrical conduits for the following systems (including conduit above hung ceilings) shall be identified with semi-rigid identification markers equal to "SETMARK" electrical markers as manufactured by Seton Name Plate Co.**

    1. Feeders

    2. Fire Alarm Wiring

    3. Wiring Devices (Receptacles)

35. Each marker background shall be color coded with a clearly printed legend to identify the conductor. Size of markers and lettering to generally conform with the "Scheme for Identification of Piping Systems" (ANSI A13.1-1975).

36. Locations for electrical markers to be as follows:

    1. On all vertical runs - marked every 20 feet and at supply and termination points.

    2. On all horizontal runs - marked every 20 feet and at supply and termination points.

37. Minimum Size: ¾ inch unless otherwise specified.

38. Outdoor Locations, Above Grade: Use rigid steel conduit.

39. In Slab Above Grade:

    1. Use rigid steel conduit.

40. Wet and Damp Locations: Use Aluminum conduit.

41. Dry Locations:

    1. Concealed: Electrical metallic tubing. (Lighting and general receptacles)

    2. Exposed: Use rigid steel conduit or aluminum conduit.

    3. Hallway & corridor ceilings: Use electrical metallic tubing.

42. Use flexible metallic conduits only in dry indoor locations for not more than 3 feet.

43. MC cable for final tie-ins, inside partitions where required.

44. Corridors shall have electrical metallic tubing. MC cable for final tie-ins.

45. Fire alarm systems shall be installed in electrical metallic tubing EMT.

46. **Seton Style No. M8080 tag seals for M/C cable.**

47. **Provide wire markers on each conductor in panel board gutters, pull boxes, outlet and junction boxes, and at load connection.** Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

48. Use Seton Style No. M4883 to identify conduit system. Space tape on 20 feet center.

49. Emergency Systems: Identification by name: fire alarm, etc: Red background.

THE USE OF SPRAY PAINT IS NOT ALLOWED

THE USE OF FREEHAND WRITING IS NOT ALLOWED

THE USE OF STRING AND PAPER AND CARD STOCK IS NOT ALLOWED

PART 2 - ELECTRICAL MOUNTING HEIGHTS

2.1 HEIGHTS

A. Refer to drawings, however if no other instructions or information is given, the Contractor shall submit an RFI to Architect/Engineer for a reply in writing.

PART 3 - PRODUCTS

3.1 NOT USED

PART 4 - EXECUTION

4.1 NOT USED

END OF SECTION

SECTION 260515

ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 REFERENCE

A. Electrical demolition as required in Division 1, Division 2, Division 23 and 26.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition is based on General Contract requirements and electrical drawings. Report discrepancies to Architect/Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal, within the contract limit lines and General Contractor requirements.

B. Coordinate utility service outages with Utility Company (if required) and General Contractor.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service. Disable system only to make switchovers and connections. Obtain permission from Architect/Engineer at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in full service. Disable system only to make switchovers and new connections. Notify Architect/Engineer and local fire service at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Emergency Lighting: Maintain existing system in service. Disable system only to make switchovers and new connections. Notify Architect/Engineer and General Contractor at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of Division 1, Division 2, Division 26 and Division 28.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. 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.

F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

G. Disconnect and remove abandoned luminaries. Remove brackets, stems, hangers, and other accessories.

H. Disconnect and remove electrical devices and equipment servicing utilization equipment that has been removed.

I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel appropriately.

J. Extend existing installations using materials and methods as specified.

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment, which remain or are to be reused.

B. Panel boards: Clean exposed surfaces and check tightness of electrical connections. Replace all circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

3.5 INSTALLATION

A. Install relocated materials and equipment under the provisions of Division 1, Division 2, Division 23, Division 26 and Division 28.

3.6 STORAGE OF REMOVED EQUIPMENT

A. Contractor shall store electrical items at a location designated by the construction manager, and the engineer and construction manager shall indicate items to be disposed of by the contractor. Contractor shall be responsible for a storage list.

