

Project Manual



TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID

Hopkinton Fire Department Headquarters
73 Main Street
Hopkinton, Massachusetts 01748

Bid #24-05-002IFB

Bid Documents – March 27, 2024 (Rebid)

OWNER / AWARDING AUTHORITY

THE TOWN OF HOPKINTON acting by and through its TOWN MANAGER and SELECT BOARD
Town Hall
18 Main Street
Hopkinton, Massachusetts 01748

ARCHITECT

GORMAN RICHARDSON LEWIS ARCHITECTS, INC.
239 South Street
Hopkinton, Massachusetts 01748

ENGINEER

R.W. SULLIVAN ENGINEERING
The Schrafft Center, 529 Main Street, Suite 203
Boston, Massachusetts 02129-1107

GRLA Project No. 2019023.01

PROJECT MANUAL

PROJECT: TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

BID NUMBER: 24-05-002IFB

OWNER/AWARDING AUTHORITY: TOWN OF HOPKINTON, MASSACHUSETTS
acting by and through its

Town Manager: Norman Khumalo

Select Board: Muriel Kramer, Chair
Shahidul Mannan, Vice Chair
Mary Jo LaFreniere, Member
Irfan Nasrullah, Member
Amy Ritterbusch, Member

Town Engineer: Dave Daltorio, P.E.

Fire Department: Gary T. Daugherty Jr., Chief

Procurement & Grants Manager: Maureen McKeon

DESIGN TEAM

ARCHITECT: GORMAN RICHARDSON LEWIS ARCHITECTS, INC.
239 South Street
Hopkinton, Massachusetts 01748
Telephone: 508-544-2600

STRUCTURAL ENGINEERING: DeSIMONE CONSULTING ENGINEERS
60 Man Mar Drive, Unit #2
Plainville, Massachusetts 02762
Telephone: 508-384-0163

MECHANICAL & ELECTRICAL
ENGINEERING: R.W. SULLIVAN ENGINEERING (RWS)
The Schrafft Center, 529 Main Street, Suite 203
Boston, Massachusetts 02129-1107
Telephone: 627-523-8227

SPECIFICATIONS CONSULTANT: PAUL DIBONA SPECIFICATIONS LLC
108 Hayden Rowe Street
Hopkinton, Massachusetts 01748-2508
Telephone: 508-625-1098

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* These documents shall be submitted with the General Bid.

** These documents shall be submitted with each Sub-bid.

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Not Used.

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* These documents shall be submitted with the General Bid.
** These documents shall be submitted with each Sub-bid.

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LIST OF DRAWINGS

PART 1 - GENERAL

1.01 DRAWING LIST

- A. The List of Drawings for TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE – REBID at Hopkinton Fire Department Headquarters, 73 Main Street, Hopkinton, Massachusetts 01748; is as follows:

<u>Drawing No.</u>	<u>Date of Issue</u>	<u>Rev. No.</u>	<u>Rev. Date</u>	<u>Drawing Title</u>
GENERAL (G-Series)				
G0.0	03/27/24	-	-	COVER SHEET
G0.1	03/27/24	-	-	CODE ANALYSIS AND GENERAL NOTES
EXISTING CONDITIONS (EX- Series)				
EX1.1	03/27/24	-	-	EXISTING FIRST FLOOR PLAN
EX1.2	03/27/24	-	-	EXISTING SECOND FLOOR PLAN
ARCHITECTURAL (A- Series and AD- Series)				
AD1.3	03/27/24	-	-	DEMOLITION ROOF PLAN
AD2.1	03/27/24	-	-	DEMOLITION 1ST FIRST REFLECTED CEILING PLAN
AD2.2	03/27/24	-	-	DEMOLITION SECOND FLOOR REFLECTED CEILING PLAN
A1.3	03/27/24	-	-	CONSTRUCTION ROOF PLAN
A2.1	03/27/24	-	-	1ST FLOOR REFLECTED CEILING PLAN
A2.2	03/27/24	-	-	SECOND FLOOR REFLECTED CEILING PLAN
A7.0	03/27/24	-	-	TYPICAL ROOF DETAILS

<u>Drawing No.</u>	<u>Date of Issue</u>	<u>Rev. No.</u>	<u>Rev. Date</u>	<u>Drawing Title</u>
STRUCTURAL (S- Series)				
S-1.0	03/27/24	-	-	ROOF FRAMING PLAN AND GENERAL NOTES
FIRE ALARM (FA- Series and FAD- Series)				
FA0.0	03/27/24	-	-	FIRE ALARM LEGEND AND GENERAL NOTES
FA1.2	03/27/24	-	-	FIRE ALARM SECOND FLOOR PLAN
FA1.3	03/27/24	-	-	FIRE ALARM ROOF PLAN
FAD1.2	03/27/24	-	-	FIRE ALARM DEMOLITION SECOND FLOOR PLAN
MECHANICAL (H- Series and HD- Series)				
H-000	03/27/24	-	-	HVAC LEGEND AND GENERAL NOTES
H-001	03/27/24	-	-	HVAC SCHEDULES
H-002	03/27/24	-	-	HVAC DETAILS SHEET NO. 1
H-003	03/27/24	-	-	HVAC DETAILS SHEET NO. 2
H-101	03/27/24	-	-	HVAC FIRST FLOOR PLAN
H-102	03/27/24	-	-	HVAC SECOND FLOOR DUCTWORK PLAN
H-102P	03/27/24	-	-	HVAC SECOND FLOOR PIPING PLAN
H-103	03/27/24	-	-	HVAC ROOF PLAN
HD-101	03/27/24	-	-	HVAC DEMOLITION FIRST FLOOR PLAN
HD-102	03/27/24	-	-	HVAC DEMOLITION SECOND FLOOR DUCTWORK PLAN
HD-102P	03/27/24	-	-	HVAC DEMOLITION SECOND FLOOR PIPING PLAN
HD-103	03/27/24	-	-	HVAC DEMOLITION ROOF PLAN
ELECTRICAL (E- Series and ED-Series)				
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<u>Drawing No.</u>	<u>Date of Issue</u>	<u>Rev. No.</u>	<u>Rev. Date</u>	<u>Drawing Title</u>
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E1.1	03/27/24	-	-	ELECTRICAL FIRST FLOOR PLAN
E1.2	03/27/24	-	-	ELECTRICAL SECOND FLOOR PLAN
E1.3	03/27/24	-	-	ELECTRICAL ROOF PLAN
E3.0	03/27/24	-	-	ELECTRICAL RISER AND SCHEDULES
ED1.1	03/27/24	-	-	ELECTRICAL DEMOLITION FIRST FLOOR PLAN
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ED1.3	03/27/24	-	-	ELECTRICAL DEMOLITION ROOF PLAN

INFORMATIONAL DRAWINGS (prepared by The Carell Group)

<i>H-1</i>	<i>8/8/96</i>			<i>FIRST FLOOR HVAC PLAN AND BASEMENT</i>
<i>H-2</i>	<i>8/8/96</i>			<i>SECOND FLOOR HVAC PLAN</i>

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF DOCUMENT

DOCUMENT 00 02 00

INVITATION TO BID

1.01 RE-BID OF PREVIOUSLY BID 2023 PROJECT

- A. Please note that this Project is being rebid. The project was put out to bid in 2023; bids were received and bids exceeded the Awarding Authority's budget. Subsequently additional monies have been approved by the Town and the project is going out to bid again.

1.02 RECEIPT OF BIDS

- A. The **Town of Hopkinton**, the Awarding Authority, invites sealed bids for rebidding of the project - **HVAC Upgrades at the Fire Department Headquarters**, located at 73 Main Street, Hopkinton, Massachusetts, in accordance with the documents prepared by the Architect, Gorman Richardson Lewis Architects.
- B. The scope of work includes the removal, disposal, and replacement of rooftop HVAC equipment and related ductwork and all associated work, electrical system upgrades, structural roof reinforcement, roof patching and related work, replacement acoustical ceilings, painting, drywall, and a new building management system including all system control and monitoring points, as indicated on the Bidding and Contract Documents.
- C. Copies of this IFB can be viewed and downloaded by visiting the Town of Hopkinton's website for free beginning on 3/27/2024. There will be a \$75 fee if you wish to obtain hard copy bid documents and plans. A non-mandatory pre-bid conference will take place at the Main Fire Station, 73 Main St., Hopkinton, MA 01748 at 10 a.m. on 4/3/2024.
- D. Sealed bids shall be submitted on a form furnished by the Awarding Authority and clearly identified as a bid, endorsed with the name and address of the bidder, and the name of the project no later than the times set forth below.
- E. Sealed responses (hard copy only) must be received at the Town's Procurement Office located at Town Hall, 18 Main Street, 2nd Floor, Hopkinton, MA 01748 no later than 10 am on April 10, 2024 for Filed Sub Bids (Heating, Ventilating and Air Conditioning and Electrical) and 10 a.m. on April 24, 2024 for General Contractor Bids.
 - 1. All laws pertaining to M.G.L. c.149 for Building Construction must be adhered to for this project, including the payment of State-issued prevailing wage rates.
 - 2. Bids submissions from sub bidders will be opened publicly on April 10, 2024 at 10 a.m. at Town Hall and bid submission from General Contracts will be opened publicly on April 24, 2024 at 10 a.m. at Town Hall.
- F. The Town reserves the right to reject any and all bids/proposals, to waive informalities and to award in the best interest of the Town. All MGL Procurement Laws pertaining to c. 149/c.30/39M/c. 30B, including min. wage requirements, apply to this bid. The Town of Hopkinton, the Awarding Authority, is an EOE employer and encourages sealed bids from Massachusetts-certified minority and women-owned businesses.

1.03 QUALIFICATIONS OF BIDDERS

- A. In order to be eligible and responsible to bid on this project, General Bidders and Filed Sub-bidders shall submit with their bid, issued by the Division of Capital Asset Management and Maintenance, a current Certificate of Eligibility, and an Update Statement.

1. General Bidders must be certified by the Division of Capital Asset Management and Maintenance (DCAMM) in the category of **General Construction**.

1.04 BIDDING REQUIREMENTS

- A. Bidding procedures shall be in accordance with the provisions of M.G.L Chapter 149, Section 44A through Section 44J, inclusive, and Chapter 30, Section 39M, as amended.
- B. Bid security is required in the form of a bid bond, cash, certified check, treasurer's or cashier's check made payable to the Town of HOPKINTON in the amount of five percent (5%) of the total bid amount.
- C. The successful bidder must furnish 100% Performance Bond and a Labor and Materials Bond. The estimated value of this contract is \$900,000.
- D. Materials, equipment and supplies to be used on this project are exempt from sales tax to the extent provided by M.G.L. Chapter 66H, Section 6(f).
- E. Prevailing Wage Rates as determined by the Director of the Executive Office of Labor and Workforce Development under the provisions of the Massachusetts General Laws Chapter 149, Section 26 to 27H, as amended, apply to this project.
- F. All questions regarding this procurement shall be directed *in writing* via email to the Procurement & Grants Manager, Maureen McKeon at mmckeon@hopkintonma.gov.

1.05 PROJECT DURATION

- A. Duration of Project: 105 calendar days from the Notice to Proceed to Substantial Completion. Refer to Document 00 31 00, FORM FOR GENERAL BID.

1.06 SALES TAX EXEMPTION

- A. Materials, equipment and supplies to be used on this project are exempt from sales tax to the extent provided by M.G.L. Chapter 66H, Section 6(f).

1.07 LIQUIDATED DAMAGES

- A. Liquidated damages for not completing the work within the time limit specified above will be assessed by the Owner.
 1. The liquidated damages amount per calendar day is a minimum damage figure to compensate the Owner for administrative costs and loss or delay of its use of the project, and for added Owner's Project Manager, Architect and consultant fees, and does not limit in any way the liability of the Contractor for damages in excess of the specified liquidated damages amount for other damages, in particular, damages for breach of Contract. It is expressly understood that such liquidated damages do not constitute a penalty.
 2. Liquidated damages will be five hundred dollars (\$500.00) per calendar day.

1.08 REQUIREMENTS OSHA APPROVED SAFETY AND HEALTH TRAINING

- A. OSHA-Approved Safety and Health Training: Be advised that Massachusetts law has been enacted that requires all employees who work on Massachusetts public works construction sites must have no less than 10 hours of OSHA-approved safety and health training. See Chapter 306 of the Acts of 2004.

1.09 BIDDER'S AGREEMENT TO HOLD BID

- A. The bidder agrees that its bid shall be good and may not be withdrawn for a period of 30 days, Saturdays, Sundays and legal holidays excluded, after the opening of the bids.

1.10 COMPLIANCE WITH PROVISIONS OF MASSACHUSETTS GENERAL LAWS

- A. All bids for this project are subject to applicable public bidding laws of the Commonwealth of Massachusetts, including M.G.L. c.149, §44A through 44J, as amended.
- B. The Awarding Authority is exempt from sales and federal excise tax to the extent permitted under law; bidders should not include such taxes in figuring or in references to any bid.
- C. Attention is directed to the minimum wage rates to be paid as determined by the Commissioner of Labor and Workforce Development, Division of Occupational Safety, under the provisions of Commonwealth of Massachusetts General Laws, Chapter 149, Section 26 and 27D inclusive; a copy of which is included in the Contract Documents, and will be made a part of the Contract.
- D. Attention is further directed to the requirements of Massachusetts M.G.L. c.149, §44D requiring submission of a DCAMM approved Contractor's 'Certificate of Eligibility (Form CQ7)' and 'Update Statement (Form CQ3)' for each General Bidder and each Filed Sub-bidder.
- E. Commonwealth of Massachusetts General Laws are incorporated herein by reference. Any inconsistency between the Invitation to Bid, Instructions to Bidders, Bid Form, Conditions of the Contract, and any other Bidding Documents and these statutes, or any other applicable statutes, bylaws, or regulations existing on the date on which the bids are to be received, shall not be grounds for invalidating the bid solicitation procedures, but, where required by law, such statute, bylaw, or regulation shall be deemed to govern.
- F. Reference is made also to the following:
 - 1. Document 00 31 00, FORM FOR GENERAL BID.
 - 2. Document 00 35 00, FORM FOR SUB-BID.
 - 3. Document 00 51 00, AGREEMENT.
 - 4. Document 00 80 00, GENERAL CONDITIONS.

1.11 AWARD OF CONTRACT AND AWARDING AUTHORITY PROVISIONS

- A. Selection of the Contractor will be based upon bidder qualifications, including evidence of past performance in similar projects, and bid price. The Contract will be awarded to the bidder deemed by the Awarding Authority to be the lowest responsible and eligible bidder.
- B. The TOWN OF HOPKINTON is an affirmative action/equal opportunity owner and encourages participation from certified minority and women-owned businesses (M/WBE).

- C. The Awarding Authority reserves the right to waive any informalities in or to reject any or all bids, or take whatever other action may be deemed to be in the public interest to do so, and to act upon the bids and make its award in any lawful manner.

TOWN OF HOPKINTON, MASSACHUSETTS, acting by and through its:

Town Hall
18 Main Street
Hopkinton, Massachusetts 01748

Town Manager:	Norman Khumalo
Select Board:	Muriel Kramer, Chair Shahidul Mannan, Vice Chair Mary Jo LaFreniere, Member Irfan Nasrullah, Member Amy Ritterbusch, Member
Town Engineer:	Dave Daltorio, P.E.
Fire Department:	Gary T. Daugherty Jr., Chief
Procurement & Grants Manager:	Maureen McKeon

END OF DOCUMENT

DOCUMENT 00 10 00

INSTRUCTIONS TO BIDDERS

1.00 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

2.00 RECEIPT AND OPENING OF BIDS

- A. The **TOWN OF HOPKINTON, MASSACHUSETTS**, hereinafter called the Owner or Awarding Authority, acting through its **TOWN MANAGER** and its **SELECT BOARD** will receive sealed Bids in accordance with the requirements of Document 00 02 00, INVITATION TO BID.
- B. Any bid may be withdrawn prior to the above scheduled time for the opening of bids or authorized postponement thereof. Any bid received after the time and date specified will not be considered. The bidder agrees that this bid shall be good and may not be withdrawn for a period of 30 days, Saturdays, Sundays, and legal holidays excluded, after the opening of bids.
- C. RE-BID OF PREVIOUSLY BID PROJECT IN 2023: Please note that this is Project is being rebid. The project was put out to bid in 2023; bids at were received and bids exceeded the Awarding Authority's budget. Subsequently additional monies have been approved by the Town and the project is being rebid.

3.00 COMPLEMENTARY DOCUMENT

- A. Document 00 02 00, INVITATION TO BID, included herewith, is complementary to this document and shall be carefully reviewed by Bidders for specific instructions which are not repeated herein.

4.00 STATUTES REGULATING COMPETITIVE PROPOSAL SOLICITATION

- A. Proposal solicitation procedures and award of contract shall be in accordance with the General Laws of the Commonwealth of Massachusetts, including all current amendments.
- B. In the event of any discrepancy or inconsistency between the provisions of these Document 00 10 00, INSTRUCTIONS TO BIDDERS and Document 00 02 00, INVITATION TO BID and the above-mentioned statutes, the provisions of the above-mentioned statutes shall govern. In such event, the application of all remaining provisions not in conflict to any circumstance other than that in which the conflict occurs shall not be affected thereby.

5.00 BIDDER'S QUALIFICATIONS

- A. No individual or firm may submit a Proposal unless it includes, in the Bid Form, a list of at least three (3) references of similar projects completed in the last five (5) years.
- B. The Awarding Authority will reject bids when required to do so by the above- referenced General Laws. In addition, the Awarding Authority reserves the right to waive any informalities in proposal solicitation and to reject any and all bids if it deems to be in the public interest to do so. Also, the Awarding Authority reserves the right to reject any bid if it determines that such bid does not represent the bid of a person or firm competent to perform the work as specified, or if less than three bids are received, or if proposed prices are not acceptable without further competition.

6.00 INTERPRETATION OF DOCUMENTS: NOTIFICATION OF ERRORS

- A. Interpretation of the provisions of the Bidding Documents will be made by the Architect, **GORMAN RICHARDSON LEWIS ARCHITECTS, INC (GRLA)**, attention: **George O'Neill, Project Manager**, Goneill@grlarchitects.com, upon written request of any Bidder, provided that such request is received by the Architect at least five (5) business days prior to date of applicable proposal opening, and that the Architect considers such interpretation to be of sufficient importance. Oral or telephone interpretations will not generally be made, and if made, shall be strictly informal and not legally valid or binding.
- B. Architect's interpretations shall be in the form of Addenda to the Bidding Documents.
- C. Bidders are urged to communicate all errors or discrepancies found in the Bidding Documents to the Architect. Telephone calls pointing out any such errors or discrepancies will be taken by the Architect, but only for the purpose of receiving the information in order that it may be properly processed, and not for interpretation or clarification.

7.00 EXAMINATION OF BIDDING DOCUMENTS AND SITE

- A. Each bidder shall carefully examine the Bidding Documents to obtain a thorough understanding of the work of his bid in addition to work of related trades. In addition, each bidder shall personally visit the site to become thoroughly acquainted with the conditions as they exist thereon.
- B. Failure of any bidder to thoroughly examine the Bidding Documents or to visit and examine the site shall in no way relieve the bidder of any obligation with respect to his bid or of any responsibility assigned the bidder under the Contract.

8.00 PRE-BID SITE VISIT

- A. Pre-bid site visit (optional) will be held at location and time stipulated in the Document 00 02 00, INVITATION TO BID.

9.00 MODIFICATION AND WITHDRAWAL OF BIDS

- A. Modifications of bids will be permitted after submission of such bids provided clearly written, readily understandable instructions for same are received by the Awarding Authority in writing prior to time established for opening of such bids.
- B. No bid may be withdrawn for a period of thirty (30) days, excluding Saturdays, Sundays, and legal holidays, after actual date of the bid opening.

10.00 ADDENDA

- A. Addenda may be required during the proposal solicitation period to modify, clarify, or interpret the Bidding Documents. It is intended, but not guaranteed, that such Addenda shall be issued per Document 00 02 00, INVITATION TO BID and this Document 00 10 00, INSTRUCTIONS TO BIDDERS. Failure to receive such Addenda shall in no way relieve any bidder from the execution of its provisions. All bidders are cautioned to verify the number of Addenda that have been issued and to secure any needed addenda before submitting a bid.

11.00 ALTERNATES

- A. Refer to BID FORMS – (Document 00 31 00, FORM FOR GENERAL BID and Document 00 35 00, FORM FOR SUB-BID) and Section 01 23 00, ALTERNATES.

12.00 UNIT PRICES

- A. (Not Applicable).

13.00 BONDS

- A. A performance bond for the faithful performance of the Contract in an amount equal to 100 percent of the total amount of the bid with a surety company qualified to do business in the Commonwealth of Massachusetts and meeting requirements of MGL will be required.
- B. A payment bond (labor and materials payment bond) in an amount equal to 100 percent of the total amount of the bid with a surety company qualified to do business in the Commonwealth of Massachusetts and meeting requirements of MGL will be required.

14.00 FOREIGN CORPORATIONS

- A. The attention of Bidders is called to the General Laws, Chapter 30, Section 39L, as amended by The Acts of 1967, Chapter 3, under which the Awarding Authority may not enter into a contract with a foreign corporation (a corporation not organized under the Laws of Massachusetts), nor approve a foreign corporation as a contractor, unless the foreign corporation has filed with the Awarding Authority a certificate by the State Secretary stating that the foreign corporation has complied with General Laws, Chapter 181, Sections 3 and 5, and stating the date of such compliance.

15.00 AWARD OF CONTRACT

- A. The Contract will be awarded to the lowest responsible, competent and eligible bidder except in the event of substitution as provided under Chapter 149, Sections 44E and 44F of the above-referenced General Laws.

16.00 COMMENCEMENT AND COMPLETION OF WORK

- A. The successful bidder, upon execution of the Contract Agreement, which may constitute as the Notice to Proceed unless specifically indicated by Awarding Authority otherwise, shall commence the work of the Contract within seven (7) calendar days. Thereafter the Contractor shall diligently and continuously carry on the work in such manner as to substantially complete the work of on or before the date as stipulated in Document 00 51 00, AGREEMENT.
- B. Duration of Project: The duration of this Project to Substantial Completion shall be 105 calendar days from date of Notice to Proceed or date of Contract Agreement.

17.00 LIQUIDATED DAMAGES

- A. Liquidated damages for not completing the work within the time limit specified above will be assessed by the Owner. Liquidated damages will be in the amount as stipulated Document 00 51 00, AGREEMENT.
 - 1. The liquidated damages amount per calendar day is a minimum damage figure to compensate the Owner for administrative costs and loss or delay of its use of the project, and for added Owner's Project Manager, Architect and consultant fees, and does not limit in any way the liability of the Contractor for damages in excess of the specified liquidated damages amount for other damages, in particular, damages for breach of Contract. It is expressly understood that such liquidated damages do not constitute a penalty.
 - 2. Liquidated damages will be five hundred dollars (\$500.00) per calendar day.

18.00 PROPRIETARY MATERIALS

- A. Attention is directed to the provisions of MGL Chapter 30, Section 39M, which require full competition on each item of material to be furnished under contracts for public work, except those items recorded in the public record of the Awarding Authority (TOWN OF HOPKINTON) deemed to be in the public interest.

19.00 FORMS/DOCUMENTS TO BE SUBMITTED WITH BIDS

- A. General Bids: All General Bids shall be submitted using Document 00 31 00, FORM FOR GENERAL BID. The following Documents shall be submitted with this BID FORM:
1. Bid Bond / Bid Security: 5% bid bond; refer to Document 00 31 70, BID SECURITY FORM.
 2. DCAMM Prime / General Contractor Update Statement for Certification; refer to Document 00 31 20, DCAMM PRIME / GENERAL CONTRACTOR UPDATE STATEMENT.
 3. Non-Collusion Affidavit; refer to Document 00 31 50, FORM OF NON-COLLUSIVE AFFIDAVIT OF GENERAL BIDDER.
 4. Tax Compliant Certificate; refer to Document 00 31 60, CERTIFICATE OF TAX COMPLIANCE.
- B. Filed Sub-bids: All Filed Sub-bids shall be submitted using Document 00 35 00, FORM FOR SUB-BID. The following Documents shall be submitted with this SUB-BID FORM:
1. DCAMM Sub-bidder Update Statement for Certification; refer to Document 00 35 20, DCAMM SUB-BIDDER UPDATE STATEMENT.
 2. Non-Collusion Affidavit; refer to Document 00 35 50, FORM OF NON-COLLUSIVE AFFIDAVIT OF SUBCONTRACTOR.

20.00 THE TOWN OF HOPKINTON BY-LAWS AND ZONING BY-LAWS

- A. The Town of Hopkinton By-Laws and Zoning By-Laws are included by reference as part of the Contract Documents. Contractor shall abide by all applicable by-laws.

END OF DOCUMENT

DOCUMENT 00 23 00

EXISTING CONDITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 INFORMATION NOT GUARANTEED

- A. Information on the Drawings and in the Project Manual relating to existing conditions of building and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor, and the accuracy or completeness of this information is not guaranteed.

1.03 EXISTING CONDITIONS

- A. Coordinate and comply with requirements regarding use of the site, buildings, access, dumpster locations, utilities, and related facilities, as agreed to between the Owner and the Contractor.
- B. Information on existing conditions, such as existing building(s) dimensions, existing building(s) construction and similar information, which is bound with the Contract Documents or otherwise made available to the Contractor was obtained by the Owner for use by the Architect in the design of the Project.
 - 1. Accuracy and Completeness: The Owner and Architect do not warrant or contend that this information is complete or accurate. The Contractor may use this information at his sole risk and judgment.
 - 2. Concealed Conditions: No claim for extra cost or extension of time may be made because of the use of this information by the Contractor, except as provided in the Conditions of the Contract regarding *Concealed Conditions*. The Contractor may obtain additional information on existing conditions at his sole expense, if prior approval is obtained from the Owner.
- C. Contractor's Responsibilities:
 - 1. The Contractor shall become thoroughly familiar with the existing information and shall carefully examine the existing record information prior to construction including attachment, cutting, and drilling to avoid accidental damage to existing conditions including utilities and to avoid cutting structure not specifically indicated to be cut.
 - 2. The Contractor shall examine existing building and structure to verify existing conditions including building and elevations, dimensions, and locations and conditions affecting proposed renovations and improvements.
- D. Asbestos and Other Hazardous Materials Abatement: It is not anticipated that the existing building structure, piping, finishes, equipment, and building areas may contain asbestos-containing materials (ACM) or other hazardous materials. If asbestos or other hazardous material is found on the site and recognized as such, all work will cease without penalty to the Contractor or Architect so that the Owner can take appropriate steps for its legal removal and disposal.

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF DOCUMENT

BIDDERS' CHECKLIST

This checklist is provided to assist Bidders (General Bidders and File Sub-bidders) in determining what documents are required to be submitted with each bid.

GENERAL BIDS: EACH GENERAL BID SHALL BE ACCOMPANIED BY:

1. Form For General Bid: Refer to Document 00 31 00, FORM FOR GENERAL BID.
2. DCAMM Certificate of Eligibility and a signed DCAMM Prime/General Contractor Update Statement: Refer to Document 00 31 20, DCAMM PRIME/GENERAL CONTRACTOR UPDATE STATEMENT.
3. Certificate as to Corporate Bidder: Refer to Document 00 31 40, CERTIFICATE AS TO CORPORATE BIDDER.
4. Non-Collusive Affidavit of General Bidder: Refer to Document 00 31 50, FORM OF NON-COLLUSIVE AFFIDAVIT OF GENERAL BIDDER.
5. Certificate of Tax Compliance: Refer to Document 00 31 60, CERTIFICATE OF COMPLIANCE WITH TAX LAWS.
6. Bid Bond: Refer to Document 00 31 70, BID SECURITY FORM.

FILE SUB-BIDS: EACH FILE SUB-BID SHALL BE ACCOMPANIED BY:

1. Form for Sub-bid: Refer to Document 00 35 00, FORM FOR SUB-BID.
2. DCAMM Certificate of Eligibility and a signed DCAMM Sub-bidder Update Statement: Refer to Document 00 35 20, DCAMM SUB-BIDDER UPDATE STATEMENT.
3. Non-Collusive Affidavit of Subcontractor: Refer to Document 00 35 50, FORM OF NON-COLLUSIVE AFFIDAVIT OF SUBCONTRACTOR.

END OF CHECKLIST

DOCUMENT 00 31 00

FORM FOR GENERAL BID

TO: The **TOWN OF HOPKINTON, MASSACHUSETTS** acting by and through its **TOWN MANAGER** and its **SELECT BOARD** (hereinafter called "Awarding Authority" or "Owner")

A. The Undersigned (hereinafter referred as "Bidder"), proposes to furnish all labor and materials required for construction of:

**TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS**

73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

in accordance with the accompanying Bidding and Contract Documents (Plans and Specifications) prepared by the Architect, **GORMAN RICHARDSON LEWIS ARCHITECTS, INC.**, for the Base Bid Contract Price specified below, subject to additions and deductions according to the terms of the Specifications.

B. ADDENDA: This Bid includes Addenda numbered _____

C. BASE BID CONTRACT PRICE: The proposed Base Bid Contract Price is _____

Dollars (\$ _____).

For Alternate No. ___ Add \$ _____ Subtract \$ _____

For Alternate No. ___ Add \$ _____ Subtract \$ _____

For Alternate No. ___ Add \$ _____ Subtract \$ _____

D. SUBDIVISION OF CONTRACT PRICE: The subdivision of the proposed Contract Price is as follows:

Item 1. The work of the General Contractor, being all work other than that covered by Item 2:

_____.

Item 2. Sub-bids as follows:

<u>Sub Trade / Section No.</u>	<u>Name of Sub-bidder</u>	<u>Amount</u>	<u>Bonds required indicated by 'Yes' or 'No'</u>
------------------------------------	---------------------------	---------------	--

HVAC _____ \$ _____
Section 23 00 01, HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) _____

<u>Sub Trade / Section No.</u>	<u>Name of Sub-bidder</u>	<u>Amount</u>	<u>Bonds required indicated by 'Yes' or 'No'</u>
ELECTRICAL WORK Section 26 00 01, ELECTRICAL WORK	_____	\$ _____	_____

- E. SCHEDULE OF UNIT PRICES: (Not Applicable).
- F. COMMENCEMENT OF WORK AND SUBSTANTIAL COMPLETION DATE
1. The Bidder hereby agrees to commence work under this Contract on or before a date to be specified in written "Notice to Proceed" issued by the Owner, and to thereafter diligently and continuously carry on the Work.
 2. Substantial Completion Date: The undersigned agrees to substantially complete the Work within 105 days from the date established in the Notice to Proceed.
- G. LIQUIDATED DAMAGES: Liquidated damages for not completing the work within the time limit specified above will be assessed by the Owner. Liquidated damages will be in the amount as stipulated Document 00 51 00, AGREEMENT.
1. The liquidated damages amount per calendar day is a minimum damage figure to compensate the Owner for administrative costs and loss or delay of its use of the project, and for added Owner's Project Manager, Architect, and consultant fees, and does not limit in any way the liability of the Contractor for damages in excess of the specified liquidated damages amount for other damages, in particular, damages for breach of Contract. It is expressly understood that such liquidated damages do not constitute a penalty.
 2. Liquidated damages for this Project will be five hundred dollars (\$500.00) per calendar day.
- H. EXECUTION OF CONTRACT AND BONDS: The undersigned agrees that, if selected as General Contractor, he will within five (5) days, Saturdays, Sundays and legal holidays excluded, after presentation thereof by the Awarding Authority, execute a Contract in accordance with the terms of this Bid and furnish a 100% Performance Bond and a 100% Labor and Materials Payment Bond, of a surety company qualified to do business under the laws of the Commonwealth and satisfactory to the Awarding Authority and each in the sum of the Contract Price, the premiums for which are to be paid by the General Contractor and are included in the Contract Price.
- I. The undersigned offers the following information as evidence of his qualifications to perform the work as proposed upon according to all the requirements of the Contract Documents:
1. Have been in business under present business name for _____ years.
 2. Ever failed to complete any work awarded? _____ .

3. List three (3) separate Owner references for projects completed in the past five (5) years on which you served as contractor for work of similar character as required for this project:

<u>Project</u>	<u>Owner</u>	<u>Ref. Name</u>	<u>Telephone No.</u>	<u>Amount of Contract</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

4. Bank Reference: _____ .

- J. The undersigned hereby certifies, under the pains and penalties of perjury, that he has carefully examined the Contract Documents, established a thorough understanding of the existing conditions, and has obtained sufficient information for executing the work of his Proposal and the work of all related trades.
- K. The undersigned agrees that, if selected as Contractor, he will within five (5) days, Saturdays, Sundays, and legal holidays excluded, after presentation thereof by the Awarding Authority, execute the Contract in accordance with the terms of this Bid.
- L. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work and that he will comply fully with all laws and regulations applicable to awards made subject to MGL Section 44A.
- M. The undersigned further certifies that all employees to be employed at the work site have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least ten (10) hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that he will comply fully with all laws and regulations applicable to award of contracts subject to MGL Section 44F.
- N. The undersigned bidder hereby certifies, under the pains and penalties of perjury, that the foregoing bid is based upon the payment to laborers to be employed on the project of wages in an amount no less than the applicable prevailing wage rates established for the project by the Massachusetts Department of Labor and Workforce Development, Division of Occupational Safety. The undersigned bidder agrees to indemnify the Awarding Authority for, from and against any loss, expense, damages, actions or claims, including any expense incurred in connection with any delay or stoppage of the project work, arising out of or as a result of (1) the failure of the said bid to be based upon the payment of the said applicable prevailing wage rates or (2) the failure of the bidder, if selected as the contractor, to pay laborers employed on the project the said applicable prevailing wage rates.
- O. The undersigned further certifies that he has reviewed the requirements of the Contract Documents regarding site safety and will as part of the requirements of this Contract after award of Contract submit to Owner and Architect an acceptable OSHA-approved Health and Safety Plan for this Contract.
- P. The undersigned further certifies that he will comply with affirmative action/equal opportunity provisions of this Contract.
- Q. The undersigned further certifies under the penalties of perjury that this Proposal is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

BID #24-05-002IFB
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TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

R. Pursuant to M.G.L. CH. 62C, Sec 49A, I certify under the penalties of perjury that I have filed all state tax returns and paid all State Taxes required under law.

Date: _____

(SEAL - if bid is by a corporation)

By: _____

(Signature)

(Name of Bidder)

(Title)

(Business Address)

(City and State)

(Telephone No. and Fax No.)

END OF DOCUMENT

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

DOCUMENT 00 31 20

DCAMM PRIME / GENERAL CONTRACTOR UPDATE STATEMENT

The DCAMM Prime / General Contractor Update Statement (11 pages total) immediately follows this Document.

END OF DOCUMENT

**PRIME/GENERAL UPDATE STATEMENTS ARE NOT PUBLIC RECORDS AND
ARE NOT OPEN TO PUBLIC INSPECTION (M.G.L. C.149, §44D)**

TO ALL BIDDERS AND AWARDING AUTHORITIES

A COMPLETED AND SIGNED PRIME/GENERAL CONTRACTOR UPDATE STATEMENT MUST BE SUBMITTED WITH EVERY PRIME/GENERAL BID FOR A CONTRACT PURSUANT TO M.G.L. c.149, §44A AND M.G.L. c. 149A. ANY PRIME/GENERAL BID SUBMITTED WITHOUT AN APPROPRIATE UPDATE STATEMENT IS INVALID AND MUST BE REJECTED.

Caution: This form is to be used for submitting Prime/General Contract bids. It is not to be used for submitting Filed Sub-Bids or Trade Sub-Bids.

AWARDING AUTHORITIES

If the Awarding Authority determines that the bidder does not demonstrably possess the skill, ability and integrity necessary to perform the work on the project, it must reject the bid.

BIDDER'S AFFIDAVIT

I swear under the pains and penalties of perjury that I am duly authorized by the bidder named below to sign and submit this Prime/General Contractor Update Statement on behalf of the bidder named below, that I have read this Prime/General Contractor Update Statement, and that all of the information provided by the bidder in this Prime/General Contractor Update Statement is true, accurate, and complete as of the bid date.

Bid Date	Print Name of Prime/General Contractor
Project Number (or name if no number)	Business Address
Awarding Authority	Telephone Number

SIGNATURE⇒

Bidder's Authorized Representative

INSTRUCTIONS

INSTRUCTIONS TO BIDDERS

- This form must be completed and submitted by all Prime/General contractors bidding on projects pursuant to M.G.L. c. 149, §44A and M.G.L. c. 149A.
- You must give complete and accurate answers to all questions and provide all of the information requested. MAKING A MATERIALLY FALSE STATEMENT IN THIS UPDATE STATEMENT IS GROUNDS FOR REJECTING YOUR BID AND FOR DEBARRING YOU FROM ALL PUBLIC CONTRACTING.
- **This Update Statement must include all requested information that was not previously reported on the Application used for your firm's most recently issued (not extended or amended) Prime/General Contractor Certificate of Eligibility. The Update Statement must cover the entire period since the date of your Application, NOT since the date of your Certification.**
- You must use this official form of Update Statement. Copies of this form may be obtained from the awarding authority and from the Asset Management Web Site: www.mass.gov/dcam.
- If additional space is needed, please copy the appropriate page of this Update Statement and attach it as an additional sheet.
- See the section entitled "Bidding Limits" in the *Instructions to Awarding Authorities* for important information concerning your bidding limits.

INSTRUCTIONS TO AWARDING AUTHORITIES

Determination of Bidder Qualifications

- It is the awarding authority's responsibility to determine who is the lowest eligible and responsible bidder. You must consider all of the information in the low bidder's Update Statement in making this determination. Remember: this information was not available to the Division of Capital Asset Management and Maintenance at the time of certification.
- The bidder's performance on the projects listed in Parts 1 and 2 must be part of your review. Contact the project references.
- AWARDING AUTHORITIES ARE STRONGLY ENCOURAGED TO REVIEW THE LOW BIDDER'S

ENTIRE CERTIFICATION FILE AT THE DIVISION OF CAPITAL ASSET MANAGEMENT AND MAINTENANCE. Telephone (617) 727-9320 for an appointment.

Bidding Limits

Single Project Limit: The total amount of the bid, including all alternates, may not exceed the bidder's Single Project Limit.

Aggregate Work Limit: The annual value of the work to be performed on the contract for which the bid is submitted, when added to the annual cost to complete the bidder's other currently held contracts, may not exceed the bidder's Aggregate Work Limit. Use the following procedure to determine whether the low bidder is within its Aggregate Work Limit:

Step 1 Review Update Statement Question #2 to make sure that all requested information is provided and that the bidder has accurately calculated and totaled the annualized value of all incomplete work on its currently held contracts (column 9).

Step 2 Determine the annual dollar value of the work to be performed on your project. This is done as follows:

(i) If the project is to be completed in less than 12 months, the annual dollar value of the work is equal to the full amount of the bid.

(ii) If the project will take more than 12 months to complete, calculate the number of years given to complete the project by dividing the total number of months in the project schedule by 12 (calculate to 3 decimal places), then divide the amount of the bid by the calculated number of years to find the annual dollar value of the work.

Step 3 Add the annualized value of all of the bidder's incomplete contract work (the

total of column 9 on page 5) to the annual dollar value of the work to be performed on your project. **The total may not exceed the bidder's Aggregate Work Limit.**

Correction of Errors and Omissions in Update Statements

Matters of Form: An awarding authority shall not reject a contractor's bid because there are mistakes or omissions of form in the Update Statement submitted with the bid, provided the contractor promptly

corrects those mistakes or omissions upon request of the awarding authority. [810 CMR 8.05(1)].

Correction of Other Defects: An awarding authority may, in its discretion, give a contractor notice of defects, other than mistakes or omissions of form, in the contractor's Update Statement, and an opportunity to correct such defects, provided the correction of such defects is not prejudicial to fair competition. An awarding authority may reject a corrected Update Statement if it contains unfavorable information about the contractor that was omitted from the Update Statement filed with the contractor's bid. [810 CMR 8.05(2)].

PART 1 - COMPLETED PROJECTS

LIST ALL PUBLIC AND PRIVATE *BUILDING* PROJECTS YOUR FIRM HAS COMPLETED SINCE THE DATE OF APPLICATION FOR YOUR MOST RECENTLY ISSUED (NOT EXTENDED OR AMENDED) DCAM CERTIFICATE OF ELIGIBILITY. YOU MUST REPORT ALL REQUESTED INFORMATION NOT PREVIOUSLY REPORTED ON THAT DCAM APPLICATION*.

PROJECT TITLE & LOCATION	WORK CATEGORY	CONTRACT PRICE	START DATE	DATE COMPLETED

Attach additional sheets if necessary

* If your firm has been terminated from a project prior to completion of the work or has failed or refused to complete its work under any contract, full details and an explanation must be provided. See Part 3 of this Update Statement.

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH COMPLETED PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE	COMPANY NAME	CONTACT PERSON	TELEPHONE
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above, either through a business or family relationship? YES NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? YES NO

If you have answered YES to either question, explain. _____

PART 2 - CURRENTLY HELD CONTRACTS

LIST ALL PUBLIC AND PRIVATE BUILDING AND NON-BUILDING *CONSTRUCTION* PROJECTS YOUR FIRM HAS UNDER CONTRACT ON THIS DATE REGARDLESS OF WHEN OR WHETHER THE WORK COMMENCED.

1	2	3	4	5	6	7	8	9
PROJECT TITLE & LOCATION	WORK CATEGORY	START AND END DATES	ON SCHEDULE (yes / no)	CONTRACT PRICE	% NOT COMPLETE	\$ VALUE OF WORK NOT COMPLETE (col. 5 X col. 6)	NO. OF YEARS REMAINING (see note below)	ANNUALIZED VALUE OF INCOMPLETE WORK (col. 7 ÷ col. 8) (divided by)

ANNUALIZED VALUE OF ALL INCOMPLETE CONTRACT WORK (Total of Column 9)

\$ _____

- Column 8
- If less than one year is left in the project schedule, write 1.
 - If more than 12 months are left in the project schedule, divide the number of months left in the project schedule by 12 (calculate to three decimal places).

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH INCOMPLETE PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE	COMPANY NAME	CONTACT PERSON	TELEPHONE
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone
	OWNER: Owner	Contact Person	Telephone
	DESIGNER: Designer	Contact Person	Telephone
	GC: GC	Contact Person	Telephone

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above either through a business or family relationship? YES NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? YES NO

If you have answered YES to either question, explain. _____

PART 3 - PROJECT PERFORMANCE

For Parts 3 and 4, if you answer YES to any question, please provide on a separate page a complete explanation. Information you provide herein must supplement the Application for your most recently issued (not extended or amended) DCAM Certificate of Eligibility. You must report all requested information not previously reported on that DCAM Application for Prime/General Certificate of Eligibility. Include all details [project name(s) and location(s), names of all parties involved, relevant dates, etc.].

	YES	NO
1. Has your firm been terminated on any contract prior to completing a project or has any officer, partner or principal of your firm been an officer, partner or principal of another firm that was terminated or failed to complete a project?	<input type="checkbox"/>	<input type="checkbox"/>
2. Has your firm failed or refused either to perform or complete any of its work under any contract prior to substantial completion?	<input type="checkbox"/>	<input type="checkbox"/>
3. Has your firm failed or refused to complete any punch list work under any contract?	<input type="checkbox"/>	<input type="checkbox"/>
4. Has your firm filed for bankruptcy, or has any officer, principal or individual with a financial interest in your current firm been an officer, principal or individual with a financial interest in another firm that filed for bankruptcy?	<input type="checkbox"/>	<input type="checkbox"/>
5. Has your surety taken over or been asked to complete any of your work under any contract?	<input type="checkbox"/>	<input type="checkbox"/>
6. Has a payment or performance bond been invoked against your current firm, or has any officer, principal or individual with a financial interest in your current firm been an officer, principal or individual with a financial interest in another firm that had a payment or performance bond invoked?	<input type="checkbox"/>	<input type="checkbox"/>
7. Has your surety made payment to a materials supplier or other party under your payment bond on any contract?	<input type="checkbox"/>	<input type="checkbox"/>
8. Has any subcontractor filed a demand for direct payment with an awarding authority for a public project on any of your contracts?	<input type="checkbox"/>	<input type="checkbox"/>
9. Have any of your subcontractors or suppliers filed litigation to enforce a mechanic's lien against property in connection with work performed or materials supplied under any of your contracts?	<input type="checkbox"/>	<input type="checkbox"/>
10. Have there been any deaths of an employee or others occurring in connection with any of your projects?	<input type="checkbox"/>	<input type="checkbox"/>
11. Has any employee or other person suffered an injury in connection with any of your projects resulting in their inability to return to work for a period in excess of one year?	<input type="checkbox"/>	<input type="checkbox"/>

PART 4 - Legal or Administrative Proceedings; Compliance with Laws

Please answer the following questions. Information must supplement all judicial and administrative proceedings involving bidder’s firm, which were instituted or concluded (adversely or otherwise) since your firm’s Application for your most recently issued (not extended or amended) Certificate of Eligibility. You must report all requested information not previously reported on that DCAM Application for Prime/General Certificate of Eligibility.

The term “administrative proceeding” as used in this Prime/General Contractor Update Statement includes (i) any action taken or proceeding brought by a governmental agency, department or officer to enforce any law, regulation, code, legal, or contractual requirement, except for those brought in state or federal courts, or (ii) any action taken by a governmental agency, department or officer imposing penalties, fines or other sanctions for failure to comply with any such legal or contractual requirement.

The term “anyone with a financial interest in your firm” as used in this Section “I”, shall mean any person and/or entity with a 5% or greater ownership interest in the applicant’s firm.

If you answer YES to any question, on a separate page provide a complete explanation of each proceeding or action and any judgment, decision, fine or other sanction or result. Include all details (name of court or administrative agency, title of case or proceeding, case number, date action was commenced, date judgment or decision was entered, fines or penalties imposed, etc.).

	YES	NO
1. Have any civil, judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to the procurement or performance of any construction contract, including but not limited to actions to obtain payment brought by subcontractors, suppliers or others?	<input type="checkbox"/>	<input type="checkbox"/>
2. Have any criminal proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to the procurement or performance of any construction contract including, but not limited to, any of the following offenses: fraud, graft, embezzlement, forgery, bribery, falsification or destruction of records, or receipt of stolen property?	<input type="checkbox"/>	<input type="checkbox"/>
3. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state’s or federal procurement laws arising out of the submission of bids or proposals?	<input type="checkbox"/>	<input type="checkbox"/>
4. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of M.G.L. Chapter 268A, the State Ethics Law?	<input type="checkbox"/>	<input type="checkbox"/>

PART 4 - Legal or Administrative Proceedings; Compliance with Laws (continued)

	YES	NO
5. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state or federal law regulating hours of labor, unemployment compensation, minimum wages, prevailing wages, overtime pay, equal pay, child labor or worker's compensation?	<input type="checkbox"/>	<input type="checkbox"/>
6. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of any state or federal law prohibiting discrimination in employment?	<input type="checkbox"/>	<input type="checkbox"/>
7. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a claim of repeated or aggravated violation of any state or federal law regulating labor relations?	<input type="checkbox"/>	<input type="checkbox"/>
8. Have any proceedings by a municipal, state, or federal agency been brought, concluded, or settled relating to decertification, debarment, or suspension of your firm or any principal or officer or anyone with a financial interest in your firm from public contracting?	<input type="checkbox"/>	<input type="checkbox"/>
9. Have any judicial or administrative proceedings involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled relating to a violation of state or federal law regulating the environment?	<input type="checkbox"/>	<input type="checkbox"/>
10. Has your firm been fined by OSHA or any other state or federal agency for violations of any laws or regulations related to occupational health or safety? Note: this information may be obtained from OSHA's Web Site at www.osha.gov	<input type="checkbox"/>	<input type="checkbox"/>
11. Has your firm been sanctioned for failure to achieve DBE/MBE/WBE goals, workforce goals, or failure to file certified payrolls on any public projects?	<input type="checkbox"/>	<input type="checkbox"/>
12. Other than previously reported in the above paragraphs of this Section I, have any administrative proceedings or investigations involving your firm or a principal or officer or anyone with a financial interest in your firm been brought, concluded, or settled by any local, state or federal agency relating to the procurement or performance of any construction contract?	<input type="checkbox"/>	<input type="checkbox"/>
13. Are there any other issues that you are aware which may affect your firm's responsibility and integrity as a building contractor?	<input type="checkbox"/>	<input type="checkbox"/>

PART 5 - SUPERVISORY PERSONNEL

List all supervisory personnel, such as project managers and superintendents, who will be assigned to the project if your firm is awarded the contract. **Attach the resume of each person listed below.**

NAME	TITLE OR FUNCTION

PART 6 - CHANGES IN BUSINESS ORGANIZATION OR FINANCIAL CONDITION

Have there been any changes in your firm’s business organization, financial condition or bonding capacity since the date your current Certificate of Eligibility was issued? Yes No

If YES, attach a separate page providing complete details.

PART 7 – LIST OF COMPLETED CONSTRUCTION PROJECTS SUBMITTED TO THE DIVISION OF CAPITAL ASSET MANAGEMENT AND MAINTENANCE.

Attach here a copy of the list of completed construction projects which was submitted with your firm’s DCAM Application for your most recently issued (not extended or amended) DCAM Certificate of Eligibility. The Attachment must include a complete copy of the entire Section G – “Completed Projects” and the final page – “Certification” (Section J) containing the signature and date that the Completed Projects list (Section G) was submitted to the Division of Capital Asset Management and Maintenance.

DOCUMENT 00 31 40

CERTIFICATE AS TO CORPORATE BIDDER

I _____

certify that I am _____ of the

Corporation named as Bidder in the within Bid Form that _____

_____ who signed said Bid Form on behalf of the

Bidder was then _____ of said

Corporation; that I know his signature and that his signature hereto is genuine and that said Bid Form was duly signed, sealed, and executed for and on behalf of said Corporation by authority of its Board of Directors.

(Corporate Seal)

(Signature)

(Title)

This Certificate must be completed where the Bidder is a Corporation and should be so completed by its Clerk. In the event that the Clerk is the person signing the Proposal on behalf of the Corporation, this Certificate must be completed by another Officer of the Corporation.

END OF DOCUMENT

DOCUMENT 00 31 50

FORM OF NON-COLLUSIVE AFFIDAVIT OF GENERAL BIDDER

The undersigned certifies that under penalties of perjury that this bid has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word 'person' shall mean any natural person, business, partnership, corporation, union, committee, club or other organization, entity or group of individuals.

Bidder _____

By _____

Title _____

Subscribed and sworn to before me this _____ day of _____, 2024

(Name)

(Title)

My commission expires _____

END OF DOCUMENT

DOCUMENT 00 31 60

CERTIFICATION OF COMPLIANCE WITH TAX LAWS

Pursuant to Commonwealth of Massachusetts General Laws, Chapter 62C, Section 49A, I certify

under the pains and penalties of perjury that, _____
(Contractor)

has filed all Commonwealth of Massachusetts state tax returns, has complied with all Commonwealth of Massachusetts laws relating to taxes, and has paid all Commonwealth of Massachusetts State Taxes required under law.

(Contractor)

By: _____

Contractor's Federal Tax I.D. No. _____

END OF DOCUMENT

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

DOCUMENT 00 31 70

BID SECURITY FORM

KNOW ALL MEN BY THESE PRESENTS, that we the undersigned, _____

_____, as Principal, and
(insert name of bidder)

_____, as Surety,
(insert name of surety)

and firmly bound unto the **TOWN OF HOPKINTON, MASSACHUSETTS** acting by and through its

TOWN MANAGER and its **SELECT BOARD** as Owner, in the sum of _____

_____ Dollars (\$ _____)

for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns.

The condition of this obligation is such that whereas the Principal has submitted to the Owner a certain Bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, hereinafter referred to as the "AGREEMENT" for:

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

NOW THEREFORE,

- (a) If said BID shall be rejected, or in the alternative,
- (b) If said BID shall be accepted and the Principal shall duly execute and deliver the form of AGREEMENT attached hereto and shall furnish the specified bonds for the faithful performance of the Contract and for the payment for labor and materials furnished for the performance of the AGREEMENT, then this obligation shall be void, otherwise it shall remain in full force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder in no event shall exceed the amount of this obligation as herein stated.

The Surety, for value received, hereby agrees that the obligations of said Surety and its bond shall be in no way impaired or affected by any extensions of the time within which the Owner may accept such BID; and said Surety does hereby waive notice of any such extensions.