B. Electrical Contractor shall dispose of unwanted electrical equipment, fluorescent fixtures including fixtures containing ballast that are not labeled as having “no PCB”. The Contractor shall be responsible for disposing of the fixtures at no additional cost to the owner and shall dispose of the ballast in the fixture as required by state of Connecticut state law.

END OF SECTION 26 05 15

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. This Section includes the following:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent 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 in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. 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.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Southwire Company.

C. Aluminum and Copper Conductors: Comply with NEMA WC 70.

D. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW.

E. Multiconductor Cable: Comply with NEMA WC 70 for armored cable, Type AC, metal-clad cable, Type MC, nonmetallic-sheathed cable, Type NM, Type SO and Type USE with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.

C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-THWN, single conductors in raceway, Type XHHW, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway. All boiler room wiring shall be in conduit (EMT).

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC, Mineral-insulated, metal-sheathed cable, Type MI.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN or XHHW, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC, Mineral-insulated, metal-sheathed cable, Type MI.

F. Feeders in Cable Tray: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC, Nonmetallic-sheathed cable, Type NM.

G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW, single conductors in raceway.

J. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

K. Branch Circuits in Cable Tray: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

M. Class 1 Control Circuits: Type THHN-THWN, in raceway.

N. Class 2 Control Circuits: Type THHN-THWN, in raceway, Power-limited cable, concealed in building finishes, Power-limited tray cable, in cable tray.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 8 inches of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 "Firestopping."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 23

CONTROL-VOLTAGE ELECTRICAL POWER CABLES

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. UTP cabling.
2. 62.5/125-micrometer, multimode optical fiber cabling.
3. RS-232 cabling.
4. RS-485 cabling.
5. Low-voltage control cabling.
6. Control-circuit conductors.
7. Identification products.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

B. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

F. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

G. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

H. RCDD: Registered Communications Distribution Designer.

I. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.

J. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

K. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

1. Vertical and horizontal offsets and transitions.
2. Clearances for access above and to side of cable trays.
3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wire and cable to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. 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.

C. 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install UTP and optical fiber cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. Support of Open Cabling: NRTL labeled for support of Category 5e cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to brackets.
2. Lacing bars, spools, J-hooks, and D-rings.
3. Straps and other devices.

B. Cable Trays:

1. Manufacturers: Subject to compliance with requirements,

a. Cable Management Solutions, Inc.
b. Cablofil Inc.
c. Cooper B-Line, Inc.
d. Cope - Tyco/Allied Tube & Conduit.
e. GS Metals Corp.

2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch (0.012 mm) thick or hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch (0.055 mm) thick.

   a. Basket Cable Trays: 6 inches (150 mm) wide and 2 inches (50 mm) deep Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).
   b. Trough or Ventilated Cable Trays: Nominally 6 inches (150 mm) wide.
   c. Ladder Cable Trays: [Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).
   d. Channel Cable Trays: One-piece construction, nominally 4 inches (100 mm) wide. Slot spacing shall not exceed 4-1/2 inches (115 mm) o.c.
   e. Solid-Bottom or Nonventilated Cable Trays: One-piece construction, nominally 12 inches (305 mm) wide. Provide without solid covers.

C. Conduit and Boxes: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."Flexible metal conduit shall not be used".

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated,]3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope, Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, four-pair UTP[**,** formed into 25-pair binder groups covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, Category 5e.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM or Type CMG
    b. Communications, Plenum Rated: Type CMPcomplying with NFPA 262.
    c. Communications, Riser Rated: Type CMR; complying with UL 1666.
    d. Communications, Limited Purpose: Type CMX Multipurpose: Type MP or Type MPG
    e. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    f. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Technology Systems Industries, Inc.
2. Dynacom Corporation.
3. Hubbell Premise Wiring.
4. KRONE Incorporated.
5. Leviton Voice & Data Division.
6. Molex Premise Networks; a division of Molex, Inc.
7. Nordex/CDT; a subsidiary of Cable Design Technologies.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110 style for Category 5e Provide blocks for the number of cables terminated on the block, plus 25 percent spare; integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CommScope, Inc.
2. Corning Cable Systems.
3. General Cable Technologies Corporation.
4. Mohawk; a division of Belden CDT.
5. Nordex/CDT; a subsidiary of Cable Design Technologies.
6. Optical Connectivity Solutions Division; Emerson Network Power.