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

IN WITNESS WHEREOF, the parties to these presents have duly executed this bond on this _____

_____ day of _____, 2024.

(SEAL)

(Name of Principal)

By: _____

(SEAL)

(Name of Surety)

By: _____

Sealed and delivered in the presence of

END OF DOCUMENT

DOCUMENT 00 35 00

FORM FOR SUB-BID

To all General Bidders Except Those Excluded:

- A. The undersigned proposes to furnish all labor and materials required for completion, in accordance with the Contract Documents dated _____, together with all Addenda issued and received prior to closing time for receipt of Bids of all the work specified in Section(s) _____ of the Specifications and in any Drawings specified in these Sections, prepared by:

GORMAN RICHARDSON LEWIS ARCHITECTS, INC. (GRLA)

239 South Street
Hopkinton, Massachusetts 01748
Phone: 508-544-2600

for construction of:

**TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS**

73 Main Street
Hopkinton, Massachusetts 01748

for the Contract Sum of: _____

_____ Dollars (_____)

For Alternate No. ___ Add \$ _____ Subtract \$ _____

For Alternate No. ___ Add \$ _____ Subtract \$ _____

For Alternate No. ___ Add \$ _____ Subtract \$ _____

- B. This sub-bid includes the following addenda:

Addendum No. __, __, __, __, __, __, __.

- C. This Sub-bid:

[] may be used by any General Bidder except: _____

[] may only be used by the following General Bidders: _____

(To exclude General Bidders, insert "X" in one box only and fill in blank following that box. Do not answer C. if no General Bidders are excluded.)

D. The undersigned agrees that, if he/she is selected as sub-bidder, he/she will within five days, Saturdays, Sundays, and legal holidays excluded, after presentation of a subcontract by the General Bidder selected as the General Contractor, execute with such General Bidder a subcontract in accordance with the terms of this sub-bid and contingent upon the execution of the General Contract, and, if requested to do so in the general bid by such general bidder, who shall pay the premiums therefore, furnish a performance and payment bond of a surety company qualified to do business under the laws of the Commonwealth of Massachusetts and satisfactory to the Awarding Authority, in the full sum of the subcontract price.

E. The names of all persons, firms and corporations furnishing to the undersigned labor or labor and materials for the class or classes or part thereof of work for which the provisions of the section of the specifications for this subtrade require a listing in this paragraph, (including the undersigned if customarily furnished by persons on his/her own payroll and in the absence of a contrary provision in the specifications) the name of each such class of work or part thereof and the bid price for each such class of work or part thereof are:

<u>Name</u>	<u>Class of Work</u>	<u>Bid Price</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____

(Do not give price for any class or part thereof furnished by the undersigned.)

F. The undersigned agrees that the above list of bids to the undersigned represents bona fide bids based on the hereinbefore described Drawings, Specifications, and Addenda and that, if the undersigned is awarded the Contract, they will be used for the work indicated at the amounts stated, if satisfactory to the Awarding Authority.

G. The undersigned further agrees to be bound to the General Contractor by the terms of the hereinbefore described Drawings, Specifications (including all General Conditions and Supplemental Conditions stated therein), and Addenda, and to assume toward him/her all the obligations and responsibilities that he/she, by those documents, assumes toward the Awarding Authority.

H. The undersigned offers the following information as evidence of his/her qualifications to perform the work as bid upon according to all the requirements of the Contract Documents:

1. Have been in business under present business name for _____ years.
2. Ever failed to complete any work awarded? _____ .
3. List one or more recent buildings with names of General Contractor and Architect on which you served as subcontractor for work of similar character as required for the above-named building.

<u>Building</u>	<u>Architect</u>	<u>General Contractor</u>	<u>Amount of Contract</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

4. Bank Reference: _____ .
- J. The undersigned hereby certifies that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work and that he/she will comply fully with all laws and regulations applicable to awards of subcontracts subject to Section 44F.
- K. The undersigned further certifies under penalties of perjury that this sub-bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this subsection the word "person" shall mean any natural person, joint venture, partnership, corporation, or other business or legal entity.
- L. The undersigned further certifies under penalties of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of Section 29F of Chapter 29, or any other applicable debarment provisions of any chapter of the Massachusetts General Laws or any rule or regulation promulgated thereunder.

Date: _____
_____ (Name of Sub-bidder)

(Seal) By: _____
_____ (Name and Title of Person Signing Bid)

(Business Address)

(City and State)

(Telephone)

END OF DOCUMENT

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

DOCUMENT 00 35 20

DCAMM SUB-BIDDER UPDATE STATEMENT

The DCAMM Sub-bidder Update Statement (10 pages total) immediately follows this Document.

END OF DOCUMENT



**SUB-BIDDERS' UPDATE STATEMENTS ARE NOT PUBLIC RECORDS AND
ARE NOT OPEN TO PUBLIC INSPECTION (M.G.L. C.149, §44D)**

Sub-Bidder Update Statement

TO ALL SUB-BIDDERS, TRADE CONTRACTORS AND AWARDING AUTHORITIES

A COMPLETED AND SIGNED SUB-BIDDER UPDATE STATEMENT MUST BE SUBMITTED WITH EVERY FILED SUB-BID PURSUANT TO M.G.L. c.149, §44F AND EVERY TRADE SUB-BID PURSUANT TO M.G.L. c. 149A. ANY FILED SUB-BID OR TRADE SUB-BID SUBMITTED WITHOUT AN APPROPRIATE SUB-BIDDER UPDATE STATEMENT IS INVALID AND MUST BE REJECTED.

Caution: This form is to be used for submitting Filed Sub-Bids and Trade Sub-Bids Only

AWARDING AUTHORITIES

If the Awarding Authority determines that the Sub-Bidder is not competent to perform the work as specified on the project, it should reject the bid.

SUB-BIDDER'S AFFIDAVIT

I swear under the pains and penalties of perjury that I am duly authorized by the bidder named below to sign and submit this Sub-Bidder Update Statement on behalf of the bidder named below, that I have read this Sub-Bidder Update Statement, and that all of the information provided by the bidder in this Sub-Bidder Update Statement is true, accurate, and complete as of the bid date.

Bid Date

Print Name of Sub-Bidder or Trade Contractor

Project Number
(or name if no number)

Business Address

Awarding Authority

Telephone Number

SIGNATURE⇒

Bidder's Authorized Representative

INSTRUCTIONS

INSTRUCTIONS TO SUB-BIDDERS

- This form must be completed and submitted by all Filed Sub-Bidders bidding on projects and Trade Contractors bidding on projects.
- You must give complete and accurate answers to all questions and provide all of the information requested. MAKING A MATERIALLY FALSE STATEMENT IN THIS SUB-BIDDER UPDATE STATEMENT IS GROUNDS FOR REJECTING YOUR BID AND FOR DEBARRING YOU FROM ALL PUBLIC CONTRACTING.
- This Sub-Bidder Update Statement must include all requested information that was not previously reported on the application used for your company's most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. **The Sub-Bidder Update Statement must cover the entire period since the date of that application, NOT since the date of your Certification.**
- You must use this official form of Sub-Bidder Update Statement. Copies of this form may be obtained from the awarding authority or from the DCAMM Web Site:
www.mass.gov/DCAMM/certification.
- If additional space is needed, please copy the appropriate page of this Sub-Bidder Update Statement and attach it as an additional sheet.
- It is acceptable to attach your projects in progress and completed projects spreadsheet for Part 7.

INSTRUCTIONS TO AWARDING AUTHORITIES

Determination of Sub-Bidder Qualifications

- It is the awarding authority's responsibility to determine each responsible bidder. You must consider all of the information in the bidder's Sub-Bidder Update Statement in making this determination. **Remember: this information was not available to the Division of Capital Asset Management and Maintenance at the time of certification.**
- The Sub-Bidder's performance on the projects listed in Parts 1 and 2 must be part of your review.
- Contact the project references.
- AWARDING AUTHORITIES ARE STRONGLY ENCOURAGED TO REVIEW THE LOW BIDDERS CERTIFICATION FILE. WITH THE IMPLEMENTATION OF ELECTRONIC DOCUMENT MANAGEMENT FILE REVIEWS CAN BE PROVIDED ELECTRONICALLY. To discuss your request/options contact DCAMM's Contractor Certification (857) 204-1305.

Correction of Errors and Omissions in Sub-Bidder Update Statements

Matters of Form: An awarding authority shall not reject a Sub-Bidder's bid because there are mistakes or omissions of form in the Sub-Bidder Update Statement submitted with the bid provided the Sub-Bidder promptly corrects those mistakes or omissions upon request of the awarding authority.

Correction of Other Defects: An awarding authority may, in its discretion, give a Sub-Bidder notice of minor defects and omissions as to form in the Sub-Bidder's Update Statement and provide an opportunity to correct its Sub-Bidder Update Statement. However, the Sub-Bidder shall not be allowed to make corrections to a Sub-Bidder Update Statement if material information about the Sub-Bidder was omitted from the Sub-Bidder Update Statement filed with the Sub-Bidder's bid. The Awarding Authority shall advise DCAMM of any material omissions in a Sub-Bidder's Update Statement.

PART 1 - COMPLETED PROJECTS

List All Public And Private Projects Of \$20,000 or more your company has completed since the date of application for your most recently issued (not extended or amended) Sub-Bidder Certificate Of Eligibility*.

PROJECT TITLE & LOCATION	WORK CATEGORY	CONTRACT PRICE	START DATE	DATE COMPLETED

Attach additional sheets if necessary

* If your company has been terminated from a project prior to completion of the work or has failed or refused to complete its work under any contract, full details and an explanation must be provided. See Part 3 of this Sub-Bidder Update Statement.

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH COMPLETED PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE		COMPANY NAME	CONTACT PERSON	TELEPHONE	EMAIL ADDRESS
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above, either through a business or family relationship? YES NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? YES NO

If you have answered YES to either question, explain. _____

PART 2 – PROJECTS IN PROGRESS CONTRACTS

List all public and private projects of \$20,000 or more your company has under contract on this date regardless of when or whether the work commenced.

1	2	3	4	5	6	7
PROJECT TITLE & LOCATION	WORK CATEGORY	START AND END DATES (MM/YYYY)	ON SCHEDULE (yes / no)	CONTRACT PRICE	% NOT COMPLETE	\$ VALUE OF WORK NOT COMPLETE (col. 5 X col. 6)

PROVIDE THE FOLLOWING REFERENCE INFORMATION FOR EACH INCOMPLETE PROJECT LISTED ON THE PREVIOUS PAGE.

PROJECT TITLE		COMPANY NAME	CONTACT PERSON	TELEPHONE	EMAIL ADDRESS
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				
	OWNER:				
	DESIGNER				
	GC:				

Is your company or any individual who owns, manages or controls your company affiliated with any owner, designer or general contractor named above either through a business or family relationship? YES NO

Are any of the contact persons named above affiliated with your company or any individual who owns, manages or control your company, either through a business or family relationship? YES NO

If you have answered YES to either question, explain. _____

PART 3 - GENERAL PERFORMANCE (in the prime update it's called Project Performance – can we change it?)

For Parts 3 and 4, if you answer YES to any question, please provide on a separate page a complete explanation. Information you provide herein must supplement the application for your most recently issued (not extended or amended) DCAMM Sub-Bidder Certificate of Eligibility. You must report all requested information not previously reported on that application. Include all details [project name(s) and location(s), names of all parties involved, relevant dates, etc.].

	YES	NO
1. Has your company been terminated on any contract prior to completing a project or has any officer, partner or principal of your company been an officer, partner or principal of another company that was terminated or failed to complete a project?	<input type="checkbox"/>	<input type="checkbox"/>
2. Has your company failed or refused either to perform or complete any of its work under any contract prior to substantial completion?	<input type="checkbox"/>	<input type="checkbox"/>
3. Has your company failed or refused to complete any punch list work under any contract?	<input type="checkbox"/>	<input type="checkbox"/>
4. Has your company filed for bankruptcy, or has any officer, principal or individual with a financial interest in your current company been an officer, principal or individual with a financial interest in another company that filed for bankruptcy?	<input type="checkbox"/>	<input type="checkbox"/>
5. Has your surety taken over or been asked to complete any of your work under any contract?	<input type="checkbox"/>	<input type="checkbox"/>
6. Has a payment or performance bond been invoked against your current company, or has any officer, principal or individual with a financial interest in your current company been an officer, principal or individual with a financial interest in another company that had a payment or performance bond invoked?	<input type="checkbox"/>	<input type="checkbox"/>
7. Has your surety made payment to a materials supplier or other party under your payment bond on any contract?	<input type="checkbox"/>	<input type="checkbox"/>
8. Has any subcontractor filed a demand for direct payment with an awarding authority for a public project on any of your contracts?	<input type="checkbox"/>	<input type="checkbox"/>
9. Have any of your subcontractors or suppliers filed litigation to enforce a mechanic's lien against property in connection with work performed or materials supplied under any of your contracts?	<input type="checkbox"/>	<input type="checkbox"/>
10. Have there been any deaths of an employee or others occurring in connection with any of your projects?	<input type="checkbox"/>	<input type="checkbox"/>
11. Has any employee or other person suffered an injury in connection with any of your projects resulting in their inability to return to work for a period in excess of one year?	<input type="checkbox"/>	<input type="checkbox"/>

PART 4 - Legal or Administrative Proceedings; Compliance with Laws

Please answer the following questions. Information must supplement all judicial and administrative proceedings involving bidder’s company, which were instituted or concluded (adversely or otherwise) since your company’s Application for your most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. You must report all requested information not previously reported on that DCAMM Application.

The term “administrative proceeding” as used in this Sub-Bidder Update Statement includes (i) any action taken or proceeding brought by a governmental agency, department or officer to enforce any law, regulation, code, legal, or contractual requirement, except for those brought in state or federal courts, or (ii) any action taken by a governmental agency, department or officer imposing penalties, fines or other sanctions for failure to comply with any such legal or contractual requirement.

The term “anyone with a financial interest in your company” as used in this Section “1”, shall mean any person and/or entity with a 5% or greater ownership interest in the applicant’s company.

If you answer YES to any question, on a separate page provide a complete explanation of each proceeding or action and any judgment, decision, fine or other sanction or result. Include all details (name of court or administrative agency, title of case or proceeding, case number, date action was commenced, date judgment or decision was entered, fines or penalties imposed, etc.).

	YES	NO
1. Have any civil, judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to the procurement or performance of any construction contract, including but not limited to actions to obtain payment brought by subcontractors, suppliers or others?	<input type="checkbox"/>	<input type="checkbox"/>
2. Have any criminal proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to the procurement or performance of any construction contract including, but not limited to, any of the following offenses: fraud, graft, embezzlement, forgery, bribery, falsification or destruction of records, or receipt of stolen property?	<input type="checkbox"/>	<input type="checkbox"/>
3. Have any judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to a violation of any state’s or federal procurement laws arising out of the submission of bids or proposals?	<input type="checkbox"/>	<input type="checkbox"/>
4. Have any judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to a violation of M.G.L. Chapter 268A, the State Ethics Law?	<input type="checkbox"/>	<input type="checkbox"/>

PART 4 - Legal or Administrative Proceedings; Compliance with Laws (continued)

	YES	NO
5. Have any judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to a violation of any state or federal law regulating hours of labor, unemployment compensation, minimum wages, prevailing wages, overtime pay, equal pay, child labor or worker’s compensation?	<input type="checkbox"/>	<input type="checkbox"/>
6. Have any judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to a violation of any state or federal law prohibiting discrimination in employment?	<input type="checkbox"/>	<input type="checkbox"/>
7. Have any judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to a claim of repeated or aggravated violation of any state or federal law regulating labor relations?	<input type="checkbox"/>	<input type="checkbox"/>
8. Have any proceedings by a municipal, state, or federal agency been brought, concluded, or settled relating to decertification, debarment, or suspension of your company or any principal or officer or anyone with a financial interest in your company from public contracting?	<input type="checkbox"/>	<input type="checkbox"/>
9. Have any judicial or administrative proceedings involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled relating to a violation of state or federal law regulating the environment?	<input type="checkbox"/>	<input type="checkbox"/>
10. Has your company been fined by OSHA or any other state or federal agency for violations of any laws or regulations related to occupational health or safety? Note: this information may be obtained from OSHA’s Web Site at www.osha.gov	<input type="checkbox"/>	<input type="checkbox"/>
11. Has your company been sanctioned for failure to achieve DBE/MBE/WBE goals, workforce goals, or failure to file certified payrolls on any public projects?	<input type="checkbox"/>	<input type="checkbox"/>
12. Other than previously reported in the above paragraphs of this Section I, have any administrative proceedings or investigations involving your company or a principal or officer or anyone with a financial interest in your company been brought, concluded, or settled by any local, state or federal agency relating to the procurement or performance of any construction contract?	<input type="checkbox"/>	<input type="checkbox"/>
13. Are there any other issues that you are aware which may affect your company’s responsibility and integrity as a building contractor?	<input type="checkbox"/>	<input type="checkbox"/>

PART 5 - SUPERVISORY PERSONNEL

List all supervisory personnel who will be assigned to the project if your company is awarded the contract.

Attach the resume of each person listed below.

NAME	TITLE OR FUNCTION

PART 6 - CHANGES IN BUSINESS ORGANIZATION OR FINANCIAL CONDITION

Have there been any changes in your company’s business organization, financial condition or bonding capacity since the date your current Contractor Certificate of Eligibility was issued? Yes No

If YES, attach a separate page providing complete details.

PART 7 – LIST OF COMPLETED CONSTRUCTION PROJECTS SUBMITTED TO THE DIVISION OF CAPITAL ASSET MANAGEMENT AND MAINTENANCE ALONG WITH CERTIFICATION SIGNATURE PAGE.

Attach here a copy of the list of completed construction projects which was submitted with your company’s application for your most recently issued (not extended or amended) Sub-Bidder Certificate of Eligibility. The Attachment must include a complete copy of the entire Completed Projects spreadsheet and the final page Certification Page of the online application, containing the signature and date the completed projects list was submitted to the Division of Capital Asset Management and Maintenance.

DOCUMENT 00 35 50

FORM OF NON-COLLUSIVE AFFIDAVIT OF SUBCONTRACTOR

The undersigned certifies that under penalties of perjury that this bid has been made and submitted in good faith and without collusion or fraud with any other person. As used in this certification, the word 'person' shall mean any natural person, business, partnership, corporation, union, committee, club or other organization, entity or group of individuals.

Bidder _____

By _____

Title _____

Subscribed and sworn to before me this _____ day of _____, 2024.

(Name)

(Title)

My commission expires _____

END OF DOCUMENT

DOCUMENT 00 51 00

AGREEMENT

THIS AGREEMENT, made this _____ day of _____, 2024 by and between the party of the first part, the TOWN OF HOPKINTON, MASSACHUSETTS hereinafter called "OWNER" or "AWARDING AUTHORITY", acting herein through its _____, and the party of the second part, _____, doing business as a corporation located in the City/Town of _____, County of _____, State of _____, hereinafter called the "CONTRACTOR"

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned, to be made and performed by the OWNER, the CONTRACTOR hereby agrees with the OWNER to commence and complete the project described as follows:

**TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS**

73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

hereinafter called the "PROJECT" for the sum of _____ Dollars (\$ _____)

The Contract Sum includes incorporation into the Contract and at his (its or their) own proper cost and expense to furnish all the materials, supplies, machinery equipment, tools, superintendence, labor, insurance, and other accessories and services necessary to complete the said project in accordance with the conditions and prices stated in Document 00 31 00, FORM FOR GENERAL BID; Document 00 80 00, GENERAL CONDITIONS and all the BIDDING REQUIREMENTS, CONTRACTING REQUIREMENTS and DIVISION 01 - GENERAL REQUIREMENTS, as listed in the PROJECT MANUAL and the Specifications (refer to Document 00 01 10, TABLE OF CONTENTS) and the plans, which include all maps, plates, blue prints (refer to Document 00 01 15, LIST OF DRAWINGS) and all other Contract Documents as prepared by the OWNER all of which are attached hereto and incorporated by reference herein in their entirety.

The undersigned CONTRACTOR agrees to commence work on the Contract on or before the _____ (____ th) day following the Notice of Award and to thereafter diligently and continuously carry out the work in such manner as to fully complete all the different elements of the work within _____ (____) days thereafter.

The CONTRACTOR agrees not to discriminate against or exclude any person from participation herein on grounds of race, religion, color, sex, age or national origin; and that it shall take affirmative actions to insure that applicants are employed, and that employees are treated during their employment, without regard to race, religion, color, sex, age, handicapped status, or national origin.

The CONTRACTOR agrees not to participate in or cooperate with an international boycott, as defined in Section 999 (b)(3) and (4) of the Internal Revenue Code of 1954, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Commonwealth of Massachusetts General Laws.

Pursuant to M.G.L. c. 62(c), §49 (a), the individual signing this Agreement on behalf of the CONTRACTOR hereby certifies, under the penalties of perjury, that to the best of his or her knowledge and belief the CONTRACTOR has complied with any and all applicable state and federal tax laws. The individual signing this Agreement on behalf of the CONTRACTOR further certifies under penalties of perjury that the Contractor is not presently debarred from doing public construction work in the Commonwealth under the provisions of M.G.L. c. 29, § 29F, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder and is not presently debarred from doing public construction work by any agency of the United States Government.

The OWNER agrees to pay the CONTRACTOR in current funds for the performance of the contract, subject to additions and deductions, as provided in Document 00 80 00, GENERAL CONDITIONS, and to make payments on account thereof as provided therein.

IN WITNESS WHEREOF, the parties to these presents have executed this contract in two (2) counterparts, each of which shall be deemed an original, on the year and day first above mentioned.

AGREED:

OWNER: TOWN OF HOPKINTON, MASSACHUSETTS

by its _____

By: _____

CONTRACTOR: _____

(Name of Company)

By: _____

(Name)

(Title)

(Address)

(City and State)

In accordance with M.G.L. c. 44, Section 31C, this is to certify that an appropriation in the amount of this Contract is available therefor and that the _____ has been authorized to execute the Contract and approve all requisitions and change orders.

By: _____
(Town Treasurer)

END OF DOCUMENT

DOCUMENT 00 59 00

SUBCONTRACT

THIS AGREEMENT made this _____ day of _____, 2024

by and between _____

a corporation organized and existing under the laws of _____
 a partnership consisting of _____
 an individual doing business as _____

hereinafter called the "Contractor", and _____

a corporation organized and existing under the laws of _____
 a partnership consisting of _____
 an individual doing business as _____

hereinafter called the "Subcontractor",

WITNESSETH that the Contractor and the Subcontractor, for the considerations hereafter named, agree as follows:

1. The Subcontractor agrees to furnish all labor and materials required for the completion of all work specified in Section No(s) _____ of the Specifications for _____ and the Drawings referred to therein and Addenda No. ____, ____, ____, ____, ____, ____, ____, for construction of:

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

all as prepared by the Architect, Gorman Richardson Lewis Architects, Inc., 239 South Street, Hopkinton, Massachusetts 01748 for the sum _____ Dollars (\$ _____)

and the Contractor agrees to pay the Subcontractor said sum for said work.

This price includes the following alternates (and other items set forth in the sub-bid):

Alternate No(s): _____ . _____ .

- (a) The Subcontractor agrees to be bound to the Contractor by the terms of the hereinbefore described Drawings, Specifications (including all General Conditions stated therein) and Addenda and to assume to the Contractor all the obligations and responsibilities that the Contractor by those documents assumes to the TOWN OF HOPKINTON, MASSACHUSETTS hereinafter called the "Awarding Authority", except to the extent that provisions contained therein are by their terms or by law applicable only to the Contractor.
 - (b) The Contractor agrees to be bound to the Subcontractor by the terms of the hereinbefore described documents and to assume to the Subcontractor all the obligations and responsibilities that the Awarding Authority by the terms of the hereinbefore described documents assumes to the Contractor, except to the extent that provisions contained therein are by their terms or by law applicable only to the Awarding Authority.
2. The Contractor agrees to begin, prosecute, and complete the entire Work specified by the Awarding Authority in an orderly manner so that the Subcontractor will be able to begin, prosecute, and complete the work described in this Subcontract; and, in consideration thereof, upon notice from the Contractor, either oral or in writing, the Subcontractor agrees to begin, prosecute, and complete the work described in this Subcontract in an orderly manner and with due consideration to the date or time specified by the Awarding Authority for the completion of the entire Work.
 3. The Subcontractor agrees to furnish to the Contractor within a reasonable time after the execution of this Subcontract, evidence of Workmen's Compensation Insurance as required by law, and evidence of Public Liability and Property Damage Insurance of the type and in limits required to be furnished to the Awarding Authority by the Contractor.
 4. The Contractor agrees that no claim for services rendered or materials furnished by the Contractor to the Subcontractor shall be valid unless written notice thereof is given by the Contractor to the Subcontractor during the first ten (10) days of the calendar month following that in which the claim originated.
 5. This Agreement is contingent upon the execution of a General Contract between the Contractor and the Awarding Authority for the complete Work.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement the day and year first above-written.

SEAL

ATTEST _____

(Name of Subcontractor)

By:

(Name and Title of Person Signing Subcontract)

SEAL

ATTEST _____

(Name of Contractor)

By:

(Name and Title of Person Signing Subcontract)

END OF DOCUMENT

DOCUMENT 00 61 00
PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____

(Name of Contractor)

as Principal a _____
(Corporation, Partnership, or Individual)

hereinafter called "Principal" and _____

(Surety)

_____ of _____,

State of _____, hereinafter called the "Surety", are held and firmly bound into the **TOWN OF HOPKINTON, MASSACHUSETTS** acting by and through its **TOWN MANAGER** and its **SELECT BOARD** hereinafter called the "Owner" or the

"Awarding Authority", in the penal sum of _____

_____ Dollars (\$ _____), in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that Whereas, the Principal entered into a certain

contract with the Owner, dated the _____ day of _____, 2024; a

copy of which is hereto attached and made a part hereof for the construction of:

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

NOW, THEREFORE, if the Principal shall well, truly and faithfully perform its duties, all the undertakings, covenants, terms, conditions, and agreements of said contract during the original term thereof, and any extensions thereof which may be granted by the Owner, with or without notice to the Surety, and if he shall satisfy all claims and demands incurred under such contract, and shall fully indemnify and save harmless the Owner from all costs and damages which it may suffer by reason of failure to do so, and shall reimburse and repay the Owner all outlay and expense which the Owner may incur in making good any default, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, FURTHER, that the said Surety, for value received hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the contract or to the work to be performed thereunder or the specifications accompanying the same shall in any way affect its obligation of this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the contract or to the work or to the specifications.