7. Superior Essex Inc.
8. SYSTIMAX Solutions; a CommScope, Inc. brand.
9. 3M.
10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Multimode, 62.5/125-micrometer, 24 -fiber, nonconductive**,** tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA/EIA-568-B.3 for performance specifications.
3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

   a. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR[complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or Type OFCG Plenum Rated, Conductive: Type OFCP complying with NFPA 262.
   e. Riser Rated, Conductive: Type OFCR**;** complying with UL 1666.

5. Conductive cable shall be steel-armored type.
6. Maximum Attenuation: 3.5 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Orange for 62.5/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.6 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements,

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Dynacom Corporation.
6. Hubbell Premise Wiring.
7. Molex Premise Networks; a division of Molex, Inc.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Optical Connectivity Solutions Division; Emerson Network Power.
10. Siemon Co. (The).

B. Cable Connecting Hardware: Comply with the Fiber Optic Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.9 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

D. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Plastic jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.10 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway, complying with UL 83.

B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.

C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or Type TF, complying with UL 83.

2.11 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. HellermannTyton.
3. Kroy LLC.
4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows if possible.

E. Pathway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed or in the corner of room if multiple sheets of plywood are installed around perimeter walls of room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering room from overhead.
4. Extend conduits 3 inches (75 mm) above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

F. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Install 110-style IDC termination hardware unless otherwise indicated.
3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

F. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

G. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 72 inches (1830) long shall be neatly coiled not less than 12 inches (305 mm) in diameter below each feed point.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (305 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (305 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits, No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits, No 12 AWG.

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. For data communication wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling according to TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not after cross connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    b. Link End-to-End Attenuation Tests:

        1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
        2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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: Grounding systems and equipment.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.
2. Grounding arrangements and connections for separately derived systems.
3. Grounding for sensitive electronic equipment.

B. Qualification Data: For qualified testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals, include the following:

1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.

   a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
   b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Bare Grounding Conductor and Conductor Protector for Wood Poles:

1. No. 4 AWG minimum, soft-drawn copper.
2. Conductor Protector: Half-round PVC or wood molding; if wood, use pressure-treated fir, cypress, or cedar.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solder less compression or exothermic - type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: 3/4 inch by 10 feet in diameter. (If Required)

B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch grounding bus.
3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

H. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.4 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

FIELD QUALITY CONTROL

C. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

E. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

F. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal**,** and at individual ground rods. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method according to IEEE 81.

G. Grounding system will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

I. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

J. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Division 26 Section "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.; a division of Cooper Industries.
c. Fabco Plastics Wholesale Limited.
d. Seasafe, Inc.

2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Cooper B-Line, Inc.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes,

transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section " Cast-in-Place Concrete (Limited Applications)."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 29

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. FMC: Flexible metal conduit.

E. IMC: Intermediate metal conduit.

F. LFMC: Liquidtight flexible metal conduit.

G. LFNC: Liquidtight flexible nonmetallic conduit.

H. NBR: Acrylonitrile-butadiene rubber.

I. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.
2. For handholes and boxes for underground wiring, including the following:

a. Duct entry provisions, including locations and duct sizes.
b. Frame and cover design.
c. Grounding details.
d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

D. Manufacturer Seismic Qualification Certification: Submit certification that enclosures and cabinets and their mounting provisions, including those for internal components, will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the cabinet or enclosure will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will retain its enclosure characteristics, including its interior accessibility, after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit or IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel or aluminum.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type EPC-40-PVC**,** unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.

C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Hinged type.

F. Finish: Manufacturer's standard enamel finish.

2.5 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Thomas & Betts Corporation.
   b. Walker Systems, Inc.; Wiremold Company (The).
   c. Wiremold Company (The); Electrical Sales Division.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with SCTE 77.

1. Color of Frame and Cover: Green.
2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 24 inches wide by 36 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armorcast Products Company.
b. Carson Industries LLC.
c. CDR Systems Corporation.
d. NewBasis.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: (over 600V): Rigid steel conduit
2. Exposed Conduit (600V and less): Rigid steel conduit or IMC.
3. Concealed Conduit, Aboveground: Rigid steel conduit or IMC.
4. Underground Conduit (non-primary service): RNC, Type EPC-40-PVC, direct burial.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
7. Application of Handholes and Boxes for Underground Wiring:

    a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
    b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.
    c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit or IMC.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway EMT.
8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a

blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

O. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Q. Set metal floor boxes level and flush with finished floor surface.

R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, 36” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches thickness shall be 0.052 inches.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inches.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by the following, provide products by one of the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).

d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

3. Sealing Elements: EPDM or Nitrile Buna N rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel, Plastic, Stainless steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel, cast-iron, pipe 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.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

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. This Section includes the following:

1. Isolation pads.
2. Spring isolators.
3. Restrained spring isolators.
4. Channel support systems.
5. Restraint cables.
6. Hanger rod stiffeners.
7. Anchorage bushings and washers.

B. Related Sections include the following:

1. Division 26 Section "Hangers and Supports For Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.

a. Component Importance Factor: 1.0.
b. Component Response Modification Factor: 1.5.
c. Component Amplification Factor: 1.0.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 25.9%.
4. Design Spectral Response Acceleration at 1.0-Second Period: 9.92%.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

    a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.

    a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 16 Sections for equipment mounted outdoors.

2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:

    a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
    c. Preapproval and Evaluation Documentation: an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

D. Welding certificates.

E. Qualification Data: For professional engineer.

F. Field quality-control test reports.

G. **Seismic submittal package shall be complete and submitted by Vibra-Conn, Inc., 1-800-379-9119, or equal.**

H. **Engineering Design Criteria shall be provided by Laurel Engineering, (860) 379-6898, contact: Robert Colabella, P.E.**

1.6 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.

8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.

6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

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 will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.

8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch-high letters on 20-inch centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. White letters on black field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.

D. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

D. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I (Over 600V):

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils
3. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.

D. Tag: Type ID (600V and less):

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Overall Thickness: 5 mils
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.

3. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 6-foot maximum intervals.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl tape applied in bands. Install labels at 6-foot maximum intervals.

C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

F. Install instructional sign including thecolor-code for grounded and ungrounded conductors using adhesive-film-type labels.

G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

   a. Power transfer switches.
   b. Controls with external control power connections.

K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
g. Substations.
h. Emergency system boxes and enclosures.
i. Enclosed switches.
j. Enclosed circuit breakers.
k. Enclosed controllers.
l. Variable-speed controllers.
m. Push-button stations.
n. Contactors.
o. Remote-controlled switches, dimmer modules, and control devices.
p. Battery-inverter units.
q. Monitoring and control equipment.

END OF SECTION 26 05 53

SECTION 26 24 16

PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Electronic-grade panelboards.

1.3 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

C. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. 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.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to [NEMA PB 1].

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

   a. Ambient Temperature: Not exceeding [23 deg F (minus 5 deg C)] to plus 104 deg F (plus 40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.11 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. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
c. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
5. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Same finish as panels and trim.