PROVIDED, FURTHER, that no final settlement between the Owner and the Contractor shall abridge the right of any beneficiary hereunder, whose claim may be unsatisfied.

IN WITNESS WHEREOF, the parties to these present have duly executed in this bond on the _____

_____ day of _____, 2024.

ATTEST:

(SEAL)

(Principal)

By _____
(Secretary)

(Address - Zip Code)

(SEAL)

(Witness as to Principal)

(Address - Zip Code)

NOTE:

1. Date of Bond must not be prior to date of Contract. If Contractor is a Partnership, all partners should execute Bond.
2. Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the Project is located).

END OF DOCUMENT

DOCUMENT 00 62 00

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS: That we _____

(Name of Contractor)

as Principal a _____
(Corporation, Partnership, or Individual)

hereinafter called "Principal" and _____

(Surety)

_____ of _____ State of

_____, hereinafter called the "Surety", are held and firmly bound into the **TOWN OF HOPKINTON, MASSACHUSETTS** acting by and through its **TOWN MANAGER** and its **SELECT BOARD** hereinafter called the "Owner" or the "Awarding Authority",

in the penal sum of _____

_____ Dollars (\$ _____),

in lawful money of the United States, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION is such that Whereas, the Principal entered into a certain contract with the Owner, dated the _____ day of _____, ___, 2024; a copy of which is hereto attached and made a part hereof for the construction of:

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

NOW, THEREFORE, if the Contractor and his Sub-contractors shall pay for labor performed and materials used or employed in the prosecution of the work provided for in said Contract, and for all other items of the kind and nature specified in Chapter 149, Section 29, of the General Laws of Massachusetts, then this obligation shall be void; otherwise to remain in full force and effect;

PROVIDED, HOWEVER, that in order to obtain the benefits of this bond, all claimants shall comply with all the provisions of said Chapter 149, Section 29, which are pertinent to their claims, and all rights and liabilities on this bond shall be determined and limited by said section to the same extent as if this were copied at length herein."

IN WITNESS WHEREOF, the parties to these present have duly executed in this bond on this _____

_____ day of _____ 2024.

ATTEST:

(SEAL)

(Principal)

By _____
(Secretary)

(Address - Zip Code)

(SEAL)

(Witness as to Principal)

(Address - Zip Code)

NOTE:

1. Date of Bond must not be prior to date of Contract. If Contractor is a Partnership, all partners should execute Bond.
2. Surety companies executing Bonds must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State where the Project is located).

END OF DOCUMENT

DOCUMENT 00 80 00

GENERAL CONDITIONS

1.0 GENERAL PROVISIONS

1.1 Definitions.

1.1.1 Awarding Authority. Where the term "Awarding Authority" appears in any statutory provision, it shall mean "the Owner."

1.1.2 Contracting Officer. The term "Contracting Officer" shall mean the town official so designated below, or the individual duly appointed by him for the performance of any of his functions or responsibilities under this Contract. The Work shall be carried out under the direction and subject to the approval and acceptance of the TOWN OF HOPKINTON TOWN ENGINEER (hereinafter called the Contracting Officer).

1.2 Scope of the Work. The Work comprises the completed project described in the Contract Documents and includes all labor, professional services, transportation, tools, materials, supplies, equipment, permits, approvals, documents, calculations, submittals, and certificates necessary to develop, perform, construct and complete the project in accordance with all applicable laws, ordinances, and regulations, and in accordance with the Contract Documents.

1.3 Interpretation. The Plans and Specifications and other Contract Documents are to be considered together and are intended to be mutually complementary, so that any work shown on the Plans though not specified in the Specifications, and any work specified in the Specifications though not shown on the Plans, is part of the Work to be performed by the Contractor.

1.4 Written Authorization. Actions taken, and approvals and decisions made by the Owner under this Contract require the prior approval and signature of the Contracting Officer. These include, but are not limited to, the following: changes in the Contract Price, time for completion, or any other provision of this Contract; written orders, notices, and approvals given by the Contracting Officer pursuant to the Contract Documents or pursuant to any laws applicable to this Contract, including approval of "or equal" submissions; issuance of stop work orders; approval of Contractor's applications for payment; and termination of the Contract. Work undertaken by the Contractor not authorized by the Contracting Officer's signature prior to the start of such work shall be considered unauthorized work and shall not entitle the Contractor to any extra payment. The Contractor shall perform, at its own expense, corrective measures required by the Owner due to any failure to obtain prior approval for any item of work.

1.5 Contractor's General Duties. The Contractor shall perform the Work in a competent manner in accordance with the Contract Documents and all applicable laws. The Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures, and coordination of all portions of the Work under this Contract. The Contractor shall provide and perform for the Contract Price all of the duties and obligations set forth in the Contract Documents. Except as otherwise specified in this Contract, it is not the Contractor's responsibility to ascertain that the Contract Documents are in accordance with applicable Laws. However, if the Contractor observes that portions of the Contract Documents are at variance with legal requirements, the Contractor shall promptly notify the Owner of that fact in writing. If the Contractor performs Work knowing it to be contrary to legal requirements, the Contractor shall be liable for all damages caused thereby, including the cost of correcting the Work.

- 1.6 Sales Tax Exemption and Other Taxes. To the extent that materials and supplies are used or incorporated in the performance of this Contract, the Contractor is considered an exempt purchaser under the Massachusetts Sales Act, Chapter 14 of the Acts of 1966. The Contractor shall pay all taxes and tariffs of any sort related to the Work, subject to the applicable exemptions.
- 1.7 Permits, Fees and Notices. The Contractor shall secure and pay for all permits and governmental fees, licenses, and inspections necessary for proper execution and completion of the Work. The Contractor shall coordinate all efforts required to obtain these permits unless otherwise directed in writing by the Owner. The Contractor shall comply with and give notices required by laws, ordinances, rules, regulations, codes, and lawful orders of public authorities bearing on the performance of the Work.
- 1.8 Safety Requirements. The Contractor shall comply with all Federal, State, and local safety laws and regulations applicable to the Work.
- 1.9 Minimum Wage Rates. The Contractor shall comply with M.G.L. c. 149, §§ 26- 27H. The wage schedule found in the Project Manual lists the minimum wage rates that must be paid to all workers employed in the Work throughout the term of this Contract, subject to the exceptions provided in M.G.L. c.149, §§ 26-27H. The Owner is not responsible for any errors, omissions, or misprints in the said schedule. The Contractor shall not have any claim for extra compensation from the Owner arising from the fact that the actual wages paid to workers employed in the Work exceed the rates listed on the schedule or as otherwise provided by law. The Contractor shall cause a copy of the schedule to be posted in a conspicuous place at the Site during the term of the Contract. If reserve police officers are employed by the Contractor, they shall be paid the prevailing wage of regular police officers. (See M.G.L. c. 149, § 34B).
- 1.10 Corporate Disclosures. The Contractor, if a foreign corporation, shall comply with M.G.L. c. 181, §§ 3 and 5, and M.G.L. c. 30, § 39L.
- 1.11 Safety Requirements; OSHA Training [M.G.L. c. 30, s. 39S]. The Contractor shall comply and shall cause all subcontractors and persons employed on the Work to comply with all applicable safety requirements. By executing this contract the Contractor hereby certifies that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and that all employees to be employed in the work subject to this bid have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration. Any employee found on a worksite subject to this section without documentation of successful completion of a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration shall be subject to immediate removal.
- 1.12 Payroll Records and Statement of Compliance. The Contractor shall comply and shall cause its subcontractors to comply with Massachusetts General Law c. 149, § 27B, which requires that a true and accurate record be kept of all persons employed on a project for which the prevailing wage rates have been provided. The Contractor and all Subcontractors shall keep these records and preserve them for a period of six years from the date of completion of the Contract. Such records shall be open to inspection by any authorized representative of the Owner at any reasonable time, and as often as may be necessary. The Contractor shall, and shall cause its subcontractors to, submit weekly copies of their weekly payroll records to the Owner. In addition, the Contractor and each Subcontractor shall furnish to the Executive Department of Labor within fifteen days after completion of its portion of the Work a signed statement in the form required by the Owner.

- 1.13 Workforce Qualifications. The Contractor shall: (i) employ competent workers; (ii) enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Work; (iii) not permit employment of unfit persons or persons not skilled in tasks assigned to them. Whenever the Contracting Officer shall notify the Contractor in writing that any worker is, in the Contracting Officer's opinion, incompetent, unfaithful, disorderly, or otherwise unsatisfactory, such employee shall be discharged from the Work and shall not again be employed on the Work except with the consent of the Contracting Officer.
- 1.14 Non-Discrimination in Hiring and Employment. By signing this Contract the Contractor hereby certifies under the pains and penalties of perjury that the Contractor currently complies with and will continue to comply with all federal and state laws, rules and regulations promoting fair employment practices or prohibiting employment discrimination and unfair labor practices and shall not discriminate in the hiring of any applicant for employment nor shall any qualified employee be demoted, discharged or otherwise subject to discrimination in the tenure, position, promotional opportunities, wages, benefits or terms and conditions of their employment because of race, color, national origin, ancestry, age, sex, religion, disability, handicap, sexual orientation or for exercising any rights afforded by law.
- 1.15 Veterans Preference. In the employment of mechanics and apprentices, teamsters, chauffeurs, and laborers in the performance of Work in the Commonwealth, preference shall first be given to citizens of the Commonwealth who have been residents of the Commonwealth for at least six months at the commencement of their employment and who are veterans as defined M.G.L. c. 4, § 7 (34), and who are qualified to perform the work to which the employment relates and, within such preference, preference shall be given to service-disabled veterans; and secondly, to citizens of the Commonwealth generally who have been residents of the Commonwealth for at least six months at the commencement of their employment, and if they cannot be obtained in sufficient numbers, then to citizens of the United States.
- 1.16 Weekly or Bi-weekly wage payments [M.G.L. c. 149, § 148]. The Contractor shall comply with and shall cause its Subcontractors to comply with M.G.L. c. 149, § 148, which requires the weekly or bi-weekly payment of employees within six days of the end of the pay period during which wages were earned if employed for five or six days of a calendar week, and within other periods of time under certain circumstances as set forth therein.
- 1.17 Labor Harmony [M.G.L. c. 30, s. 39S]. By executing this contract, the Contractor hereby certifies that (1) that Contractor is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work. The Contractor shall procure materials from such sources and shall manage its own forces and the forces of its Subcontractors and any sub-subcontractors in such a manner as will result in harmonious labor relations on the site. The Contractor shall cause persons to be employed in the Work who will work in harmony with others so employed. Should the Work be stopped or materially delayed in the Owner's reasonable judgment due to a labor dispute, the Owner shall have the right to require the Contractor to employ substitutes acceptable to the Owner.
- 1.18 Risk of Loss. The Contractor shall bear the risk of loss with respect to any of its or its agents', employees' or subcontractors' vehicles, equipment or tools brought onto or left at the worksite and for any materials stored at the worksite.
- 1.19 CORI Checks. No person shall be given access to the Site without first passing a Criminal Offender Record Information (CORI) check. Contractor shall provide Owner with proof, satisfactory to Owner, that each employee, agent, contractor, subcontractor and invitee ("Contractor Worker(s)") that visits the site has passed a CORI check. The Contractor shall see to it that no Contractor Worker shall perform any Work at the Site if the Owner has objected to such person being at the site based upon information contained in the CORI check. The Contractor shall not allow any Contractor Worker on the site until the Owner has reviewed such worker's CORI check and has not objected within ten (10) days after the receipt of the

CORI check to such worker being at the site on account of the CORI check, unless the Owner waives such requirement for advance review of a Contractor Worker's CORI check prior to that worker entering the site (which waiver shall only be effective as to the Contractor Worker(s) that the Contractor requests the Owner to provide such waiver in each instance). Notwithstanding the foregoing, the Contractor shall remain liable for the conduct of its workers, employees, subcontractors, agents and invitees on Site.

2.0 MATERIALS AND EQUIPMENT WARRANTY

Materials and equipment to be installed as part of the Work (both or either of which are hereinafter referred to as "materials") shall be new, unused, of recent manufacture, assembled, and used in accordance with the best construction practices. The Contractor shall inform itself as to, and shall comply with, the provisions of M.G.L. c. 7, § 23A, as amended.

3.0 PROSECUTION OF THE WORK - LIQUIDATED DAMAGES

3.1. Beginning, Progress Schedule. The Contract time shall commence upon the date specified in the Notice to Proceed executed by the Contracting Officer and delivered to the Contractor after the execution of this Contract. The Contractor shall begin Work at the Site within ten days of said date unless otherwise ordered in writing by the Owner. Prior to commencing the Work, the Contractor shall meet with representatives of the Owner to discuss the quality assurance program, safety program, labor provisions, progress schedule, schedule of values, and other Contract procedures. Upon Approval by the Contracting Officer, the progress schedule shall constitute the progress schedule for the Work. Upon approval by the Contracting Officer, the schedule of values shall be the basis for payment for the Work. The Contractor shall at the end of each month, or more often if required, furnish to the Owner a schedule meeting the requirements of the Specifications showing the actual progress of the parts of the Work in comparison with the approved progress schedule.

3.2. Time for Completion of Work. Time is of the essence of this Contract. The Work shall be completed within the time specified in Agreement subject only to extensions specifically permitted in accordance with the terms of this Contract.

3.3. Definition of "Substantial Completion". For the purposes of this Contract the term "Substantial Completion" shall occur when (1) the Contractor fully completes the Work or substantially completes the Work so that the value of the Work remaining to be done is, in the estimate of the Owner, less than one percent of the original Contract price, or (2) the Contractor substantially completes the work and the Owner takes possession for occupancy, whichever occurs first. For the purposes of the preceding sentences the term "substantially completes" means that the work required by the Contract has been completed except for minor incomplete or unsatisfactory work items that do not materially impair the usefulness of the Work.

3.4. Failure to Complete Work on Time - Liquidated Damages.

Because both parties recognize (1) that the time for completion of this Contract is of the essence, (2) that the Owner will suffer loss if the work is not completed in accordance with the phasing requirements and within the contract time specified, plus any extensions thereof allowed in accordance with the provisions of this Contract, and (3) that there are significant delays, expense and difficulties associated with a legal proceeding to determine the actual loss suffered by the Owner if the work is not completed on time; therefore, it is agreed that the Contractor will pay the Owner, as liquidated damages, the sum of **five hundred dollars (\$500.00) per calendar day** for each and every day thereafter that it fails to deliver such Work completed according to the requirements of the Contract Documents. Such liquidated damages shall be paid not as a penalty, but to partially cover losses and expenses to the Owner, including intangible costs and losses that are or may be impracticable to ascertain. Allowing the Contractor to continue to finish the work (or any portion of the work) after the

time specified for completion of the Work shall not operate as a waiver on the part of the Owner of any of its rights under the Contract Documents or otherwise under law or equity. The Owner's right to impose liquidated damages shall in no way prohibit or restrict the Owner's right to bring legal action for damages in lieu of its option to impose liquidated damages from money due the Contractor, and if such money is insufficient to cover the liquidated damages, then the Contractor shall pay the amount due.

3.5 Collection of Liquidated Damages.

The Owner may recover liquidated damages by deducting the amount thereof from any moneys due or that might become due the Contractor, and if such moneys shall be insufficient to cover the liquidated damages, then the Contractor or the Surety shall pay to the Owner the amount due.

3.6 Owner's Approvals and Interpretations. Decisions by the Owner regarding interpretation of the specifications, approval of equipment, material or any other approval, or progress of the Work, shall be made promptly and, in any event, no later than thirty days after the Contractor's written submission for decision; but if such decision requires extended investigation and study, the Owner shall, within thirty days after the receipt of the submission, give the Contractor written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made.

3.7 Extension for Delays Caused by Owner. The only circumstances under which the Contract Price shall be increased due to delays caused by the Owner are those specified in M.G.L. c. 30, § 390. In all other cases the Contractor shall be entitled neither to increase the Contract Price nor to receive damages on account of any hindrances or delays, avoidable or unavoidable, but if the delay is caused by the Owner, the Contractor shall be entitled to an extension of time to the extent provided in M.G.L. c. 30, §390. The Contractor must submit any claim under this paragraph to the Owner in writing as soon as practicable after the end of the Owner's suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this Contract. Except for costs due to a suspension order, the Owner shall not approve any costs in the claim incurred more than 20 days before the Contractor notified the Owner in writing of the act or failure to act or the Owner that gave rise to the claim.

3.8 Owner's Right to Reject Defective Materials and Work. Except as otherwise provided herein, the Owner's inspection of the Work shall not relieve the Contractor of any of its responsibilities hereunder, and defective work shall be corrected. The Owner may reject unsuitable work, notwithstanding that such work and materials have been previously accepted for payment. If any part of the Work shall be found defective at any time before the final acceptance of the whole Work, the Contractor shall promptly correct such defect in a manner satisfactory to the Owner. If any material brought upon the site for use in the Work shall be rejected by the Owner as not in conformity with the Contract Documents, the Contractor shall promptly remove such materials from the site.

3.9 Substantial Completion of the Work; Final Completion; Owner's Remedies. When the Work has reached the point of Substantial Completion as shown on Approved payment request, the Contractor shall assist the Owner in the development of a punch list identifying those items of unfinished or unacceptable Work that remain to be performed or corrected under the Contract. The Contractor shall complete the punch list items to final completion within 30 days after the Owner's approval of the punch list. At any time after the value of the Work remaining to be done is, in the estimation of the Owner, less than 1 per cent of the adjusted Contract price, or the Owner has determined that the Contractor has substantially completed the work and the Owner has taken possession for occupancy, the Owner may send to the Contractor by certified mail, return receipt requested, a complete and final list of all incomplete and unsatisfactory work items, including, for each item on the list, a good faith estimate of the fair and reasonable cost of completing such item. The Contractor shall then complete all such work items within

30 days of receipt of such list or before the Contract completion date, whichever is later. If the Contractor fails to complete all incomplete and unsatisfactory work items within 45 days after receipt of such items furnished by the Owner or before the Contract completion date, whichever is later, subsequent to an additional 14 days' written notice to the Contractor by certified mail, return receipt requested, the Owner may terminate this Contract and complete the incomplete and unsatisfactory work items and charge the cost of same to the Contractor and such termination shall be without prejudice to any other rights or remedies the Owner may have under this Contract.

4.0 CHANGES IN THE WORK

4.1 Changes within the Scope of the Work. A change order may be issued by the Owner for changes in the Work within the scope of the Contract, including but not limited to, changes in: (1) the Plans and Specifications; (2) the method or manner of performance of the Work; (3) the Owner-furnished facilities, equipment, materials, services, or Site; or (4) the schedule for performance of the Work. The Contractor shall immediately perform any change order work that is ordered in writing by the Owner.

4.2. Request for Equitable Adjustment due to Change Order. Whenever a change order is issued by the Owner that will cause a change in the Contractor's cost or time for performance, the Contractor or the Owner may request an equitable adjustment in the Contract Price or the Contract time. A request for such an adjustment shall be in writing and shall be submitted by the party making such claim to the other party.

4.3. Latent Conditions. If, during the progress of the Work, the Contractor or the Owner discovers that the actual subsurface or latent physical conditions encountered at the Site differ substantially or materially from those indicated in the Contract Documents, then either the Contractor or the Owner may request an equitable adjustment in the Contract Price in accordance with M.G.L. c. 30, § 39N. Likewise if the latent or subsurface physical condition causes a change in the time for performing the Work, either the Contractor or the Owner may request an equitable adjustment of the time for the performance of the Work.

4.4 Computation of Equitable Adjustments. Equitable adjustments in the Contract Price shall be determined according to one of the following methods, or a combination thereof, as determined by the Owner: (1) fixed price basis, provided that the fixed price shall be inclusive of items described in 4.4.1 below and shall be computed in accordance with that provision; (2) estimated lump sum basis to be adjusted in accordance with Contract unit prices or other agreed upon unit prices provided that the unit prices shall be inclusive of all costs related to such equitable adjustment; (3) time and materials basis to be subsequently adjusted on the basis of actual costs (but subject to a predetermined "not to exceed limit") calculated as follows:

4.4.1 Where the value of work performed directly by the Contractor under an change order is determined either by a lump sum proposal or by actual cost of work as it progresses, the Contractor will be allowed an additional amount of ten percent (10%) of the total cost of work plus an additional amount of two percent (2%) for the cost of bonds and insurance associated with the added work. Where such work is performed by a Subcontractor, the Contractor will be allowed an additional amount of five percent (5%) to the total payment made to the Subcontractor, plus an additional amount of two percent (2%) for the cost of bonds and insurance associated with the added work. The cost of work shall include the cost at the minimum wage rates established for this contract pursuant to M.G.L. c. 149, §§ 26-27H for direct labor, material and use of equipment, plus the cost of workmen's compensation insurance, liability insurance, federal social security and Massachusetts unemployment compensation. The cost of work may include the cost of added mobilization, engineering, layout, transit staging/scaffolding, lifting, hoisting, dumpster, handling, cleanup, street sweeping, safety protection, temporary weather protection, temporary heat and utilities,

shipping/receiving, construction fences, police barricades and signs; provided, however, that such added costs may be included only to the extent that they are directly attributable to the added work and are properly substantiated as determined by the Owner and Architect, in their discretion. Mark-up for overhead, superintendence and profit shall include (and no additional payment shall be made for) general conditions, management, supervision coordination, record drawings, small tools/computers, "tools of the trade", administration, accounting, punch list, O&M manuals, estimator time, schedule updating, and certified payrolls. Contractor and Subcontractor mark-up of such rates for payroll costs associated FUI, SUI, MUI, worker's compensation insurance and other direct payroll costs, shall only be calculated on the direct labor rate as computed above and shall not exceed 30%, except that a higher rate may be allowed for subcontractors only to the extent such higher rate is based on actual payroll costs of the subcontractor for which substantiating documentation of how such higher cost is calculated provided, and no other labor cost mark-ups other than those specified above will be allowed.

4.5 Timely Decision by the Owner. In accordance with M.G.L. c. 30, § 39P, "Every contract subject to section thirty-nine M of this chapter or section forty-four A of chapter one hundred forty-nine which requires the awarding authority, any official, its architect or engineer to make a decision on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, shall require that the decision be made promptly and, in any event, no later than thirty days after the written submission for decision; but if such decision requires extended investigation and study, the awarding authority, the official, architect or engineer shall, within thirty days after the receipt of the submission, give the party making the submission written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made."

4.6 Work Performed Under Protest. The Contractor must perform any work required by the Owner. If it considers the work to be 'extra' and the Owner disagrees, the work must be performed under protest.

5.0 PAYMENT PROVISIONS

5.1 Applications for Periodic Payments. Once each month, on a date established at the beginning of the Work, the Contractor shall deliver to the Owner an itemized Application for Payment, supported by such data substantiating the Contractor's right to payment as the Owner may require. The application shall reflect a minimum of 5% retainage and shall be subject to, and processed in accordance with, the provisions of M.G.L. c. 30, §39K, which provides:

"Within fifteen days (30 days in the case of the commonwealth, including local housing authorities) after receipt from the contractor, at the place designated by the awarding authority if such a place is so designated, of a periodic estimate requesting payment of the amount due for the preceding month, the awarding authority will make a periodic payment to the contractor for the work performed during the preceding month and for the materials not incorporated in the work but delivered and suitably stored at the site (or at some location agreed upon in writing) to which the contractor has title or to which a subcontractor has title and has authorized the contractor to transfer title to the awarding authority, upon certification by the contractor that he is the lawful owner and that the materials are free from all encumbrances, but less (1) a retention based on its estimate of the fair value of its claims against the contractor and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, and less (3) a retention not exceeding five per cent of the approved amount of the periodic payment. After the receipt of a periodic estimate requesting final payment and within sixty-five days after (a) the contractor fully completes the work or substantially completes the work so that the value of the work remaining to be done is, in the estimate of the awarding authority, less than one per cent of the original contract price, or (b) the contractor substantially completes the work and the awarding authority takes possession for occupancy, whichever occurs first, the

awarding authority shall pay the contractor the entire balance due on the contract less (1) a retention based on its estimate of the fair value of its claims against the contractor and of the cost of completing the incomplete and unsatisfactory items of work and less (2) a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, or based on the record of payments by the contractor to the subcontractors under this contract if such record of payment indicates that the contractor has not paid subcontractors as provided in section thirty-nine F. If the awarding authority fails to make payment as herein provided, there shall be added to each such payment daily interest at the rate of three percentage points above the rediscount rate than charged by the Federal Reserve Bank of Boston commencing on the first day after said payment is due and continuing until the payment is delivered or mailed to the contractor; provided, that no interest shall be due, in any event, on the amount due on a periodic estimate for final payment until fifteen days (twenty-four days in the case of the commonwealth) after receipt of such a periodic estimate from the contractor, at the place designated by the awarding authority if such a place is so designated. The contractor agrees to pay to each subcontractor a portion of any such interest paid in accordance with the amount due each subcontractor.

The awarding authority may make changes in any periodic estimate submitted by the contractor and the payment due on said periodic estimate shall be computed in accordance with the changes so made, but such changes or any requirement for a corrected periodic estimate shall not affect the due date for the periodic payment or the date for the commencement of interest charges on the amount of the periodic payment computed in accordance with the changes made, as provided herein; provided, that the awarding authority may, within seven days after receipt, return to the contractor for correction, any periodic estimate which is not in the required form or which contains computations not arithmetically correct and, in that event, the date of receipt of such periodic estimate shall be the date of receipt of the corrected periodic estimate in proper form and with arithmetically correct computations. The date of receipt of a periodic estimate received on a Saturday shall be the first working day thereafter. The provisions of section thirty-nine G shall not apply to any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building to which this section applies.

All periodic estimates shall be submitted to the awarding authority, or to its designee as set forth in writing to the contractor, and the date of receipt by the awarding authority or its designee shall be marked on the estimate. All periodic estimates shall contain a separate item for each filed subtrade and each sub-subtrade listed in sub-bid form as required by specifications and a column listing the amount paid to each subcontractor and sub-subcontractor as of the date the periodic estimate is filed. The person making payment for the awarding authority shall add the daily interest provided for herein to each payment for each day beyond the due date based on the date of receipt marked on the estimate.