6. Directory Card: Inside panelboard door, mounted in transparent card holder

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
5. Split Bus: Vertical buses divided into individual vertical sections.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
   1. External Control-Power Source: 120-V branch circuit

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. 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:

   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.
   4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
   1. External Control-Power Source: 120-V branch circuit.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.4 ELECTRONIC-GRADE PANELBOARDS

A. 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:

   1. Current Technology; a subsidiary of Danahar Corporation.
   2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   4. Liebert Corporation.
   5. Siemens Energy & Automation, Inc.
   6. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.

F. Buses:

1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
2. Copper equipment and isolated ground buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents. All panels listed as to be replaced shall match existing short circuit ratings.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Communication Capability: Integral communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
i. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
j. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
k. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
l. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
m. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
n. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

I. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

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. This Section includes the following:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Cord and plug sets.

B. Related Sections include the following:

1. Division 26, Section for workstation outlets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. 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.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).

c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; GF20.
b. Pass & Seymour; 2084.

2.4 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; L520R.
b. Hubbell; HBL2310.
c. Leviton; 2310.
d. Pass & Seymour; L520-R.

2.5 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

B. Pilot Light Switches, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 2221PL for 120 V and 277 V.

b. Hubbell; HPL1221PL for 120 V and 277 V.
c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
d. Pass & Seymour; PS20AC1-PLR for 120 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

C. Key-Operated Switches, 120/277 V, 20 A:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 2221L.
b. Hubbell; HBL1221L.
c. Leviton; 1221-2L.
d. Pass & Seymour; PS20AC1-L.

2. Description: Single pole, with factory-supplied key in lieu of switch handle.

D. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 1995.
b. Hubbell; HBL1557.
c. Leviton; 1257.
d. Pass & Seymour; 1251.

E. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper; 1995L.
b. Hubbell; HBL1557L.
c. Leviton; 1257L.
d. Pass & Seymour; 1251L.

2.6 OCCUPANCY SENSORS

A. Wall-Switch Sensors:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Hubbell; AT120 for 120 V, AT277 for 277 V.

b. Leviton; ODS 15-ID.

2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

2.7 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 26 27 26

SECTION 26 28 13

FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, switchboards and enclosed controllers.
2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit on translucent log-log graph paper.
4. Coordination charts and tables and related data.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.5 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.
3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay
2. Feeders: Class RK1, time delay
3. Motor Branch Circuits: Class RK1, time delay.
4. Other Branch Circuits: Class J, time delay.
5. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 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.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Submit on translucent log-log graph paper.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. 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.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, [240] 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Accessory Control Power Voltage: Remote mounted and powered; 24-V ac.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

E. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
11. Electrical Operator: Provide remote control for on, off, and reset operations.
12. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. 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. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device".

END OF SECTION 26 28 16

SECTION 26 51 00

INTERIOR LIGHTING

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 lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 262726 "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.
5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."
6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."
7. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. 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. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:

1. Lamps and ballasts, installed.
2. Cords and plugs.
3. Pendant support system.

D. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) 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. Lighting fixtures.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extends to within 12 inches of the plane of the luminaires.
4. Ceiling-mounted projectors.
5. Structural members to which suspension systems for lighting fixtures will be attached.
6. Other items in finished ceiling including the following:

    a. Air outlets and inlets.
    b. Speakers.
    c. Sprinklers.
    d. Smoke and fire detectors.
    e. Occupancy sensors.
    f. Access panels.

7. Perimeter moldings.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 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. Lamps: 10% of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 10% of each type and rating installed. Furnish at least one of each type.

3. Fluorescent-fixture-mounted, emergency battery pack: One for every 10% emergency lighting unit.
4. Ballasts: 10% of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 10% of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

C. 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.

D. Comply with NFPA 70.

E. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of fixtures for mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
2. Warranty Period for Emergency Fluorescent Ballast and Self-Powered Exit Sign Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, **provide product indicated on Drawings**.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.

C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

K. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Section 233713 "Diffusers, Registers, and Grilles."