A certificate of the architect to the effect that the contractor has fully or substantially completed the work shall, subject to the provisions of section thirty-nine J, be conclusive for the purposes of this section.

Notwithstanding the provisions of this section, at any time after the value of the work remaining to be done is, in the estimation of the awarding authority, less than 1 per cent of the adjusted contract price, or the awarding authority has determined that the contractor has substantially completed the work and the awarding authority has taken possession for occupancy, the awarding authority may send to the general contractor by certified mail, return receipt requested, a complete and final list of all incomplete and unsatisfactory work items, including, for each item on the list, a good faith estimate of the fair and reasonable cost of completing such item. The general contractor shall then complete all such work items within 30 days of receipt of such list or before the contract completion date, whichever is later. If the general contractor fails to complete all incomplete and unsatisfactory work items within 45 days after receipt of such items furnished by the awarding authority or before the contract

completion date, whichever is later, subsequent to an additional 14 days' written notice to the general contractor by certified mail, return receipt requested, the awarding authority may terminate the contract and complete the incomplete and unsatisfactory work items and charge the cost of same to the general contractor and such termination shall be without prejudice to any other rights or remedies the awarding authority may have under the contract.

The awarding authority shall note any such termination in the evaluation form to be filed by the awarding authority pursuant to the provisions of section 44D of chapter 149.

- 5.1.1 The Contractor may include in a periodic estimate the value of materials or equipment delivered at the Site (or at some location agreed to in writing) only upon delivery to the Owner of: (1) an acceptable transfer of title on the form provided by the Owner; (2) written certification by the Contractor (or applicable subcontractor) on the form provided by the Owner that the Contractor (or the Subcontractor which executed the transfer of title) is the lawful owner and that the materials or equipment are free from all encumbrances, accompanied by receipted invoices or other acceptable proof of prior payment for such materials; (3) a stored materials insurance binder that covers the materials for which payment is requested, that names the Owner as an insured party should the stored materials be subjected to any casualty, loss, or theft prior to their inclusion in the Work. The material(s) or equipment must, in the judgment of the Designer (1) meet the requirements of the Contract, including prior shop drawing, product data, and sample approval, (2) be ready for use, and (3) be properly stored by the Contractor and be adequately protected until incorporated into the Work.
- 5.1.2 In submitting an Application for Payment, the Contractor warrants that title to all work covered by an application for payment will pass to the Owner either by incorporation into the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests, or encumbrances, hereinafter referred to in this article as 'liens.' The Contractor further agrees that the submission of any application for payment shall conclusively be deemed to waive all liens with respect to set work to which the Contractor may then be entitled, provided that such waiver of the lien rights shall not waive the Contractor's right to payment for such work.
- 5.1.3 Payment for materials stored off site shall be at the sole discretion of the Owner. Any additional costs to the Owner resulting from storage of material off site for which payment is requested, such as, but not limited to, travel expenses and time for inspectors, shall be charged to, and paid by, the Contractor.
- 5.2 Deductions by the Owner. The Owner may deduct from any application for a periodic payment submitted by the Contractor a retention based upon the value of its claims (including claims of defective work and liquidated damages) against the Contractor plus a retention of 5% of the approved amount of the Application for Payment and any other amounts authorized by M.G.L. c. 30, §§ 39F, 39G and/or 39K, as applicable.
- 5.3 Final Payment. Final Payment under this Contract shall be processed in accordance with the procedures set forth in M.G.L. c. 30, §§ 39F, 39G and/or 39K, as applicable. The acceptance by the Contractor of the last payment due under this Contract or the Contractor's execution of the Final Certificate of Completion, shall operate as a release to the Owner from all claims and liability related to this Contract.
- 5.4 Payment of Subcontractors. The Contractor shall make payment to subcontractors in accordance with M.G.L. c. 30, § 39F. For purposes of this Agreement, the word "forthwith" appearing in paragraph (1)(a) of M.G.L. c. 30, § 39F shall be deemed to mean "within five (5) business days." The Contractor shall, at the Owner's request, furnish satisfactory evidence that all such obligations have been paid, discharged, or waived.

6.0 WARRANTIES AND GUARANTEE

6.1 Warranty. The Contractor warrants to the Owner that materials and equipment furnished under the Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. The Contractor guarantees and warrants to the Owner that all labor furnished under this Agreement will be competent to perform the tasks undertaken that the product of such labor will yield only first-class results.

6.2 General Guaranty. If at any time during the period of one (1) year from the date of the its final completion, as shown on an approved payment request, the Work or any part of the Work shall in the reasonable determination of the Owner require replacing or repairing due to the fact that it is broken, defective, or otherwise does not conform to the Contract Documents, the Owner will notify the Contractor to make the required repairs or replacement. If the Contractor shall neglect to commence such repairs or replacements to the satisfaction of the Owner within ten (10) days from the date of giving or mailing such notice, then the Owner may employ other persons to make said repairs or replacements. The Contractor agrees, upon demand, to pay to the Owner all amounts which the Owner expends for such repairs or replacements. For items of work completed after substantial completion, the one-year guarantee shall commence at the time the Owner approves of the completion of such items. This one-year guarantee shall not limit any express guaranty or warranty required to be assigned to the Owner pursuant to the terms of the Plans and Specifications.

6.3 All guarantees and warranties required in the various Sections of the Specifications that originate with a Subcontractor or Manufacturer must be delivered to the Owner before final payment to the Contractor may be made for the amount of the sub-trade or for the phase of work to which the guarantee or warranty relates. The failure to deliver a required guarantee or warranty shall constitute a failure of the Subcontractor to fully complete its work in accordance with the Contract Documents. The Contractor's obligation to correct work is in addition to, and not in substitution of, such guarantees or warranties as may be required in the various Sections of the Specifications.

7.0 INSURANCE REQUIREMENTS

7.1 The Contractor shall purchase from, and maintain in a company or companies lawfully authorized to do business in the Commonwealth of Massachusetts, and to which the Owner has no reasonable objection, 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 herein.

7.2 The insurance required by the above shall be written for not less than the following amounts and shall be submitted on ACORD Certificate of Insurance Form 2.5-S (08/01) or other similar form acceptable to the Owner:

7.2.1 Commonwealth of Massachusetts Statutory Worker's Compensation and other benefits as required under the General Laws of Massachusetts, including Employer's Liability Part B: \$500,000/\$500,000/\$500,000.

- 7.2.2 Broad Form Commercial General Liability, written on a "per occurrence" basis with an aggregate cap no less than three (3) times the required limit: \$1,000,000 C.S.L. Property Damage Liability shall include coverage for X-C-U hazard of explosion, collapse, and damage to underground property.
- 7.2.3 Umbrella or Excess Liability coverage following form of underlying General, Automobile and Employers' Liability Coverage: (a) Minimum of \$2,000,000 C.S.L. over primary insurance; (b) No more than \$10,000 Retention.
- 7.2.4 Comprehensive Automobile Liability covering owned, non-owned, and hired or borrowed vehicles: \$1,000,000 C.S.L.
- 7.3 The above insurance policies shall also be subject to the following requirements:
- 7.3.1 Certificates of Insurance and copies of policies acceptable to the Owner shall be addressed to and filed with the Owner prior to commencement of the work. Renewal certificates shall be filed with the Owner at least thirty (30) days prior to the expiration date of required policies.
- 7.3.2 No insurance coverage shall be subject to cancellation or non-renewal without at least thirty (30) days prior written notice forwarded by registered or certified mail to the TOWN OF HOPKINTON. The Contractor shall notify the TOWN OF HOPKINTON of the attachment of any restrictive amendments, material changes or impairment to the policies.
- 7.3.3 All premium costs shall be included in Contractor's bid. The Contractor shall be responsible for the cost of any and all deductibles.
- 7.3.4 The TOWN OF HOPKINTON (including its officials, employees, agents and representatives) shall be named as additional insured on Contractor's General Liability, Automobile Liability, and Umbrella or Excess Liability Insurance Policies.
- 7.4 Neither the Owner's authority to review certificates and policies of insurance nor its decision to raise or not to raise any objections about those certificates and policies, shall in any way give rise to any duty or responsibility on the part of the Owner to exercise this authority for the benefit of the Contractor, any Subcontractor, Sub-subcontractor, or Supplier, or any other party.
- 7.5 The Contractor's liability insurance shall remain in effect until the end of the Correction period as defined in the Contract Documents, and at all times after that when the Contractor may be correcting, removing or replacing defective Work. The Completed Operations insurance shall be maintained for three (3) years after Final Payment.
- 7.6 Insufficient insurance shall not release the Contractor from any liability for breach of its obligations under this Agreement.

8.0 INDEMNIFICATION

To the fullest extent permitted by law, the Contractor shall defend, indemnify in whole or in part, defend, pay-on-behalf of and hold harmless the Owner, the Engineer, and the agents and employees of each from and against all claims, damages, losses and expenses, including but not limited to attorneys' fees and loss of use 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 otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this Article 8.

9.0 BONDS

The Contractor shall furnish a performance bond for the full amount of the Contract, and also a labor and materials payment bond for the full amount of the Contract, the form of which bonds are set forth in the Contract Documents, each of a surety company qualified to do business under State laws and satisfactory to the Owner, the premiums for which are to be included in the Contract Price and paid by the Contractor. These bonds shall (a) guarantee the faithful performance by the Contractor of all its obligations under this contract and (b) constitute the security required by M.G.L. c. 149, § 29 and M.G.L. c. 30, § 39A, as amended, for payment by the Contractor or its subcontractors used or employed in connection with the contract. Each bond shall incorporate by reference the terms of this contract. These bonds shall remain in effect for the entire guarantee period for each phase of the work, which shall commence on the date of Final Completion, as defined in the Contract Documents.

10.0 TERMINATION

10.1 Termination for Cause. If the Contractor is adjudged a bankrupt, or if the Contractor makes a general assignment for the benefit of the Contractor's creditors, or if a receiver is appointed on account of the Contractor's insolvency, or if the Contractor consistently or repeatedly refuses or fails, excepting cases of which extension of time is appropriated, to supply enough properly skilled workmen or proper materials, or if the Contractor fails to make prompt payment to the Subcontractors of for materials or labor, or persistently disregards law, ordinances, rules, regulations, or orders of any public authority having jurisdiction or disregards an instruction, order or decision of the Contracting Officer, or otherwise is guilty of a substantial violation of any provision of the contract, then the Contractor shall be in default, and the Owner may, without prejudice to any other right or remedy and upon written notice to the Contractor, take possession of all materials, tools, appliances, equipment, construction equipment, and machinery and vehicles, offices and other facilities on the project site and all material intended for the work, wherever stored, and seven (7) days after such notice, may terminate the employment of the Contractor, accept assignment of any or all Subcontractor's contracts pursuant to this Agreement, and furnish the work by whatever method the Owner may deem expedient. The Owner shall be entitled to collect from the Contractor all direct, indirect, and consequential damages suffered by the Owner of behalf of the Contractor's defaults. The Owner shall be entitled to hold all amounts due to Contractor at the date of termination until all of the Owner's damages have been established, and to apply such amounts to such damages.

10.1.1 The Owner shall incur no liability by reason of such termination.

10.2 Termination for Convenience.

10.2.1 In the event that this Contract is terminated by the Owner prior to the completion of construction and termination is not based on a reason listed in Paragraph 10.1, the Contractor shall be compensated for its costs incurred, including reasonable costs of de-mobilization, calculated on a percent completion basis covering the period of time between the last Approved application for payment and the date of termination.

10.2.2 Payment by the Owner pursuant to Subparagraph 10.2.1 shall be deemed to fully compensate the Contractor for all claims and expenses directly or indirectly attributable to the termination, including any claims for lost profits.

10.3 The Contractor shall not be relieved of liability to the Owner by virtue of any termination of this Contract, and any claim for damages against the Contractor relating to the Contractor's performance under this Contract shall survive any termination hereunder.

10.4 In the event of termination of this Contract, the Contractor shall promptly deliver to the Town all documents, work papers, calculations, computer programs, data, drawings, plans, and other tangible work product, or materials pertaining to the Services performed under this Contract to the time of termination.

11. NON-APPROPRIATION

Payments are subject to appropriation and shall be made only for work performed in accordance with the terms of this Contract. The Contractor shall not be obligated to perform, and may not perform, work outside the duration and scope of this Contract without an appropriate amendment to this Contract, and a sufficient appropriation(s) to support such additional work. The Owner may immediately terminate or suspend this Contract in the event that the appropriation(s) funding this Contract is eliminated or reduced to an amount which will be insufficient to support anticipated future obligations under this Contract.

12. RECORDS AND LAWS

The Contractor shall comply with M.G.L. c. 30, § 39R. The Contractor shall make, and keep for at least six years after final payment, books, records, and accounts, which in reasonable detail accurately and fairly reflect the transactions and dispositions of the Contractor.

13. DISPUTE RESOLUTION

Claims, disputes or other matters in question between the parties to this Contract arising out of or relating to this Contract or breach thereof shall be subject to and decided by the Superior Court of Massachusetts in Middlesex County, if jurisdiction exists, and if jurisdiction does not exist in the Superior Court, said action shall be brought in the Middlesex County District Court of Massachusetts. A claim, dispute or other matter may be submitted to mediation, in accordance with the provisions of the American Arbitration Association, at the sole discretion of the Owner.

13.1 In the event that the Owner elects to demand mediation to settle any claim, dispute or matter in question, the parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

14. CHOICE OF LAW

This Contract shall be construed under and governed by the laws of the Commonwealth of Massachusetts. The Contractor, and the agents thereof, agree to bring any federal or state legal proceedings arising under this Contract, in which either the Commonwealth or the Owner is a party, in a court of competent jurisdiction within the Commonwealth of Massachusetts. This section shall not be construed to limit any rights a party may have to intervene in any action, in any court or wherever, pending, in which the other is a party.

15. NOTICES

Notices to the Contractor shall be deemed given when hand delivered to the Contractor's Representative in person, or when deposited in the U.S. mail addressed to the Contractor at the Contractor's address specified in the Owner-Contractor Agreement, or when delivered by courier to either location. Unless otherwise specified in writing by the Owner, notices and deliveries to the Owner shall be effective only when delivered to the Owner at the address specified in the Owner-Contractor Agreement and date-stamped at the reception desk or for which a receipt has been signed by the agent or employee designated by the Owner to receive official notices.

END OF DOCUMENT

DOCUMENT 00 84 00

WAGE RATE DETERMINATION SCHEDULE

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

- A. The BIDDING REQUIREMENTS, CONTRACTING REQUIREMENTS, and applicable parts of DIVISION 1 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 MASSACHUSETTS PREVAILING WAGE LAW (MGL. c149, §§26-27H) - AN IMPORTANT GUIDE FOR CONTRACTORS DOING PUBLIC WORKS PROJECTS IN MASSACHUSETTS

A. Prevailing Wage Schedules

1. Every contractor should obtain a schedule of prevailing wage rates for every public works project from the Awarding Authority (city, town, county, district, state agency or authority). It is the Awarding Authority's responsibility to ensure that a copy of the wage schedule is provided to all contractors from whom estimates or bids are solicited for all projects. The Commonwealth of Massachusetts Division of Occupational Safety (DOS), Department of Labor and Workforce Development will not issue wage schedules directly to contractors or employees.
2. Once a wage schedule has been issued for a project by DOS, it will remain in effect for the entire project. Appeals of wage determinations or classifications of employment may be made to the DOS Commissioner.
3. A copy of the wage schedule is required to be posted at the work site.
4. A wage schedule issued for a project may not be used on any other project. If, by chance, an Awarding Authority fails to provide you with a wage schedule to use when figuring your bid, do not use one you may have from another project. In this case, you should contact DOS immediately and urge the Awarding Authority to contact DOS to correct the oversight.
5. The failure of an Awarding Authority to provide a wage schedule does not excuse a contractor from paying the prevailing rate.

B. Bidding

1. The Attorney General's Division of Fair Labor and Business Practices enforces the prevailing wage law. All bids must reflect prevailing wage rates. Contractors may be required by an Awarding Authority to "demonstrate how (they) could complete the project and comply with Massachusetts General Laws." The Division issued an "Advisory" discussing these and other points. For a copy, please contact the Attorney General's Office.

C. Paying Employees

1. Prevailing wages must be paid to all employees on public works projects regardless of whether they are employed by the general contractor, a filed sub-bidder or any sub-contractor. The prevailing wage applies equally to unionized and non-unionized workers.
2. All employees who perform work on a public works project must be paid hourly according to the wage schedule issued for the particular project.

3. The wage schedule issued for each project is in effect for the duration of that project. All wage increases listed on the schedule must be paid on the specified dates.
4. Employers are limited in the deductions that can be made from the hourly rate (represented as the "total rate" on the wage schedules). Only contributions to the following plans may be deducted:
 - Health and Welfare
 - Pension
 - Supplementary Unemployment
5. All contributions must be made to bona fide plans.
6. If an employer contributes to any, or all, of the above plans, it may deduct the hourly amount contributed from the "total rate." If the employer does not contribute to any of the benefit plans listed above, then the employee's hourly rate of pay will be the "total rate" from the wage schedule.
7. All other deductions, including but not limited to the following, may not be subtracted from the employee's hourly prevailing wage rate:
 - Vacation Time
 - Sick Time
 - Training Funds
 - Charitable Contributions
 - Worker's Compensation
 - Unemployment Insurance
 - Uniforms
8. Overtime, which must be paid to all employees who work more than 40 hours per week, shall be at least time-and-one-half the base rate ("total rate" less benefits, if any).
9. Any "separate check" given to an employee as the "benefit portion" of the prevailing wage may not be treated differently than the check for "base wages." All "separate checks" are considered wages and subject to state and federal taxes, unemployment insurance and worker's compensation requirements.

D. Payroll Records

1. Employers are required to submit weekly certified payroll reports to the Awarding Authority and keep them on file for three (3) years. A reporting form is sent along with each wage schedule that may be used. Each report must contain at least: the employee's name, address, occupational classification, hours worked and wages paid. Do not submit weekly payroll reports to DOS.
2. After each contractor completes its portion of the public works project, the contractor must submit a Statement of Compliance to DOS. A Statement of Compliance form is also sent along with each wage schedule issued.

E. Apprentices

1. If your company employs apprentices, they must be registered with the Division of Apprentice Training (DAT). All persons not registered with DAT must be paid the "total rate" listed on the wage schedule. An apprentice sheet showing percentages based on the apprentice steps is included with all wage schedules.

F. Penalties

1. Failure to pay the prevailing wage subjects the contractor to potential civil and criminal liability.

G. Wage schedules are issued by:

Massachusetts Department of Labor and Workforce Development
Division of Occupational Safety
19 Staniford Street
Boston, Massachusetts 02108
Telephone 617-727-3492

H. Enforcement is carried out by:

Office of the Attorney General
Fair Labor and Business Practices Division
200 Portland Street
Boston, Massachusetts 02114
Telephone 617-727-3465

1.03 WAGE RATES

A. Classifications and wage rates as established by the Commonwealth of Massachusetts Division of Occupational Safety (DOS), Department of Labor and Workforce Development under the provisions of MGL Chapter 149, Section 26 immediately follows this Document.

1. The rate per hour of the wages to be paid to mechanics, apprentices, teamsters, chauffeurs, and laborers employed on the work shall not be less than the rate of wages included under "Minimum Wage Rates".
2. The Contractor shall keep posted on the site a legible copy of said schedule. The Contractor shall also keep on file the wage rates and classifications of labor employed on this work in order that they may be available for inspection by the Awarding Authority, Administrator, or the Architect.
3. Apprentices employed pursuant to this determination of wage rates must be registered and approved by the State Apprenticeship Council. Wherever rates for journeymen or apprentices are not listed, and if any other labor is not included in this list, the Contract shall insert the rates of all those employed on the work.
4. The Contractor shall pay to any reserve police officers employed on the work the prevailing rate of wages paid to regular police officers as required by MGL Chapter 149 Section 34b, as amended. Such police officers shall be covered by Workmen's Compensation Insurance and Employer's Liability Insurance by the Contractor.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF DOCUMENT



MAURA HEALEY
Governor

KIM DRISCOLL
Lt. Governor

THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS

Prevailing Wage Rates

As determined by the Director under the provisions of the
Massachusetts General Laws, Chapter 149, Sections 26 to 27H

LAUREN JONES
Secretary

MICHAEL FLANAGAN
Director

Awarding Authority: Town of Hopkinton
Contract Number: 24-05-001 **City/Town:** HOPKINTON
Description of Work: Scope: installation, renovation, and repair of the systems and apparatus to provide comfort heating, ventilation and/or cooling within or associated with this building, including incidentals assoc.
Job Location: 73 Main St., Hopkinton, MA

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- **The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor.** For multi-year CM AT RISK projects, the awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. The annual update requirement is not applicable to 27F "rental of equipment" contracts. **The updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.**
- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the "Wage Request Number" on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or a sub-contractor.
- Apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentices must keep their apprentice identification card on their persons during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DAS regardless of whether they are registered with another federal, state, local, or private agency must be paid the journeyworker's rate.**
- Every contractor or subcontractor working on the construction project must submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee's name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. For a sample payroll reporting form go to <http://www.mass.gov/dols/pw>.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Contractors must obtain the wage schedules from awarding authorities. Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may file a complaint with the Fair Labor Division of the office of the Attorney General at (617) 727-3465.

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
Construction						
(2 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	01/01/2024	\$38.95	\$15.07	\$18.67	\$0.00	\$72.69
	06/01/2024	\$39.95	\$15.07	\$18.67	\$0.00	\$73.69
	12/01/2024	\$39.95	\$15.07	\$20.17	\$0.00	\$75.19
	01/01/2025	\$39.95	\$15.57	\$20.17	\$0.00	\$75.69
	06/01/2025	\$40.95	\$15.57	\$20.17	\$0.00	\$76.69
	12/01/2025	\$40.95	\$15.57	\$21.78	\$0.00	\$78.30
	01/01/2026	\$40.95	\$16.17	\$21.78	\$0.00	\$78.90
	06/01/2026	\$41.95	\$16.17	\$21.78	\$0.00	\$79.90
	12/01/2026	\$41.95	\$16.17	\$23.52	\$0.00	\$81.64
	01/01/2027	\$41.95	\$16.77	\$23.52	\$0.00	\$82.24
(3 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	01/01/2024	\$39.02	\$15.07	\$18.67	\$0.00	\$72.76
	06/01/2024	\$40.02	\$15.07	\$18.67	\$0.00	\$73.76
	12/01/2024	\$40.02	\$15.07	\$20.17	\$0.00	\$75.26
	01/01/2025	\$40.02	\$15.57	\$20.17	\$0.00	\$75.76
	06/01/2025	\$41.02	\$15.57	\$20.17	\$0.00	\$76.76
	12/01/2025	\$41.02	\$15.57	\$21.78	\$0.00	\$78.37
	01/01/2026	\$41.02	\$16.17	\$21.78	\$0.00	\$78.97
	06/01/2026	\$42.02	\$16.17	\$21.78	\$0.00	\$79.97
	12/01/2026	\$42.02	\$16.17	\$23.52	\$0.00	\$81.71
	01/01/2027	\$42.02	\$16.77	\$23.52	\$0.00	\$82.31
(4 & 5 AXLE) DRIVER - EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	01/01/2024	\$39.14	\$15.07	\$18.67	\$0.00	\$72.88
	06/01/2024	\$40.14	\$15.07	\$18.67	\$0.00	\$73.88
	12/01/2024	\$40.14	\$15.07	\$20.17	\$0.00	\$75.38
	01/01/2025	\$40.14	\$15.57	\$20.17	\$0.00	\$75.88
	06/01/2025	\$41.14	\$15.57	\$20.17	\$0.00	\$76.88
	12/01/2025	\$41.14	\$15.57	\$21.78	\$0.00	\$78.49
	01/01/2026	\$41.14	\$16.17	\$21.78	\$0.00	\$79.09
	06/01/2026	\$42.14	\$16.17	\$21.78	\$0.00	\$80.09
	12/01/2026	\$42.14	\$16.17	\$23.52	\$0.00	\$81.83
	01/01/2027	\$42.14	\$16.77	\$23.52	\$0.00	\$82.43
ADS/SUBMERSIBLE PILOT <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
AIR TRACK OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
AIR TRACK OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
	06/01/2024	\$39.94	\$9.65	\$17.14	\$0.00	\$66.73
	12/01/2024	\$41.27	\$9.65	\$17.14	\$0.00	\$68.06
	06/01/2025	\$42.66	\$9.65	\$17.14	\$0.00	\$69.45
	12/01/2025	\$44.04	\$9.65	\$17.14	\$0.00	\$70.83
	06/01/2026	\$45.48	\$9.65	\$17.14	\$0.00	\$72.27
	12/01/2026	\$46.92	\$9.65	\$17.14	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	12/01/2023	\$40.80	\$14.50	\$11.05	\$0.00	\$66.35
	06/01/2024	\$41.80	\$14.50	\$11.05	\$0.00	\$67.35
	12/01/2024	\$42.80	\$14.50	\$11.05	\$0.00	\$68.35
	06/01/2025	\$43.80	\$14.50	\$11.05	\$0.00	\$69.35
	12/01/2025	\$44.80	\$14.50	\$11.05	\$0.00	\$70.35
ASPHALT RAKER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
ASPHALT RAKER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$55.03	\$15.00	\$16.40	\$0.00	\$86.43
	06/01/2024	\$56.33	\$15.00	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.78	\$15.00	\$16.40	\$0.00	\$89.18
	06/01/2025	\$59.08	\$15.00	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.53	\$15.00	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.83	\$15.00	\$16.40	\$0.00	\$93.23
	12/01/2026	\$63.28	\$15.00	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BACKHOE/FRONT-END LOADER <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$55.03	\$15.00	\$16.40	\$0.00	\$86.43
	06/01/2024	\$56.33	\$15.00	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.78	\$15.00	\$16.40	\$0.00	\$89.18
	06/01/2025	\$59.08	\$15.00	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.53	\$15.00	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.83	\$15.00	\$16.40	\$0.00	\$93.23
	12/01/2026	\$63.28	\$15.00	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
BARCO-TYPE JUMPING TAMPER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
	06/01/2024	\$39.94	\$9.65	\$17.14	\$0.00	\$66.73
	12/01/2024	\$41.27	\$9.65	\$17.14	\$0.00	\$68.06
	06/01/2025	\$42.66	\$9.65	\$17.14	\$0.00	\$69.45
	12/01/2025	\$44.04	\$9.65	\$17.14	\$0.00	\$70.83
	06/01/2026	\$45.48	\$9.65	\$17.14	\$0.00	\$72.27
	12/01/2026	\$46.92	\$9.65	\$17.14	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
BOILER MAKER <i>BOILERMAKERS LOCAL 29</i>	01/01/2024	\$48.12	\$7.07	\$20.60	\$0.00	\$75.79