1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
2. Heat-Removal Units: Air path leads through lamp cavity.
3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
4. Dampers: Operable from outside fixture for control of return-air volume.
5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: **Class A**
5. Total Harmonic Distortion Rating: Less than [**10**] percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: **42** kHz or higher.
8. Lamp Current Crest Factor: **1.7** or less.
9. BF: **0.88** or higher.
10. Power Factor: **0.95** or higher.

11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts for **T5**, **T8**, **T5HO**, **T5 and T5HO** Lamps as specified: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F) and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F (Minus 29 Deg C) and Higher: Electromagnetic type designed for use with indicated lamp types.

E. Ballasts for Residential Applications: Fixtures designated as "Residential" may use low-power-factor electronic ballasts having a Class B sound rating and total harmonic distortion of approximately 30 percent.

F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.

1. Dimming Range: 100 to **5** percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to **20** percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

   a. High-Level Operation: 100 percent of rated lamp lumens.
   b. Low-Level Operation: 30 percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

I. Ballasts for Tri-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.

   a. High-Level Operation: 100 percent of rated lamp lumens.
   b. Low-Level Operation: **30 and 50** percent of rated lamp lumens.

2. Ballast shall provide equal current to each lamp in each operating mode.
3. Compatibility: Certified by manufacturer for use with specific tri-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: **0.98, except fixtures designated as "Residential" may use low-power-factor electronic ballasts**] or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate Two fluorescent lamp(s) continuously at an output of **1100** lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Nightlight Connection: Operate one fluorescent lamp continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.

5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Nightlight Connection: Operate one fluorescent lamp in a remote fixture continuously.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6 BALLASTS FOR HID LAMPS

A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F) for single-lamp ballasts.
3. Rated Ambient Operating Temperature: 104 deg F.
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F for single-lamp ballasts.
2. Rated Ambient Operating Temperature: 130 deg F.
3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.

5. Total Harmonic Distortion Rating: Less than **20** percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
10. Protection: Class P thermal cutout.
11. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.

    a. High-Level Operation: 100 percent of rated lamp lumens.
    b. Low-Level Operation: [**35**] [**50**] percent of rated lamp lumens.
    c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.

12. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.

    a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.

C. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
2. Minimum Starting Temperature: Minus 40 deg F.

2.7 QUARTZ LAMP LIGHTING CONTROLLER

A. General Requirements for Controllers: Factory installed by lighting fixture manufacturer. Comply with UL 1598.

B. Standby (Quartz Restrike): Automatically switches quartz lamp on when a HID lamp in the fixture is initially energized and during the HID lamp restrike period after brief power outages.

C. Connections: Designed for a single branch -circuit connection.

D. Switching Off: Automatically switches quartz lamp off when HID lamp strikes.

E. Switching Off: Automatically switches quartz lamp off when HID lamp reaches approximately 60 percent light output.

2.8 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
    g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

4. Master/Remote Sign Configurations:

    a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply, ballast or battery for power connection to remote unit.
    b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery, and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

C. Self-Luminous Signs: Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 20 years.

D. Self-Luminous Signs: Using strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Provide with universal bracket for flush-ceiling, wall, or end mounting.

2.9 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of **15** minutes when power is restored after an outage.
8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
10. Emergency lights shall have a full 90 minute test and certified by testing agency in writing.

2.10 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life 20,000 hours unless otherwise indicated.

B. T8 rapid-start lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

C. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

D. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours unless otherwise indicated.

E. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 4100 K, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
6. 57 W: T4, triple tube, rated 4300 initial lumens (minimum).
7. 70 W: T4, triple tube, rated 5200 initial lumens (minimum).

2.11 HID LAMPS

A. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65 and color temperature 4000 K.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

D. Low-Pressure Sodium Lamps: ANSI 78.41, CRI 0, and color temperature 1800 K.

2.12 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel,12 gage (2.68 mm.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect/Engineer, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

1. Install ceiling support system rods or wires[, independent of the ceiling suspension devices,] for each fixture. Locate not more than 6 inches from lighting fixture corners.
2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

E. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect/Engineer.