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - BOILERMAKER - Local 29

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	65	\$31.28	\$7.07	\$13.22	\$0.00	\$51.57
2	65	\$31.28	\$7.07	\$13.22	\$0.00	\$51.57
3	70	\$33.68	\$7.07	\$14.23	\$0.00	\$54.98
4	75	\$36.09	\$7.07	\$15.24	\$0.00	\$58.40
5	80	\$38.50	\$7.07	\$16.25	\$0.00	\$61.82
6	85	\$40.90	\$7.07	\$17.28	\$0.00	\$65.25
7	90	\$43.31	\$7.07	\$18.28	\$0.00	\$68.66
8	95	\$45.71	\$7.07	\$19.32	\$0.00	\$72.10

Notes:

Apprentice to Journeyworker Ratio:1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)	02/01/2024	\$60.26	\$11.49	\$22.90	\$0.00	\$94.65
BRICKLAYERS LOCAL 3 (LOWELL)	08/01/2024	\$62.36	\$11.49	\$22.90	\$0.00	\$96.75
	02/01/2025	\$63.66	\$11.49	\$22.90	\$0.00	\$98.05
	08/01/2025	\$65.81	\$11.49	\$22.90	\$0.00	\$100.20
	02/01/2026	\$67.16	\$11.49	\$22.90	\$0.00	\$101.55
	08/01/2026	\$69.36	\$11.49	\$22.90	\$0.00	\$103.75
	02/01/2027	\$70.76	\$11.49	\$22.90	\$0.00	\$105.15

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - BRICK/PLASTER/CEMENT MASON - Local 3 Lowell

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.13	\$11.49	\$22.90	\$0.00	\$64.52
2	60	\$36.16	\$11.49	\$22.90	\$0.00	\$70.55
3	70	\$42.18	\$11.49	\$22.90	\$0.00	\$76.57
4	80	\$48.21	\$11.49	\$22.90	\$0.00	\$82.60
5	90	\$54.23	\$11.49	\$22.90	\$0.00	\$88.62

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.18	\$11.49	\$22.90	\$0.00	\$65.57
2	60	\$37.42	\$11.49	\$22.90	\$0.00	\$71.81
3	70	\$43.65	\$11.49	\$22.90	\$0.00	\$78.04
4	80	\$49.89	\$11.49	\$22.90	\$0.00	\$84.28
5	90	\$56.12	\$11.49	\$22.90	\$0.00	\$90.51

Notes:

Apprentice to Journeyworker Ratio:1:5

BULLDOZER/GRADER/SCRAPER	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
<i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

CAISSON & UNDERPINNING BOTTOM MAN	12/01/2023	\$45.48	\$9.65	\$18.22	\$0.00	\$73.35
<i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$46.96	\$9.65	\$18.22	\$0.00	\$74.83
	12/01/2024	\$48.43	\$9.65	\$18.22	\$0.00	\$76.30
	06/01/2025	\$49.93	\$9.65	\$18.22	\$0.00	\$77.80
	12/01/2025	\$51.43	\$9.65	\$18.22	\$0.00	\$79.30
	06/01/2026	\$52.98	\$9.65	\$18.22	\$0.00	\$80.85
	12/01/2026	\$54.48	\$9.65	\$18.22	\$0.00	\$82.35

For apprentice rates see "Apprentice- LABORER"

CAISSON & UNDERPINNING LABORER	12/01/2023	\$44.33	\$9.65	\$18.22	\$0.00	\$72.20
<i>LABORERS - FOUNDATION AND MARINE</i>	06/01/2024	\$45.81	\$9.65	\$18.22	\$0.00	\$73.68
	12/01/2024	\$47.28	\$9.65	\$18.22	\$0.00	\$75.15
	06/01/2025	\$48.78	\$9.65	\$18.22	\$0.00	\$76.65
	12/01/2025	\$50.28	\$9.65	\$18.22	\$0.00	\$78.15
	06/01/2026	\$51.83	\$9.65	\$18.22	\$0.00	\$79.70
	12/01/2026	\$53.33	\$9.65	\$18.22	\$0.00	\$81.20

For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CAISSON & UNDERPINNING TOP MAN <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2023	\$44.33	\$9.65	\$18.22	\$0.00	\$72.20
	06/01/2024	\$45.81	\$9.65	\$18.22	\$0.00	\$73.68
	12/01/2024	\$47.28	\$9.65	\$18.22	\$0.00	\$75.15
	06/01/2025	\$48.78	\$9.65	\$18.22	\$0.00	\$76.65
	12/01/2025	\$50.28	\$9.65	\$18.22	\$0.00	\$78.15
	06/01/2026	\$51.83	\$9.65	\$18.22	\$0.00	\$79.70
	12/01/2026	\$53.33	\$9.65	\$18.22	\$0.00	\$81.20

For apprentice rates see "Apprentice- LABORER"

CARBIDE CORE DRILL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

CARPENTER <i>CARPENTERS -ZONE 2 (Eastern Massachusetts)</i>	03/01/2024	\$47.12	\$9.83	\$19.97	\$0.00	\$76.92
	09/01/2024	\$48.37	\$9.83	\$19.97	\$0.00	\$78.17
	03/01/2025	\$49.62	\$9.83	\$19.97	\$0.00	\$79.42
	09/01/2025	\$50.87	\$9.83	\$19.97	\$0.00	\$80.67
	03/01/2026	\$52.12	\$9.83	\$19.97	\$0.00	\$81.92
	09/01/2026	\$53.37	\$9.83	\$19.97	\$0.00	\$83.17
	03/01/2027	\$54.62	\$9.83	\$19.97	\$0.00	\$84.42

Apprentice - CARPENTER - Zone 2 Eastern MA

Effective Date - 03/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$21.20	\$9.83	\$1.73	\$0.00	\$32.76
2	45	\$21.20	\$9.83	\$1.73	\$0.00	\$32.76
3	55	\$25.92	\$9.83	\$3.40	\$0.00	\$39.15
4	55	\$25.92	\$9.83	\$3.40	\$0.00	\$39.15
5	70	\$32.98	\$9.83	\$16.51	\$0.00	\$59.32
6	70	\$32.98	\$9.83	\$16.51	\$0.00	\$59.32
7	80	\$37.70	\$9.83	\$18.24	\$0.00	\$65.77
8	80	\$37.70	\$9.83	\$18.24	\$0.00	\$65.77

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$21.77	\$9.83	\$1.73	\$0.00	\$33.33
2	45	\$21.77	\$9.83	\$1.73	\$0.00	\$33.33
3	55	\$26.60	\$9.83	\$3.40	\$0.00	\$39.83
4	55	\$26.60	\$9.83	\$3.40	\$0.00	\$39.83
5	70	\$33.86	\$9.83	\$16.51	\$0.00	\$60.20
6	70	\$33.86	\$9.83	\$16.51	\$0.00	\$60.20
7	80	\$38.70	\$9.83	\$18.24	\$0.00	\$66.77
8	80	\$38.70	\$9.83	\$18.24	\$0.00	\$66.77

Notes:

Apprentice to Journeyworker Ratio:1:5

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
CARPENTER WOOD FRAME <i>CARPENTERS-ZONE 3 (Wood Frame)</i>	10/01/2023	\$25.55	\$7.02	\$4.80	\$0.00	\$37.37
	10/01/2024	\$26.65	\$7.02	\$4.80	\$0.00	\$38.47
	10/01/2025	\$27.75	\$7.02	\$4.80	\$0.00	\$39.57
	10/01/2026	\$28.85	\$7.02	\$4.80	\$0.00	\$40.67

All Aspects of New Wood Frame Work

Apprentice - CARPENTER (Wood Frame) - Zone 3

Effective Date - 10/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$15.33	\$7.02	\$0.00	\$0.00	\$22.35
2	60	\$15.33	\$7.02	\$0.00	\$0.00	\$22.35
3	65	\$16.61	\$7.02	\$1.00	\$0.00	\$24.63
4	70	\$17.89	\$7.02	\$1.00	\$0.00	\$25.91
5	75	\$19.16	\$7.02	\$4.80	\$0.00	\$30.98
6	80	\$20.44	\$7.02	\$4.80	\$0.00	\$32.26
7	85	\$21.72	\$7.02	\$4.80	\$0.00	\$33.54
8	90	\$23.00	\$7.02	\$4.80	\$0.00	\$34.82

Effective Date - 10/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$15.99	\$7.02	\$0.00	\$0.00	\$23.01
2	60	\$15.99	\$7.02	\$0.00	\$0.00	\$23.01
3	65	\$17.32	\$7.02	\$1.00	\$0.00	\$25.34
4	70	\$18.66	\$7.02	\$1.00	\$0.00	\$26.68
5	75	\$19.99	\$7.02	\$4.80	\$0.00	\$31.81
6	80	\$21.32	\$7.02	\$4.80	\$0.00	\$33.14
7	85	\$22.65	\$7.02	\$4.80	\$0.00	\$34.47
8	90	\$23.99	\$7.02	\$4.80	\$0.00	\$35.81

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 \$18.52/ 3&4 \$21.07/ 5&6 \$28.70/ 7&8 \$31.26

Apprentice to Journeyworker Ratio:1:5

CEMENT MASONRY/PLASTERING <i>BRICKLAYERS LOCAL 3 (LOWELL)</i>	01/01/2024	\$49.33	\$13.00	\$23.57	\$1.30	\$87.20
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Apprentice - CEMENT MASONRY/PLASTERING - Lowell

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.67	\$13.00	\$15.93	\$0.00	\$53.60
2	60	\$29.60	\$13.00	\$18.57	\$1.30	\$62.47
3	65	\$32.06	\$13.00	\$19.57	\$1.30	\$65.93
4	70	\$34.53	\$13.00	\$20.57	\$1.30	\$69.40
5	75	\$37.00	\$13.00	\$21.57	\$1.30	\$72.87
6	80	\$39.46	\$13.00	\$22.57	\$1.30	\$76.33
7	90	\$44.40	\$13.00	\$23.57	\$1.30	\$82.27

Notes:
Steps 3,4 are 500 hrs. All other steps are 1,000 hrs.

Apprentice to Journeyworker Ratio:1:3

CHAIN SAW OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$56.13	\$15.00	\$16.40	\$0.00	\$87.53
	06/01/2024	\$57.45	\$15.00	\$16.40	\$0.00	\$88.85
	12/01/2024	\$58.93	\$15.00	\$16.40	\$0.00	\$90.33
	06/01/2025	\$60.26	\$15.00	\$16.40	\$0.00	\$91.66
	12/01/2025	\$61.73	\$15.00	\$16.40	\$0.00	\$93.13
	06/01/2026	\$63.06	\$15.00	\$16.40	\$0.00	\$94.46
	12/01/2026	\$64.54	\$15.00	\$16.40	\$0.00	\$95.94

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

COMPRESSOR OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$35.62	\$15.00	\$16.40	\$0.00	\$67.02
	06/01/2024	\$36.47	\$15.00	\$16.40	\$0.00	\$67.87
	12/01/2024	\$37.42	\$15.00	\$16.40	\$0.00	\$68.82
	06/01/2025	\$38.27	\$15.00	\$16.40	\$0.00	\$69.67
	12/01/2025	\$39.22	\$15.00	\$16.40	\$0.00	\$70.62
	06/01/2026	\$40.08	\$15.00	\$16.40	\$0.00	\$71.48
	12/01/2026	\$41.03	\$15.00	\$16.40	\$0.00	\$72.43

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

DELEADER (BRIDGE) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2024	\$56.06	\$9.95	\$23.95	\$0.00	\$89.96
	07/01/2024	\$57.26	\$9.95	\$23.95	\$0.00	\$91.16
	01/01/2025	\$58.46	\$9.95	\$23.95	\$0.00	\$92.36

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.03	\$9.95	\$0.00	\$0.00	\$37.98
2	55	\$30.83	\$9.95	\$6.66	\$0.00	\$47.44
3	60	\$33.64	\$9.95	\$7.26	\$0.00	\$50.85
4	65	\$36.44	\$9.95	\$7.87	\$0.00	\$54.26
5	70	\$39.24	\$9.95	\$20.32	\$0.00	\$69.51
6	75	\$42.05	\$9.95	\$20.93	\$0.00	\$72.93
7	80	\$44.85	\$9.95	\$21.53	\$0.00	\$76.33
8	90	\$50.45	\$9.95	\$22.74	\$0.00	\$83.14

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.63	\$9.95	\$0.00	\$0.00	\$38.58
2	55	\$31.49	\$9.95	\$6.66	\$0.00	\$48.10
3	60	\$34.36	\$9.95	\$7.26	\$0.00	\$51.57
4	65	\$37.22	\$9.95	\$7.87	\$0.00	\$55.04
5	70	\$40.08	\$9.95	\$20.32	\$0.00	\$70.35
6	75	\$42.95	\$9.95	\$20.93	\$0.00	\$73.83
7	80	\$45.81	\$9.95	\$21.53	\$0.00	\$77.29
8	90	\$51.53	\$9.95	\$22.74	\$0.00	\$84.22

Notes:
 Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

DEMO: ADZEMAN LABORERS - ZONE 2	12/01/2023	\$44.48	\$9.65	\$18.07	\$0.00	\$72.20
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For apprentice rates see "Apprentice- LABORER"

DEMO: BACKHOE/LOADER/HAMMER OPERATOR LABORERS - ZONE 2	12/01/2023	\$45.48	\$9.65	\$18.07	\$0.00	\$73.20
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For apprentice rates see "Apprentice- LABORER"

DEMO: BURNERS LABORERS - ZONE 2	12/01/2023	\$45.23	\$9.65	\$18.07	\$0.00	\$72.95
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For apprentice rates see "Apprentice- LABORER"

DEMO: CONCRETE CUTTER/SAWYER LABORERS - ZONE 2	12/01/2023	\$45.48	\$9.65	\$18.07	\$0.00	\$73.20
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For apprentice rates see "Apprentice- LABORER"

DEMO: JACKHAMMER OPERATOR LABORERS - ZONE 2	12/01/2023	\$45.23	\$9.65	\$18.07	\$0.00	\$72.95
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For apprentice rates see "Apprentice- LABORER"

DEMO: WRECKING LABORER LABORERS - ZONE 2	12/01/2023	\$44.48	\$9.65	\$18.07	\$0.00	\$72.20
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For apprentice rates see "Apprentice- LABORER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
DIRECTIONAL DRILL MACHINE OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
DIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$68.70	\$9.40	\$23.12	\$0.00	\$101.22
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER TENDER (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$73.60	\$9.40	\$23.12	\$0.00	\$106.12
For apprentice rates see "Apprentice- PILE DRIVER"						
DIVER/SLURRY (EFFLUENT) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$103.05	\$9.40	\$23.12	\$0.00	\$135.57
For apprentice rates see "Apprentice- PILE DRIVER"						
DRAWBRIDGE OPERATOR (Construction) <i>DRAWBRIDGE - SEIU LOCAL 888</i>	07/01/2020	\$26.77	\$6.67	\$3.93	\$0.16	\$37.53
ELECTRICIAN <i>ELECTRICIANS LOCAL 96</i>	09/03/2023	\$45.99	\$13.00	\$18.84	\$0.00	\$77.83
	09/01/2024	\$47.05	\$13.99	\$19.22	\$0.00	\$80.26
	09/07/2025	\$48.16	\$14.98	\$19.60	\$0.00	\$82.74
	09/06/2026	\$49.38	\$15.96	\$20.00	\$0.00	\$85.34

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - ELECTRICIAN - Local 96

Effective Date - 09/03/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$18.40	\$13.00	\$0.55	\$0.00	\$31.95
2	45	\$20.70	\$13.00	\$0.62	\$0.00	\$34.32
3	48	\$22.08	\$13.00	\$15.49	\$0.00	\$50.57
4	55	\$25.29	\$13.00	\$15.94	\$0.00	\$54.23
5	65	\$29.89	\$13.00	\$16.59	\$0.00	\$59.48
6	80	\$36.79	\$13.00	\$17.55	\$0.00	\$67.34

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$18.82	\$13.99	\$0.56	\$0.00	\$33.37
2	45	\$21.17	\$13.99	\$0.64	\$0.00	\$35.80
3	48	\$22.58	\$13.99	\$15.79	\$0.00	\$52.36
4	55	\$25.88	\$13.99	\$16.26	\$0.00	\$56.13
5	65	\$30.58	\$13.99	\$16.91	\$0.00	\$61.48
6	80	\$37.64	\$13.99	\$17.90	\$0.00	\$69.53

Notes:

Steps 1-2 are 1000 hrs; Steps 3-6 are 1500 hrs.

Apprentice to Journeyworker Ratio:2:3***

ELEVATOR CONSTRUCTOR	01/01/2022	\$65.62	\$16.03	\$20.21	\$0.00	\$101.86
ELEVATOR CONSTRUCTORS LOCAL 4						

Apprentice - ELEVATOR CONSTRUCTOR - Local 4

Effective Date - 01/01/2022

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.81	\$16.03	\$0.00	\$0.00	\$48.84
2	55	\$36.09	\$16.03	\$20.21	\$0.00	\$72.33
3	65	\$42.65	\$16.03	\$20.21	\$0.00	\$78.89
4	70	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
5	80	\$52.50	\$16.03	\$20.21	\$0.00	\$88.74

Notes:

Steps 1-2 are 6 mos.; Steps 3-5 are 1 year

Apprentice to Journeyworker Ratio:1:1

ELEVATOR CONSTRUCTOR HELPER	01/01/2022	\$45.93	\$16.03	\$20.21	\$0.00	\$82.17
ELEVATOR CONSTRUCTORS LOCAL 4						

For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	11/01/2023	\$50.30	\$14.50	\$16.15	\$0.00	\$80.95
	05/01/2024	\$51.54	\$14.50	\$16.15	\$0.00	\$82.19
	11/01/2024	\$52.83	\$14.50	\$16.15	\$0.00	\$83.48
	05/01/2025	\$54.27	\$14.50	\$16.15	\$0.00	\$84.92
	11/01/2025	\$55.56	\$14.50	\$16.15	\$0.00	\$86.21
	05/01/2026	\$57.00	\$14.50	\$16.15	\$0.00	\$87.65
	11/01/2026	\$58.29	\$14.50	\$16.15	\$0.00	\$88.94
05/01/2027	\$59.72	\$14.50	\$16.15	\$0.00	\$90.37	
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	11/01/2023	\$51.87	\$14.50	\$16.15	\$0.00	\$82.52
	05/01/2024	\$53.12	\$14.50	\$16.15	\$0.00	\$83.77
	11/01/2024	\$54.42	\$14.50	\$16.15	\$0.00	\$85.07
	05/01/2025	\$55.87	\$14.50	\$16.15	\$0.00	\$86.52
	11/01/2025	\$57.17	\$14.50	\$16.15	\$0.00	\$87.82
	05/01/2026	\$58.62	\$14.50	\$16.15	\$0.00	\$89.27
	11/01/2026	\$59.92	\$14.50	\$16.15	\$0.00	\$90.57
05/01/2027	\$61.37	\$14.50	\$16.15	\$0.00	\$92.02	
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY <i>OPERATING ENGINEERS LOCAL 4</i>	11/01/2023	\$24.93	\$14.50	\$16.15	\$0.00	\$55.58
	05/01/2024	\$25.66	\$14.50	\$16.15	\$0.00	\$56.31
	11/01/2024	\$26.42	\$14.50	\$16.15	\$0.00	\$57.07
	05/01/2025	\$27.27	\$14.50	\$16.15	\$0.00	\$57.92
	11/01/2025	\$28.03	\$14.50	\$16.15	\$0.00	\$58.68
	05/01/2026	\$28.88	\$14.50	\$16.15	\$0.00	\$59.53
	11/01/2026	\$29.64	\$14.50	\$16.15	\$0.00	\$60.29
05/01/2027	\$30.49	\$14.50	\$16.15	\$0.00	\$61.14	
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FIRE ALARM INSTALLER <i>ELECTRICIANS LOCAL 96</i>	09/03/2023	\$45.99	\$13.00	\$18.84	\$0.00	\$77.83
	09/01/2024	\$47.05	\$13.99	\$19.22	\$0.00	\$80.26
	09/07/2025	\$48.16	\$14.98	\$19.60	\$0.00	\$82.74
	09/06/2026	\$49.38	\$15.96	\$20.00	\$0.00	\$85.34
For apprentice rates see "Apprentice- ELECTRICIAN"						
FIRE ALARM REPAIR / MAINT/COMMISSIONING <i>ELECTRICIANS LOCAL 96</i>	09/03/2023	\$45.99	\$13.00	\$18.84	\$0.00	\$77.83
	09/01/2024	\$47.05	\$13.99	\$19.22	\$0.00	\$80.26
	09/07/2025	\$48.16	\$14.98	\$19.60	\$0.00	\$82.74
	09/06/2026	\$49.38	\$15.96	\$20.00	\$0.00	\$85.34
For apprentice rates see "Apprentice- ELECTRICIAN"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
FIREMAN (ASST. ENGINEER) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$44.47	\$15.00	\$16.40	\$0.00	\$75.87
	06/01/2024	\$45.53	\$15.00	\$16.40	\$0.00	\$76.93
	12/01/2024	\$46.71	\$15.00	\$16.40	\$0.00	\$78.11
	06/01/2025	\$47.77	\$15.00	\$16.40	\$0.00	\$79.17
	12/01/2025	\$48.94	\$15.00	\$16.40	\$0.00	\$80.34
	06/01/2026	\$50.00	\$15.00	\$16.40	\$0.00	\$81.40
	12/01/2026	\$51.18	\$15.00	\$16.40	\$0.00	\$82.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
FLAGGER & SIGNALER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$25.48	\$9.65	\$17.14	\$0.00	\$52.27
	06/01/2024	\$26.51	\$9.65	\$17.14	\$0.00	\$53.30
	12/01/2024	\$26.51	\$9.65	\$17.14	\$0.00	\$53.30
	06/01/2025	\$27.59	\$9.65	\$17.14	\$0.00	\$54.38
	12/01/2025	\$27.59	\$9.65	\$17.14	\$0.00	\$54.38
	06/01/2026	\$28.71	\$9.65	\$17.14	\$0.00	\$55.50
	12/01/2026	\$28.71	\$9.65	\$17.14	\$0.00	\$55.50
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
FLOORCOVERER <i>FLOORCOVERERS LOCAL 2168 ZONE 1</i>	03/01/2024	\$54.73	\$8.83	\$20.27	\$0.00	\$83.83
	09/01/2024	\$56.23	\$8.83	\$20.27	\$0.00	\$85.33
	03/01/2025	\$57.73	\$8.83	\$20.27	\$0.00	\$86.83
	09/01/2025	\$59.23	\$8.83	\$20.27	\$0.00	\$88.33
	03/01/2026	\$60.73	\$8.83	\$20.27	\$0.00	\$89.83
	09/01/2026	\$62.23	\$8.83	\$20.27	\$0.00	\$91.33
	03/01/2027	\$63.73	\$8.83	\$20.27	\$0.00	\$92.83

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - FLOORCOVERER - Local 2168 Zone I

Effective Date - 03/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$24.63	\$8.83	\$1.76	\$0.00	\$35.22
2	45	\$24.63	\$8.83	\$1.76	\$0.00	\$35.22
3	55	\$30.10	\$8.83	\$3.52	\$0.00	\$42.45
4	55	\$30.10	\$8.83	\$3.52	\$0.00	\$42.45
5	70	\$38.31	\$8.83	\$16.75	\$0.00	\$63.89
6	70	\$38.31	\$8.83	\$16.75	\$0.00	\$63.89
7	80	\$43.78	\$8.83	\$18.51	\$0.00	\$71.12
8	80	\$43.78	\$8.83	\$18.51	\$0.00	\$71.12

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	45	\$25.30	\$8.83	\$1.76	\$0.00	\$35.89
2	45	\$25.30	\$8.83	\$1.76	\$0.00	\$35.89
3	55	\$30.93	\$8.83	\$3.52	\$0.00	\$43.28
4	55	\$30.93	\$8.83	\$3.52	\$0.00	\$43.28
5	70	\$39.36	\$8.83	\$16.75	\$0.00	\$64.94
6	70	\$39.36	\$8.83	\$16.75	\$0.00	\$64.94
7	80	\$44.98	\$8.83	\$18.51	\$0.00	\$72.32
8	80	\$44.98	\$8.83	\$18.51	\$0.00	\$72.32

Notes: Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

FORK LIFT/CHERRY PICKER	12/01/2023	\$55.03	\$15.00	\$16.40	\$0.00	\$86.43
<i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$56.33	\$15.00	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.78	\$15.00	\$16.40	\$0.00	\$89.18
	06/01/2025	\$59.08	\$15.00	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.53	\$15.00	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.83	\$15.00	\$16.40	\$0.00	\$93.23
	12/01/2026	\$63.28	\$15.00	\$16.40	\$0.00	\$94.68

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

GENERATOR/LIGHTING PLANT/HEATERS	12/01/2023	\$35.62	\$15.00	\$16.40	\$0.00	\$67.02
<i>OPERATING ENGINEERS LOCAL 4</i>	06/01/2024	\$36.47	\$15.00	\$16.40	\$0.00	\$67.87
	12/01/2024	\$37.42	\$15.00	\$16.40	\$0.00	\$68.82
	06/01/2025	\$38.27	\$15.00	\$16.40	\$0.00	\$69.67
	12/01/2025	\$39.22	\$15.00	\$16.40	\$0.00	\$70.62
	06/01/2026	\$40.08	\$15.00	\$16.40	\$0.00	\$71.48
	12/01/2026	\$41.03	\$15.00	\$16.40	\$0.00	\$72.43

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS) <i>GLAZIERS LOCAL 35 (ZONE 2)</i>	01/01/2024	\$45.56	\$9.95	\$23.95	\$0.00	\$79.46
	07/01/2024	\$46.76	\$9.95	\$23.95	\$0.00	\$80.66
	01/01/2025	\$47.96	\$9.95	\$23.95	\$0.00	\$81.86

Apprentice - GLAZIER - Local 35 Zone 2

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.78	\$9.95	\$0.00	\$0.00	\$32.73
2	55	\$25.06	\$9.95	\$6.66	\$0.00	\$41.67
3	60	\$27.34	\$9.95	\$7.26	\$0.00	\$44.55
4	65	\$29.61	\$9.95	\$7.87	\$0.00	\$47.43
5	70	\$31.89	\$9.95	\$20.32	\$0.00	\$62.16
6	75	\$34.17	\$9.95	\$20.93	\$0.00	\$65.05
7	80	\$36.45	\$9.95	\$21.53	\$0.00	\$67.93
8	90	\$41.00	\$9.95	\$22.74	\$0.00	\$73.69

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.38	\$9.95	\$0.00	\$0.00	\$33.33
2	55	\$25.72	\$9.95	\$6.66	\$0.00	\$42.33
3	60	\$28.06	\$9.95	\$7.26	\$0.00	\$45.27
4	65	\$30.39	\$9.95	\$7.87	\$0.00	\$48.21
5	70	\$32.73	\$9.95	\$20.32	\$0.00	\$63.00
6	75	\$35.07	\$9.95	\$20.93	\$0.00	\$65.95
7	80	\$37.41	\$9.95	\$21.53	\$0.00	\$68.89
8	90	\$42.08	\$9.95	\$22.74	\$0.00	\$74.77

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

HOISTING ENGINEER/CRANES/GRADALLS <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$55.03	\$15.00	\$16.40	\$0.00	\$86.43
	06/01/2024	\$56.33	\$15.00	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.78	\$15.00	\$16.40	\$0.00	\$89.18
	06/01/2025	\$59.08	\$15.00	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.53	\$15.00	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.83	\$15.00	\$16.40	\$0.00	\$93.23
	12/01/2026	\$63.28	\$15.00	\$16.40	\$0.00	\$94.68

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - OPERATING ENGINEERS - Local 4

Effective Date - 12/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$30.27	\$15.00	\$0.00	\$0.00	\$45.27
2	60	\$33.02	\$15.00	\$16.40	\$0.00	\$64.42
3	65	\$35.77	\$15.00	\$16.40	\$0.00	\$67.17
4	70	\$38.52	\$15.00	\$16.40	\$0.00	\$69.92
5	75	\$41.27	\$15.00	\$16.40	\$0.00	\$72.67
6	80	\$44.02	\$15.00	\$16.40	\$0.00	\$75.42
7	85	\$46.78	\$15.00	\$16.40	\$0.00	\$78.18
8	90	\$49.53	\$15.00	\$16.40	\$0.00	\$80.93

Effective Date - 06/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$30.98	\$15.00	\$0.00	\$0.00	\$45.98
2	60	\$33.80	\$15.00	\$16.40	\$0.00	\$65.20
3	65	\$36.61	\$15.00	\$16.40	\$0.00	\$68.01
4	70	\$39.43	\$15.00	\$16.40	\$0.00	\$70.83
5	75	\$42.25	\$15.00	\$16.40	\$0.00	\$73.65
6	80	\$45.06	\$15.00	\$16.40	\$0.00	\$76.46
7	85	\$47.88	\$15.00	\$16.40	\$0.00	\$79.28
8	90	\$50.70	\$15.00	\$16.40	\$0.00	\$82.10

Notes:

Apprentice to Journeyworker Ratio:1:6

HVAC (DUCTWORK) SHEETMETAL WORKERS LOCAL 17 - A	02/01/2024	\$57.22	\$14.59	\$27.50	\$2.98	\$102.29
	08/01/2024	\$58.97	\$14.59	\$27.50	\$2.98	\$104.04
	02/01/2025	\$60.72	\$14.59	\$27.50	\$2.98	\$105.79
	08/01/2025	\$62.57	\$14.59	\$27.50	\$2.98	\$107.64
	02/01/2026	\$64.52	\$14.59	\$27.50	\$2.98	\$109.59

For apprentice rates see "Apprentice- SHEET METAL WORKER"

HVAC (ELECTRICAL CONTROLS) ELECTRICIANS LOCAL 96	09/03/2023	\$45.99	\$13.00	\$18.84	\$0.00	\$77.83
	09/01/2024	\$47.05	\$13.99	\$19.22	\$0.00	\$80.26
	09/07/2025	\$48.16	\$14.98	\$19.60	\$0.00	\$82.74
	09/06/2026	\$49.38	\$15.96	\$20.00	\$0.00	\$85.34

For apprentice rates see "Apprentice- ELECTRICIAN"

HVAC (TESTING AND BALANCING - AIR) SHEETMETAL WORKERS LOCAL 17 - A	02/01/2024	\$57.22	\$14.59	\$27.50	\$2.98	\$102.29
	08/01/2024	\$58.97	\$14.59	\$27.50	\$2.98	\$104.04
	02/01/2025	\$60.72	\$14.59	\$27.50	\$2.98	\$105.79
	08/01/2025	\$62.57	\$14.59	\$27.50	\$2.98	\$107.64
	02/01/2026	\$64.52	\$14.59	\$27.50	\$2.98	\$109.59

For apprentice rates see "Apprentice- SHEET METAL WORKER"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
HVAC (TESTING AND BALANCING - WATER) <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HVAC MECHANIC <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"						
HYDRAULIC DRILLS <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
For apprentice rates see "Apprentice- LABORER"						
HYDRAULIC DRILLS (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.61	\$9.65	\$17.14	\$0.00	\$65.40
	06/01/2024	\$39.94	\$9.65	\$17.14	\$0.00	\$66.73
	12/01/2024	\$41.27	\$9.65	\$17.14	\$0.00	\$68.06
	06/01/2025	\$42.66	\$9.65	\$17.14	\$0.00	\$69.45
	12/01/2025	\$44.04	\$9.65	\$17.14	\$0.00	\$70.83
	06/01/2026	\$45.48	\$9.65	\$17.14	\$0.00	\$72.27
	12/01/2026	\$46.92	\$9.65	\$17.14	\$0.00	\$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
INSULATOR (PIPES & TANKS) <i>HEAT & FROST INSULATORS LOCAL 6 (BOSTON)</i>	09/01/2023	\$53.50	\$14.75	\$19.61	\$0.00	\$87.86
	09/01/2024	\$56.92	\$14.75	\$19.61	\$0.00	\$91.28
	09/01/2025	\$60.34	\$14.75	\$19.61	\$0.00	\$94.70
	09/01/2026	\$63.76	\$14.75	\$19.61	\$0.00	\$98.12

Apprentice - ASBESTOS INSULATOR (Pipes & Tanks) - Local 6 Boston

Effective Date - 09/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$26.75	\$14.75	\$14.32	\$0.00	\$55.82
2	60	\$32.10	\$14.75	\$15.37	\$0.00	\$62.22
3	70	\$37.45	\$14.75	\$16.43	\$0.00	\$68.63
4	80	\$42.80	\$14.75	\$17.49	\$0.00	\$75.04

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.46	\$14.75	\$14.32	\$0.00	\$57.53
2	60	\$34.15	\$14.75	\$15.37	\$0.00	\$64.27
3	70	\$39.84	\$14.75	\$16.43	\$0.00	\$71.02
4	80	\$45.54	\$14.75	\$17.49	\$0.00	\$77.78

Notes:

Steps are 1 year

Apprentice to Journeyworker Ratio:1:4

IRONWORKER/WELDER <i>IRONWORKERS LOCAL 7 (WORCESTER AREA)</i>	03/16/2024	\$53.67	\$8.35	\$26.70	\$0.00	\$88.72
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Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - IRONWORKER - Local 7 Worcester

Effective Date - 03/16/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$32.20	\$8.35	\$26.70	\$0.00	\$67.25
2	70	\$37.57	\$8.35	\$26.70	\$0.00	\$72.62
3	75	\$40.25	\$8.35	\$26.70	\$0.00	\$75.30
4	80	\$42.94	\$8.35	\$26.70	\$0.00	\$77.99
5	85	\$45.62	\$8.35	\$26.70	\$0.00	\$80.67
6	90	\$48.30	\$8.35	\$26.70	\$0.00	\$83.35

Notes:

Apprentice to Journeyworker Ratio:1:4

JACKHAMMER & PAVING BREAKER OPERATOR LABORERS - ZONE 2	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

LABORER LABORERS - ZONE 2	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
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Apprentice - LABORER - Zone 2

Effective Date - 12/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$22.72	\$9.65	\$16.89	\$0.00	\$49.26
2	70	\$26.50	\$9.65	\$16.89	\$0.00	\$53.04
3	80	\$30.29	\$9.65	\$16.89	\$0.00	\$56.83
4	90	\$34.07	\$9.65	\$16.89	\$0.00	\$60.61

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
	06/01/2024	\$39.19	\$9.65	\$17.14	\$0.00	\$65.98
	12/01/2024	\$40.52	\$9.65	\$17.14	\$0.00	\$67.31
	06/01/2025	\$41.91	\$9.65	\$17.14	\$0.00	\$68.70
	12/01/2025	\$43.29	\$9.65	\$17.14	\$0.00	\$70.08
	06/01/2026	\$44.73	\$9.65	\$17.14	\$0.00	\$71.52
	12/01/2026	\$46.17	\$9.65	\$17.14	\$0.00	\$72.96

Apprentice - LABORER (Heavy & Highway) - Zone 2

Effective Date - 12/01/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$22.72	\$9.65	\$17.14	\$0.00	\$49.51
2	70	\$26.50	\$9.65	\$17.14	\$0.00	\$53.29
3	80	\$30.29	\$9.65	\$17.14	\$0.00	\$57.08
4	90	\$34.07	\$9.65	\$17.14	\$0.00	\$60.86

Effective Date - 06/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	60	\$23.51	\$9.00	\$16.89	\$0.00	\$49.40
2	70	\$27.43	\$9.00	\$16.89	\$0.00	\$53.32
3	80	\$31.35	\$9.00	\$16.89	\$0.00	\$57.24
4	90	\$35.27	\$9.00	\$16.89	\$0.00	\$61.16

Notes:

Apprentice to Journeyworker Ratio:1:5

LABORER: CARPENTER TENDER <i>LABORERS - ZONE 2</i>	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
For apprentice rates see "Apprentice- LABORER"						
LABORER: CEMENT FINISHER TENDER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.36	\$9.40	\$16.89	\$0.00	\$64.65
For apprentice rates see "Apprentice- LABORER"						
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER <i>LABORERS - ZONE 2</i>	12/01/2023	\$37.95	\$9.65	\$17.20	\$0.00	\$64.80
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
LABORER: MASON TENDER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
LABORER: MULTI-TRADE TENDER <i>LABORERS - ZONE 2</i>	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
For apprentice rates see "Apprentice- LABORER"						
LABORER: TREE REMOVER <i>LABORERS - ZONE 2</i>	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER"						
LASER BEAM OPERATOR (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"						
MARBLE & TILE FINISHERS BRICKLAYERS LOCAL 3 - MARBLE & TILE	02/01/2024	\$47.89	\$11.49	\$21.37	\$0.00	\$80.75
	08/01/2024	\$49.57	\$11.49	\$21.37	\$0.00	\$82.43
	02/01/2025	\$50.61	\$11.49	\$21.37	\$0.00	\$83.47
	08/01/2025	\$52.33	\$11.49	\$21.37	\$0.00	\$85.19
	02/01/2026	\$53.41	\$11.49	\$21.37	\$0.00	\$86.27
	08/01/2026	\$55.17	\$11.49	\$21.37	\$0.00	\$88.03
	02/01/2027	\$56.29	\$11.49	\$21.37	\$0.00	\$89.15

Apprentice - MARBLE & TILE FINISHER - Local 3 Marble & Tile

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.95	\$11.49	\$21.37	\$0.00	\$56.81
2	60	\$28.73	\$11.49	\$21.37	\$0.00	\$61.59
3	70	\$33.52	\$11.49	\$21.37	\$0.00	\$66.38
4	80	\$38.31	\$11.49	\$21.37	\$0.00	\$71.17
5	90	\$43.10	\$11.49	\$21.37	\$0.00	\$75.96

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.79	\$11.49	\$21.37	\$0.00	\$57.65
2	60	\$29.74	\$11.49	\$21.37	\$0.00	\$62.60
3	70	\$34.70	\$11.49	\$21.37	\$0.00	\$67.56
4	80	\$39.66	\$11.49	\$21.37	\$0.00	\$72.52
5	90	\$44.61	\$11.49	\$21.37	\$0.00	\$77.47

Notes:

Apprentice to Journeyworker Ratio:1:3

MARBLE MASONS, TILELAYERS & TERRAZZO MECH BRICKLAYERS LOCAL 3 - MARBLE & TILE	02/01/2024	\$62.42	\$11.49	\$23.56	\$0.00	\$97.47
	08/01/2024	\$64.52	\$11.49	\$23.56	\$0.00	\$99.57
	02/01/2025	\$65.82	\$11.49	\$23.56	\$0.00	\$100.87
	08/01/2025	\$67.97	\$11.49	\$23.56	\$0.00	\$103.02
	02/01/2026	\$69.32	\$11.49	\$23.56	\$0.00	\$104.37
	08/01/2026	\$71.52	\$11.49	\$23.56	\$0.00	\$106.57
	02/01/2027	\$72.92	\$11.49	\$23.56	\$0.00	\$107.97

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - MARBLE-TILE-TERRAZZO MECHANIC - Local 3 Marble & Tile

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.21	\$11.49	\$23.56	\$0.00	\$66.26
2	60	\$37.45	\$11.49	\$23.56	\$0.00	\$72.50
3	70	\$43.69	\$11.49	\$23.56	\$0.00	\$78.74
4	80	\$49.94	\$11.49	\$23.56	\$0.00	\$84.99
5	90	\$56.18	\$11.49	\$23.56	\$0.00	\$91.23

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$32.26	\$11.49	\$23.56	\$0.00	\$67.31
2	60	\$38.71	\$11.49	\$23.56	\$0.00	\$73.76
3	70	\$45.16	\$11.49	\$23.56	\$0.00	\$80.21
4	80	\$51.62	\$11.49	\$23.56	\$0.00	\$86.67
5	90	\$58.07	\$11.49	\$23.56	\$0.00	\$93.12

Notes:

Apprentice to Journeyworker Ratio:1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MECHANICS MAINTENANCE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MILLWRIGHT (Zone 2) <i>MILLWRIGHTS LOCAL 1121 - Zone 2</i>	01/01/2024	\$42.76	\$10.08	\$21.47	\$0.00	\$74.31
	01/06/2025	\$45.09	\$10.08	\$21.47	\$0.00	\$76.64
	01/05/2026	\$47.42	\$10.08	\$21.47	\$0.00	\$78.97

Apprentice - MILLWRIGHT - Local 1121 Zone 2

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$23.52	\$10.08	\$5.50	\$0.00	\$39.10
2	65	\$27.79	\$10.08	\$6.50	\$0.00	\$44.37
3	75	\$32.07	\$10.08	\$18.97	\$0.00	\$61.12
4	85	\$36.35	\$10.08	\$19.97	\$0.00	\$66.40

Effective Date - 01/06/2025

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	55	\$24.80	\$10.08	\$5.50	\$0.00	\$40.38
2	65	\$29.31	\$10.08	\$6.50	\$0.00	\$45.89
3	75	\$33.82	\$10.08	\$18.97	\$0.00	\$62.87
4	85	\$38.33	\$10.08	\$19.97	\$0.00	\$68.38

Notes: Step 1&2 Appr. indentured after 1/6/2020 receive no pension, but do receive annuity. (Step 1 \$5.72, Step 2 \$6.66)
Steps are 2,000 hours

Apprentice to Journeyworker Ratio:1:4

MORTAR MIXER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

OILER (OTHER THAN TRUCK CRANES,GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$24.41	\$15.00	\$16.40	\$0.00	\$55.81
	06/01/2024	\$25.01	\$15.00	\$16.40	\$0.00	\$56.41
	12/01/2024	\$25.67	\$15.00	\$16.40	\$0.00	\$57.07
	06/01/2025	\$26.27	\$15.00	\$16.40	\$0.00	\$57.67
	12/01/2025	\$26.93	\$15.00	\$16.40	\$0.00	\$58.33
	06/01/2026	\$27.52	\$15.00	\$16.40	\$0.00	\$58.92
	12/01/2026	\$28.19	\$15.00	\$16.40	\$0.00	\$59.59

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OILER (TRUCK CRANES, GRADALLS) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$29.86	\$15.00	\$16.40	\$0.00	\$61.26
	06/01/2024	\$30.58	\$15.00	\$16.40	\$0.00	\$61.98
	12/01/2024	\$31.38	\$15.00	\$16.40	\$0.00	\$62.78
	06/01/2025	\$32.10	\$15.00	\$16.40	\$0.00	\$63.50
	12/01/2025	\$32.90	\$15.00	\$16.40	\$0.00	\$64.30
	06/01/2026	\$33.62	\$15.00	\$16.40	\$0.00	\$65.02
	12/01/2026	\$34.42	\$15.00	\$16.40	\$0.00	\$65.82

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

OTHER POWER DRIVEN EQUIPMENT - CLASS II <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PAINTER (BRIDGES/TANKS) <i>PAINTERS LOCAL 35 - ZONE 2</i>	01/01/2024	\$56.06	\$9.95	\$23.95	\$0.00	\$89.96
	07/01/2024	\$57.26	\$9.95	\$23.95	\$0.00	\$91.16
	01/01/2025	\$58.46	\$9.95	\$23.95	\$0.00	\$92.36

Apprentice - PAINTER Local 35 - BRIDGES/TANKS

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.03	\$9.95	\$0.00	\$0.00	\$37.98
2	55	\$30.83	\$9.95	\$6.66	\$0.00	\$47.44
3	60	\$33.64	\$9.95	\$7.26	\$0.00	\$50.85
4	65	\$36.44	\$9.95	\$7.87	\$0.00	\$54.26
5	70	\$39.24	\$9.95	\$20.32	\$0.00	\$69.51
6	75	\$42.05	\$9.95	\$20.93	\$0.00	\$72.93
7	80	\$44.85	\$9.95	\$21.53	\$0.00	\$76.33
8	90	\$50.45	\$9.95	\$22.74	\$0.00	\$83.14

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$28.63	\$9.95	\$0.00	\$0.00	\$38.58
2	55	\$31.49	\$9.95	\$6.66	\$0.00	\$48.10
3	60	\$34.36	\$9.95	\$7.26	\$0.00	\$51.57
4	65	\$37.22	\$9.95	\$7.87	\$0.00	\$55.04
5	70	\$40.08	\$9.95	\$20.32	\$0.00	\$70.35
6	75	\$42.95	\$9.95	\$20.93	\$0.00	\$73.83
7	80	\$45.81	\$9.95	\$21.53	\$0.00	\$77.29
8	90	\$51.53	\$9.95	\$22.74	\$0.00	\$84.22

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, NEW) *	01/01/2024	\$46.96	\$9.95	\$23.95	\$0.00	\$80.86
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. <i>PAINTERS LOCAL 35 - ZONE 2</i>	07/01/2024	\$48.16	\$9.95	\$23.95	\$0.00	\$82.06
	01/01/2025	\$49.36	\$9.95	\$23.95	\$0.00	\$83.26

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - New

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.48	\$9.95	\$0.00	\$0.00	\$33.43
2	55	\$25.83	\$9.95	\$6.66	\$0.00	\$42.44
3	60	\$28.18	\$9.95	\$7.26	\$0.00	\$45.39
4	65	\$30.52	\$9.95	\$7.87	\$0.00	\$48.34
5	70	\$32.87	\$9.95	\$20.32	\$0.00	\$63.14
6	75	\$35.22	\$9.95	\$20.93	\$0.00	\$66.10
7	80	\$37.57	\$9.95	\$21.53	\$0.00	\$69.05
8	90	\$42.26	\$9.95	\$22.74	\$0.00	\$74.95

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.08	\$9.95	\$0.00	\$0.00	\$34.03
2	55	\$26.49	\$9.95	\$6.66	\$0.00	\$43.10
3	60	\$28.90	\$9.95	\$7.26	\$0.00	\$46.11
4	65	\$31.30	\$9.95	\$7.87	\$0.00	\$49.12
5	70	\$33.71	\$9.95	\$20.32	\$0.00	\$63.98
6	75	\$36.12	\$9.95	\$20.93	\$0.00	\$67.00
7	80	\$38.53	\$9.95	\$21.53	\$0.00	\$70.01
8	90	\$43.34	\$9.95	\$22.74	\$0.00	\$76.03

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT)	01/01/2024	\$45.02	\$9.95	\$23.95	\$0.00	\$78.92
PAINTERS LOCAL 35 - ZONE 2	07/01/2024	\$46.22	\$9.95	\$23.95	\$0.00	\$80.12
	01/01/2025	\$47.42	\$9.95	\$23.95	\$0.00	\$81.32

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - Spray/Sandblast - Repaint

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.51	\$9.95	\$0.00	\$0.00	\$32.46
2	55	\$24.76	\$9.95	\$6.66	\$0.00	\$41.37
3	60	\$27.01	\$9.95	\$7.26	\$0.00	\$44.22
4	65	\$29.26	\$9.95	\$7.87	\$0.00	\$47.08
5	70	\$31.51	\$9.95	\$20.32	\$0.00	\$61.78
6	75	\$33.77	\$9.95	\$20.93	\$0.00	\$64.65
7	80	\$36.02	\$9.95	\$21.53	\$0.00	\$67.50
8	90	\$40.52	\$9.95	\$22.74	\$0.00	\$73.21

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.11	\$9.95	\$0.00	\$0.00	\$33.06
2	55	\$25.42	\$9.95	\$6.66	\$0.00	\$42.03
3	60	\$27.73	\$9.95	\$7.26	\$0.00	\$44.94
4	65	\$30.04	\$9.95	\$7.87	\$0.00	\$47.86
5	70	\$32.35	\$9.95	\$20.32	\$0.00	\$62.62
6	75	\$34.67	\$9.95	\$20.93	\$0.00	\$65.55
7	80	\$36.98	\$9.95	\$21.53	\$0.00	\$68.46
8	90	\$41.60	\$9.95	\$22.74	\$0.00	\$74.29

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, NEW) *	01/01/2024	\$45.56	\$9.95	\$23.95	\$0.00	\$79.46
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. <i>PAINTERS LOCAL 35 - ZONE 2</i>	07/01/2024	\$46.76	\$9.95	\$23.95	\$0.00	\$80.66
	01/01/2025	\$47.96	\$9.95	\$23.95	\$0.00	\$81.86

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER - Local 35 Zone 2 - BRUSH NEW

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.78	\$9.95	\$0.00	\$0.00	\$32.73
2	55	\$25.06	\$9.95	\$6.66	\$0.00	\$41.67
3	60	\$27.34	\$9.95	\$7.26	\$0.00	\$44.55
4	65	\$29.61	\$9.95	\$7.87	\$0.00	\$47.43
5	70	\$31.89	\$9.95	\$20.32	\$0.00	\$62.16
6	75	\$34.17	\$9.95	\$20.93	\$0.00	\$65.05
7	80	\$36.45	\$9.95	\$21.53	\$0.00	\$67.93
8	90	\$41.00	\$9.95	\$22.74	\$0.00	\$73.69

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$23.38	\$9.95	\$0.00	\$0.00	\$33.33
2	55	\$25.72	\$9.95	\$6.66	\$0.00	\$42.33
3	60	\$28.06	\$9.95	\$7.26	\$0.00	\$45.27
4	65	\$30.39	\$9.95	\$7.87	\$0.00	\$48.21
5	70	\$32.73	\$9.95	\$20.32	\$0.00	\$63.00
6	75	\$35.07	\$9.95	\$20.93	\$0.00	\$65.95
7	80	\$37.41	\$9.95	\$21.53	\$0.00	\$68.89
8	90	\$42.08	\$9.95	\$22.74	\$0.00	\$74.77

Notes:

Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER / TAPER (BRUSH, REPAINT)	01/01/2024	\$43.62	\$9.95	\$23.95	\$0.00	\$77.52
PAINTERS LOCAL 35 - ZONE 2	07/01/2024	\$44.82	\$9.95	\$23.95	\$0.00	\$78.72
	01/01/2025	\$46.02	\$9.95	\$23.95	\$0.00	\$79.92

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PAINTER Local 35 Zone 2 - BRUSH REPAINT

Effective Date - 01/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$21.81	\$9.95	\$0.00	\$0.00	\$31.76
2	55	\$23.99	\$9.95	\$6.66	\$0.00	\$40.60
3	60	\$26.17	\$9.95	\$7.26	\$0.00	\$43.38
4	65	\$28.35	\$9.95	\$7.87	\$0.00	\$46.17
5	70	\$30.53	\$9.95	\$20.32	\$0.00	\$60.80
6	75	\$32.72	\$9.95	\$20.93	\$0.00	\$63.60
7	80	\$34.90	\$9.95	\$21.53	\$0.00	\$66.38
8	90	\$39.26	\$9.95	\$22.74	\$0.00	\$71.95

Effective Date - 07/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$22.41	\$9.95	\$0.00	\$0.00	\$32.36
2	55	\$24.65	\$9.95	\$6.66	\$0.00	\$41.26
3	60	\$26.89	\$9.95	\$7.26	\$0.00	\$44.10
4	65	\$29.13	\$9.95	\$7.87	\$0.00	\$46.95
5	70	\$31.37	\$9.95	\$20.32	\$0.00	\$61.64
6	75	\$33.62	\$9.95	\$20.93	\$0.00	\$64.50
7	80	\$35.86	\$9.95	\$21.53	\$0.00	\$67.34
8	90	\$40.34	\$9.95	\$22.74	\$0.00	\$73.03

Notes:
Steps are 750 hrs.