END OF SECTION 265100

SECTION 26 56 00

EXTERIOR LIGHTING

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. Exterior luminaires with lamps and ballasts.

B. Related Sections:

1. Division 26 Section "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

H. Delete paragraph below if Project is outside the area shown in AASHTO LTS-4, Figure 1.2.3.

1.4 SUBMITTALS

A. Product Data: For each luminaire, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

    a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
    b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, CCT, CRI, lumens and energy-efficiency data.

B. Shop Drawings: 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. Samples: For products designated for sample submission in Exterior Lighting Device Schedule. Each Sample shall include lamps and ballasts.

D. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

E. Field quality-control reports.

F. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

G. Warranty: Sample of special warranty.

H. Lighting shall be full cutoff type fixtures.

1.4 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

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.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard polyester powder coat applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. “USES ONLY” and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming.

3.2 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.3 GROUNDING

A. Ground lighting fixtures and support fixtures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each light fixture, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-64, "Photometric Measurements of Parking Areas."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.

END OF SECTION 26 56 00

SECTION 28 31 11

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. System duct smoke detectors.
   2. Addressable interface device.
   3. Fire alarm wire and cable.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect/Engineer.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. NICET-certified fire-alarm technician, Level III minimum.
    b. Licensed Professional Engineer.

B. Product Data: For each type of product indicated.

C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
8. Coordinate final room numbers with the signage submittal for proper system programming.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

E. Qualification Data: For qualified Installer.

F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

G. Field quality-control reports.

H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 25.

I. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. 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.

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
3. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, the following:

1. Fire Lite Alarms Inc. or equal.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Duct smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators. The room number of the tripped alarm shall be displayed.
3. Transmit an alarm signal to the remote alarm receiving station.

4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
9. Recall elevators to primary or alternate recall floors.
10. Activate emergency shutoffs for gas and equipment under kitchen hood.
11. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.4 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Each sensor shall have multiple levels of detection sensitivity.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.5 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Adapter plate for outlet box mounting.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Continuous Linear Heat-Detector System:

1. Detector Cable: Rated detection temperature 155 deg F (68 deg C). NRTL listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short- circuit wires at the location of elevated temperature.
2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.6 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

D. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
2. High-Range Units: Rated 2 to 15 W.
3. Mounting: Flush.
4. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.7 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

2.8 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

2.12 FIRE ALARM WIRE AND CABLE

A. 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:
1. Comtran Corporation
2. Draka Cableteq USA
3. Genesis Cable Products; Honeywell International, Inc.
4. Rockbestos-Suprenant Cable Corp.
5. West Penn Wire; a brand of Belden Inc.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-Voltage Circuits: No. 16 AWG, minimum.
2. Line-Voltage Circuits: No. 12 AWG, minimum.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet (9 m).
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A or Appendix B in NFPA 72.
5. HVAC: Locate detectors not closer than 5 feet (1.5 m) from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

D. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

E. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

H. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

I. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

J. All low voltage wiring terminated to the fire alarm system shall be PLENUM RATED with no exceptions and no less than No. 16 AWG in size, and solid copper.

3.2 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method

1. Install rated plenum cable in building.
2. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
3. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted.
4. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.
2. Alarm-initiating connection to elevator recall system and components.
3. Alarm-initiating connection to activate emergency shutoffs for gas and kitchen equipment under hood.
4. Supervisory connections at valve supervisory switches.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 16 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

J. All smoke detectors shall be cleaned/ vacuumed by the contractor prior to turn over of system to owner.

K. Fire alarm system software and required trouble shooting devices shall be provided to the owner at turnover.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Minimum training shall be in accordance with Division 1 Requirements.

END OF SECTION 28 31 11