Apprentice to Journeyworker Ratio:1:1

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY)	12/01/2023	\$37.86	\$9.65	\$17.14	\$0.00	\$64.65
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	06/01/2024	\$39.19	\$9.65	\$17.14	\$0.00	\$65.98
	12/01/2024	\$40.52	\$9.65	\$17.14	\$0.00	\$67.31
	06/01/2025	\$41.91	\$9.65	\$17.14	\$0.00	\$68.70
	12/01/2025	\$43.29	\$9.65	\$17.14	\$0.00	\$70.08
	06/01/2026	\$44.73	\$9.65	\$17.14	\$0.00	\$71.52
	12/01/2026	\$46.17	\$9.65	\$17.14	\$0.00	\$72.96

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)

PANEL & PICKUP TRUCKS DRIVER	01/01/2024	\$38.78	\$15.07	\$18.67	\$0.00	\$72.52
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	06/01/2024	\$39.78	\$15.07	\$18.67	\$0.00	\$73.52
	12/01/2024	\$39.78	\$15.07	\$20.17	\$0.00	\$75.02
	01/01/2025	\$39.78	\$15.57	\$20.17	\$0.00	\$75.52
	06/01/2025	\$40.78	\$15.57	\$20.17	\$0.00	\$76.52
	12/01/2025	\$40.78	\$15.57	\$21.78	\$0.00	\$78.13
	01/01/2026	\$40.78	\$16.17	\$21.78	\$0.00	\$78.73
	06/01/2026	\$41.78	\$16.17	\$21.78	\$0.00	\$79.73
	12/01/2026	\$41.78	\$16.17	\$23.52	\$0.00	\$81.47
	01/01/2027	\$41.78	\$16.77	\$23.52	\$0.00	\$82.07

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) <i>PILE DRIVER LOCAL 56 (ZONE 1)</i> For apprentice rates see "Apprentice- PILE DRIVER"	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59
PILE DRIVER <i>PILE DRIVER LOCAL 56 (ZONE 1)</i>	08/01/2020	\$49.07	\$9.40	\$23.12	\$0.00	\$81.59

Apprentice - PILE DRIVER - Local 56 Zone 1

Effective Date - 08/01/2020

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$24.54	\$9.40	\$23.12	\$0.00	\$57.06
2	60	\$29.44	\$9.40	\$23.12	\$0.00	\$61.96
3	70	\$34.35	\$9.40	\$23.12	\$0.00	\$66.87
4	75	\$36.80	\$9.40	\$23.12	\$0.00	\$69.32
5	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
6	80	\$39.26	\$9.40	\$23.12	\$0.00	\$71.78
7	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68
8	90	\$44.16	\$9.40	\$23.12	\$0.00	\$76.68

Notes:

% Indentured After 10/1/17; 45/45/55/55/70/70/80/80
Step 1&2 \$34.01/ 3&4 \$41.46/ 5&6 \$62.80/ 7&8 \$69.25

Apprentice to Journeyworker Ratio:1:5

PIPEFITTER & STEAMFITTER <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - PIPEFITTER - Local 537

Effective Date - 03/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$26.11	\$12.70	\$9.05	\$0.00	\$47.86
2	45	\$29.38	\$12.70	\$21.80	\$0.00	\$63.88
3	60	\$39.17	\$12.70	\$21.80	\$0.00	\$73.67
4	70	\$45.70	\$12.70	\$21.80	\$0.00	\$80.20
5	80	\$52.22	\$12.70	\$21.80	\$0.00	\$86.72

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	40	\$26.83	\$12.70	\$9.05	\$0.00	\$48.58
2	45	\$30.19	\$12.70	\$21.80	\$0.00	\$64.69
3	60	\$40.25	\$12.70	\$21.80	\$0.00	\$74.75
4	70	\$46.96	\$12.70	\$21.80	\$0.00	\$81.46
5	80	\$53.66	\$12.70	\$21.80	\$0.00	\$88.16

Notes:
 ** 1:3; 3:15; 1:10 thereafter / Steps are 1 yr.
 Refrig/AC Mechanic **1:1;1:2;2:4;3:6;4:8;5:10;6:12;7:14;8:17;9:20;10:23(Max)

Apprentice to Journeyworker Ratio:**

PIPELAYER LABORERS - ZONE 2	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

PIPELAYER (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

PLUMBERS & GASFITTERS PLUMBERS & GASFITTERS LOCAL 12	03/03/2024	\$67.74	\$14.32	\$19.11	\$0.00	\$101.17
	09/01/2024	\$69.54	\$14.32	\$19.11	\$0.00	\$102.97
	03/02/2025	\$71.34	\$14.32	\$19.11	\$0.00	\$104.77

Apprentice - PLUMBER/GASFITTER - Local 12

Effective Date - 03/03/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$23.71	\$14.32	\$6.88	\$0.00	\$44.91
2	40	\$27.10	\$14.32	\$7.82	\$0.00	\$49.24
3	55	\$37.26	\$14.32	\$10.65	\$0.00	\$62.23
4	65	\$44.03	\$14.32	\$12.53	\$0.00	\$70.88
5	75	\$50.81	\$14.32	\$14.41	\$0.00	\$79.54

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.34	\$14.32	\$6.88	\$0.00	\$45.54
2	40	\$27.82	\$14.32	\$7.82	\$0.00	\$49.96
3	55	\$38.25	\$14.32	\$10.65	\$0.00	\$63.22
4	65	\$45.20	\$14.32	\$12.53	\$0.00	\$72.05
5	75	\$52.16	\$14.32	\$14.41	\$0.00	\$80.89

Notes:
 ** 1:2; 2:6; 3:10; 4:14; 5:19/Steps are 1 yr
 Step4 with lic\$69.00, Step5 with lic\$76.87

Apprentice to Journeyworker Ratio:**

PNEUMATIC CONTROLS (TEMP.) <i>PIPEFITTERS LOCAL 537</i>	03/01/2024	\$65.28	\$12.70	\$21.80	\$0.00	\$99.78
	09/01/2024	\$67.08	\$12.70	\$21.80	\$0.00	\$101.58
	03/01/2025	\$68.88	\$12.70	\$21.80	\$0.00	\$103.38

For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"

PNEUMATIC DRILL/TOOL OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

POWDERMAN & BLASTER <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.86	\$9.65	\$17.14	\$0.00	\$65.65
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For apprentice rates see "Apprentice- LABORER"

POWDERMAN & BLASTER (HEAVY & HIGHWAY) <i>LABORERS - ZONE 2 (HEAVY & HIGHWAY)</i>	12/01/2023	\$39.36	\$9.40	\$16.89	\$0.00	\$65.65
	06/01/2024	\$40.69	\$9.40	\$16.89	\$0.00	\$66.98
	12/01/2024	\$42.02	\$9.40	\$16.89	\$0.00	\$68.31
	06/01/2025	\$43.41	\$9.40	\$16.89	\$0.00	\$69.70
	12/01/2025	\$44.79	\$9.40	\$16.89	\$0.00	\$71.08
	06/01/2026	\$46.23	\$9.40	\$16.89	\$0.00	\$72.52
	12/01/2026	\$47.67	\$9.40	\$16.89	\$0.00	\$73.96

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)						
POWER SHOVEL/DERRICK/TRENCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$55.03	\$15.00	\$16.40	\$0.00	\$86.43
	06/01/2024	\$56.33	\$15.00	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.78	\$15.00	\$16.40	\$0.00	\$89.18
	06/01/2025	\$59.08	\$15.00	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.53	\$15.00	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.83	\$15.00	\$16.40	\$0.00	\$93.23
	12/01/2026	\$63.28	\$15.00	\$16.40	\$0.00	\$94.68
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (CONCRETE) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
PUMP OPERATOR (DEWATERING, OTHER) <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$35.62	\$15.00	\$16.40	\$0.00	\$67.02
	06/01/2024	\$36.47	\$15.00	\$16.40	\$0.00	\$67.87
	12/01/2024	\$37.42	\$15.00	\$16.40	\$0.00	\$68.82
	06/01/2025	\$38.27	\$15.00	\$16.40	\$0.00	\$69.67
	12/01/2025	\$39.22	\$15.00	\$16.40	\$0.00	\$70.62
	06/01/2026	\$40.08	\$15.00	\$16.40	\$0.00	\$71.48
	12/01/2026	\$41.03	\$15.00	\$16.40	\$0.00	\$72.43
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
READY-MIX CONCRETE DRIVER <i>TEAMSTERS 170 - Dauphinais (Bellingham)</i>	01/01/2024	\$27.00	\$10.76	\$5.45	\$0.00	\$43.21
	12/01/2024	\$27.60	\$11.26	\$6.15	\$0.00	\$45.01
	01/01/2025	\$27.60	\$11.26	\$6.15	\$0.00	\$45.01
RECLAIMERS <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
RIDE-ON MOTORIZED BUGGY OPERATOR <i>LABORERS - ZONE 2</i>	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
For apprentice rates see "Apprentice- LABORER"						
ROLLER/SPREADER/MULCHING MACHINE <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
ROOFER (Inc.Roofer Waterproofing &Roofer Damproofg) ROOFERS LOCAL 33	02/01/2024	\$50.03	\$12.78	\$21.45	\$0.00	\$84.26
	08/01/2024	\$51.53	\$12.78	\$21.45	\$0.00	\$85.76
	02/01/2025	\$52.78	\$12.78	\$21.45	\$0.00	\$87.01
	08/01/2025	\$54.28	\$12.78	\$21.45	\$0.00	\$88.51
	02/01/2026	\$55.53	\$12.78	\$21.45	\$0.00	\$89.76

Apprentice - ROOFER - Local 33

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.02	\$12.78	\$6.21	\$0.00	\$44.01
2	60	\$30.02	\$12.78	\$21.45	\$0.00	\$64.25
3	65	\$32.52	\$12.78	\$21.45	\$0.00	\$66.75
4	75	\$37.52	\$12.78	\$21.45	\$0.00	\$71.75
5	85	\$42.53	\$12.78	\$21.45	\$0.00	\$76.76

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$25.77	\$12.78	\$6.21	\$0.00	\$44.76
2	60	\$30.92	\$12.78	\$21.45	\$0.00	\$65.15
3	65	\$33.49	\$12.78	\$21.45	\$0.00	\$67.72
4	75	\$38.65	\$12.78	\$21.45	\$0.00	\$72.88
5	85	\$43.80	\$12.78	\$21.45	\$0.00	\$78.03

Notes: ** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1
 Step 1 is 2000 hrs.; Steps 2-5 are 1000 hrs.
 (Hot Pitch Mechanics' receive \$1.00 hr. above ROOFER)

Apprentice to Journeyworker Ratio:**

ROOFER SLATE / TILE / PRECAST CONCRETE ROOFERS LOCAL 33	02/01/2024	\$50.28	\$12.78	\$21.45	\$0.00	\$84.51
	08/01/2024	\$51.78	\$12.78	\$21.45	\$0.00	\$86.01
	02/01/2025	\$53.03	\$12.78	\$21.45	\$0.00	\$87.26
	08/01/2025	\$54.53	\$12.78	\$21.45	\$0.00	\$88.76
	02/01/2026	\$55.78	\$12.78	\$21.45	\$0.00	\$90.01

For apprentice rates see "Apprentice- ROOFER"

SHEETMETAL WORKER SHEETMETAL WORKERS LOCAL 17 - A	02/01/2024	\$57.22	\$14.59	\$27.50	\$2.98	\$102.29
	08/01/2024	\$58.97	\$14.59	\$27.50	\$2.98	\$104.04
	02/01/2025	\$60.72	\$14.59	\$27.50	\$2.98	\$105.79
	08/01/2025	\$62.57	\$14.59	\$27.50	\$2.98	\$107.64
	02/01/2026	\$64.52	\$14.59	\$27.50	\$2.98	\$109.59

Apprentice - SHEET METAL WORKER - Local 17-A

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$24.03	\$14.59	\$6.13	\$0.00	\$44.75
2	42	\$24.03	\$14.59	\$6.13	\$0.00	\$44.75
3	47	\$26.89	\$14.59	\$12.11	\$1.61	\$55.20
4	47	\$26.89	\$14.59	\$12.11	\$1.61	\$55.20
5	52	\$29.75	\$14.59	\$13.09	\$1.72	\$59.15
6	52	\$29.75	\$14.59	\$13.34	\$1.73	\$59.41
7	60	\$34.33	\$14.59	\$14.75	\$1.91	\$65.58
8	65	\$37.19	\$14.59	\$15.73	\$2.03	\$69.54
9	75	\$42.92	\$14.59	\$17.69	\$2.26	\$77.46
10	85	\$48.64	\$14.59	\$19.15	\$2.47	\$84.85

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	42	\$24.77	\$14.59	\$6.13	\$0.00	\$45.49
2	42	\$24.77	\$14.59	\$6.13	\$0.00	\$45.49
3	47	\$27.72	\$14.59	\$12.11	\$1.63	\$56.05
4	47	\$27.72	\$14.59	\$12.11	\$1.63	\$56.05
5	52	\$30.66	\$14.59	\$13.09	\$1.75	\$60.09
6	52	\$30.66	\$14.59	\$13.34	\$1.76	\$60.35
7	60	\$35.38	\$14.59	\$14.75	\$1.94	\$66.66
8	65	\$38.33	\$14.59	\$15.73	\$2.06	\$70.71
9	75	\$44.23	\$14.59	\$17.69	\$2.30	\$78.81
10	85	\$50.12	\$14.59	\$19.15	\$2.52	\$86.38

Notes:

Steps are 6 mos.

Apprentice to Journeyworker Ratio:1:4

SPECIALIZED EARTH MOVING EQUIP < 35 TONS	01/01/2024	\$39.24	\$15.07	\$18.67	\$0.00	\$72.98
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	06/01/2024	\$40.24	\$15.07	\$18.67	\$0.00	\$73.98
	12/01/2024	\$40.24	\$15.07	\$20.17	\$0.00	\$75.48
	01/01/2025	\$40.24	\$15.57	\$20.17	\$0.00	\$75.98
	06/01/2025	\$41.24	\$15.57	\$20.17	\$0.00	\$76.98
	12/01/2025	\$41.24	\$15.57	\$21.78	\$0.00	\$78.59
	01/01/2026	\$41.24	\$16.17	\$21.78	\$0.00	\$79.19
	06/01/2026	\$42.24	\$16.17	\$21.78	\$0.00	\$80.19
	12/01/2026	\$42.24	\$16.17	\$23.52	\$0.00	\$81.93
	01/01/2027	\$42.24	\$16.77	\$23.52	\$0.00	\$82.53

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
SPECIALIZED EARTH MOVING EQUIP > 35 TONS <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	01/01/2024	\$39.53	\$15.07	\$18.67	\$0.00	\$73.27
	06/01/2024	\$40.53	\$15.07	\$18.67	\$0.00	\$74.27
	12/01/2024	\$40.53	\$15.07	\$20.17	\$0.00	\$75.77
	01/01/2025	\$40.53	\$15.57	\$20.17	\$0.00	\$76.27
	06/01/2025	\$41.53	\$15.57	\$20.17	\$0.00	\$77.27
	12/01/2025	\$41.53	\$15.57	\$21.78	\$0.00	\$78.88
	01/01/2026	\$41.53	\$16.17	\$21.78	\$0.00	\$79.48
	06/01/2026	\$42.53	\$16.17	\$21.78	\$0.00	\$80.48
	12/01/2026	\$42.53	\$16.17	\$23.52	\$0.00	\$82.22
	01/01/2027	\$42.53	\$16.77	\$23.52	\$0.00	\$82.82
SPRINKLER FITTER <i>SPRINKLER FITTERS LOCAL 550 - (Section A) Zone 1</i>	03/01/2024	\$69.75	\$10.90	\$23.20	\$0.00	\$103.85
	10/01/2024	\$71.55	\$10.90	\$23.20	\$0.00	\$105.65
	03/01/2025	\$73.35	\$10.90	\$23.20	\$0.00	\$107.45

Apprentice - SPRINKLER FITTER - Local 550 (Section A) Zone 1

Effective Date - 03/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$24.41	\$10.90	\$12.80	\$0.00	\$48.11
2	40	\$27.90	\$10.90	\$13.60	\$0.00	\$52.40
3	45	\$31.39	\$10.90	\$14.40	\$0.00	\$56.69
4	50	\$34.88	\$10.90	\$15.20	\$0.00	\$60.98
5	55	\$38.36	\$10.90	\$16.00	\$0.00	\$65.26
6	60	\$41.85	\$10.90	\$16.80	\$0.00	\$69.55
7	65	\$45.34	\$10.90	\$17.60	\$0.00	\$73.84
8	70	\$48.83	\$10.90	\$18.40	\$0.00	\$78.13
9	75	\$52.31	\$10.90	\$19.20	\$0.00	\$82.41
10	80	\$55.80	\$10.90	\$20.00	\$0.00	\$86.70

Effective Date - 10/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	35	\$25.04	\$10.90	\$12.80	\$0.00	\$48.74
2	40	\$28.62	\$10.90	\$13.60	\$0.00	\$53.12
3	45	\$32.20	\$10.90	\$14.40	\$0.00	\$57.50
4	50	\$35.78	\$10.90	\$15.20	\$0.00	\$61.88
5	55	\$39.35	\$10.90	\$16.00	\$0.00	\$66.25
6	60	\$42.93	\$10.90	\$16.80	\$0.00	\$70.63
7	65	\$46.51	\$10.90	\$17.60	\$0.00	\$75.01
8	70	\$50.09	\$10.90	\$18.40	\$0.00	\$79.39
9	75	\$53.66	\$10.90	\$19.20	\$0.00	\$83.76
10	80	\$57.24	\$10.90	\$20.00	\$0.00	\$88.14

Notes: Apprentice entered prior 9/30/10:
40/45/50/55/60/65/70/75/80/85
Steps are 850 hours

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
STEAM BOILER OPERATOR <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TERRAZZO FINISHERS <i>BRICKLAYERS LOCAL 3 - MARBLE & TILE</i>	02/01/2024	\$61.34	\$11.49	\$23.59	\$0.00	\$96.42
	08/01/2024	\$63.44	\$11.49	\$23.59	\$0.00	\$98.52
	02/01/2025	\$64.74	\$11.49	\$23.59	\$0.00	\$99.82
	08/01/2025	\$66.89	\$11.49	\$23.59	\$0.00	\$101.97
	02/01/2026	\$68.24	\$11.49	\$23.59	\$0.00	\$103.32
	08/01/2026	\$70.44	\$11.49	\$23.59	\$0.00	\$105.52
	02/01/2027	\$71.84	\$11.49	\$23.59	\$0.00	\$106.92

Apprentice - TERRAZZO FINISHER - Local 3 Marble & Tile

Effective Date - 02/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$30.67	\$11.49	\$23.59	\$0.00	\$65.75
2	60	\$36.80	\$11.49	\$23.59	\$0.00	\$71.88
3	70	\$42.94	\$11.49	\$23.59	\$0.00	\$78.02
4	80	\$49.07	\$11.49	\$23.59	\$0.00	\$84.15
5	90	\$55.21	\$11.49	\$23.59	\$0.00	\$90.29

Effective Date - 08/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$31.72	\$11.49	\$23.59	\$0.00	\$66.80
2	60	\$38.06	\$11.49	\$23.59	\$0.00	\$73.14
3	70	\$44.41	\$11.49	\$23.59	\$0.00	\$79.49
4	80	\$50.75	\$11.49	\$23.59	\$0.00	\$85.83
5	90	\$57.10	\$11.49	\$23.59	\$0.00	\$92.18

Notes:

Apprentice to Journeyworker Ratio:1:3

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TEST BORING DRILLER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2023	\$48.33	\$9.65	\$18.22	\$0.00	\$76.20
	06/01/2024	\$49.81	\$9.65	\$18.22	\$0.00	\$77.68
	12/01/2024	\$51.28	\$9.65	\$18.22	\$0.00	\$79.15
	06/01/2025	\$52.78	\$9.65	\$18.22	\$0.00	\$80.65
	12/01/2025	\$54.28	\$9.65	\$18.22	\$0.00	\$82.15
	06/01/2026	\$55.83	\$9.65	\$18.22	\$0.00	\$83.70
	12/01/2026	\$57.33	\$9.65	\$18.22	\$0.00	\$85.20
For apprentice rates see "Apprentice- LABORER"						
TEST BORING DRILLER HELPER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2023	\$44.45	\$9.65	\$18.22	\$0.00	\$72.32
	06/01/2024	\$45.93	\$9.65	\$18.22	\$0.00	\$73.80
	12/01/2024	\$47.40	\$9.65	\$18.22	\$0.00	\$75.27
	06/01/2025	\$48.90	\$9.65	\$18.22	\$0.00	\$76.77
	12/01/2025	\$50.40	\$9.65	\$18.22	\$0.00	\$78.27
	06/01/2026	\$51.95	\$9.65	\$18.22	\$0.00	\$79.82
	12/01/2026	\$53.45	\$9.65	\$18.22	\$0.00	\$81.32
For apprentice rates see "Apprentice- LABORER"						
TEST BORING LABORER <i>LABORERS - FOUNDATION AND MARINE</i>	12/01/2023	\$44.33	\$9.65	\$18.22	\$0.00	\$72.20
	06/01/2024	\$45.81	\$9.65	\$18.22	\$0.00	\$73.68
	12/01/2024	\$47.28	\$9.65	\$18.22	\$0.00	\$75.15
	06/01/2025	\$48.78	\$9.65	\$18.22	\$0.00	\$76.65
	12/01/2025	\$50.28	\$9.65	\$18.22	\$0.00	\$78.15
	06/01/2026	\$51.83	\$9.65	\$18.22	\$0.00	\$79.70
	12/01/2026	\$53.33	\$9.65	\$18.22	\$0.00	\$81.20
For apprentice rates see "Apprentice- LABORER"						
TRACTORS/PORTABLE STEAM GENERATORS <i>OPERATING ENGINEERS LOCAL 4</i>	12/01/2023	\$54.43	\$15.00	\$16.40	\$0.00	\$85.83
	06/01/2024	\$55.71	\$15.00	\$16.40	\$0.00	\$87.11
	12/01/2024	\$57.15	\$15.00	\$16.40	\$0.00	\$88.55
	06/01/2025	\$58.43	\$15.00	\$16.40	\$0.00	\$89.83
	12/01/2025	\$59.87	\$15.00	\$16.40	\$0.00	\$91.27
	06/01/2026	\$61.15	\$15.00	\$16.40	\$0.00	\$92.55
	12/01/2026	\$62.59	\$15.00	\$16.40	\$0.00	\$93.99
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
TRAILERS FOR EARTH MOVING EQUIPMENT <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	01/01/2024	\$39.82	\$15.07	\$18.67	\$0.00	\$73.56
	06/01/2024	\$40.82	\$15.07	\$18.67	\$0.00	\$74.56
	12/01/2024	\$40.82	\$15.07	\$20.17	\$0.00	\$76.06
	01/01/2025	\$40.82	\$15.57	\$20.17	\$0.00	\$76.56
	06/01/2025	\$41.82	\$15.57	\$20.17	\$0.00	\$77.56
	12/01/2025	\$41.82	\$15.57	\$21.78	\$0.00	\$79.17
	01/01/2026	\$41.82	\$16.17	\$21.78	\$0.00	\$79.77
	06/01/2026	\$42.82	\$16.17	\$21.78	\$0.00	\$80.77
	12/01/2026	\$42.82	\$16.17	\$23.52	\$0.00	\$82.51
01/01/2027	\$42.82	\$16.77	\$23.52	\$0.00	\$83.11	

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
TUNNEL WORK - COMPRESSED AIR <i>LABORERS (COMPRESSED AIR)</i>	12/01/2023	\$56.56	\$9.65	\$18.67	\$0.00	\$84.88
	06/01/2024	\$58.04	\$9.65	\$18.67	\$0.00	\$86.36
	12/01/2024	\$59.51	\$9.65	\$18.67	\$0.00	\$87.83
	06/01/2025	\$61.01	\$9.65	\$18.67	\$0.00	\$89.33
	12/01/2025	\$62.51	\$9.65	\$18.67	\$0.00	\$90.83
	06/01/2026	\$64.06	\$9.65	\$18.67	\$0.00	\$92.38
	12/01/2026	\$65.56	\$9.65	\$18.67	\$0.00	\$93.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE) <i>LABORERS (COMPRESSED AIR)</i>	12/01/2023	\$58.56	\$9.65	\$18.67	\$0.00	\$86.88
	06/01/2024	\$60.04	\$9.65	\$18.67	\$0.00	\$88.36
	12/01/2024	\$61.51	\$9.65	\$18.67	\$0.00	\$89.83
	06/01/2025	\$63.01	\$9.65	\$18.67	\$0.00	\$91.33
	12/01/2025	\$64.51	\$9.65	\$18.67	\$0.00	\$92.83
	06/01/2026	\$66.06	\$9.65	\$18.67	\$0.00	\$94.38
	12/01/2026	\$67.56	\$9.65	\$18.67	\$0.00	\$95.88
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR <i>LABORERS (FREE AIR TUNNEL)</i>	12/01/2023	\$48.63	\$9.65	\$18.67	\$0.00	\$76.95
	06/01/2024	\$50.11	\$9.65	\$18.67	\$0.00	\$78.43
	12/01/2024	\$51.58	\$9.65	\$18.67	\$0.00	\$79.90
	06/01/2025	\$53.08	\$9.65	\$18.67	\$0.00	\$81.40
	12/01/2025	\$54.58	\$9.65	\$18.67	\$0.00	\$82.90
	06/01/2026	\$56.13	\$9.65	\$18.67	\$0.00	\$84.45
	12/01/2026	\$57.63	\$9.65	\$18.67	\$0.00	\$85.95
For apprentice rates see "Apprentice- LABORER"						
TUNNEL WORK - FREE AIR (HAZ. WASTE) <i>LABORERS (FREE AIR TUNNEL)</i>	12/01/2023	\$50.63	\$9.65	\$18.67	\$0.00	\$78.95
	06/01/2024	\$52.11	\$9.65	\$18.67	\$0.00	\$80.43
	12/01/2024	\$53.58	\$9.65	\$18.67	\$0.00	\$81.90
	06/01/2025	\$55.08	\$9.65	\$18.67	\$0.00	\$83.40
	12/01/2025	\$56.58	\$9.65	\$18.67	\$0.00	\$84.90
	06/01/2026	\$58.13	\$9.65	\$18.67	\$0.00	\$86.45
	12/01/2026	\$59.63	\$9.65	\$18.67	\$0.00	\$87.95
For apprentice rates see "Apprentice- LABORER"						
VAC-HAUL <i>TEAMSTERS JOINT COUNCIL NO. 10 ZONE B</i>	01/01/2024	\$39.24	\$15.07	\$18.67	\$0.00	\$72.98
	06/01/2024	\$40.24	\$15.07	\$18.67	\$0.00	\$73.98
	12/01/2024	\$40.24	\$15.07	\$20.17	\$0.00	\$75.48
	01/01/2025	\$40.24	\$15.57	\$20.17	\$0.00	\$75.98
	06/01/2025	\$41.24	\$15.57	\$20.17	\$0.00	\$76.98
	12/01/2025	\$41.24	\$15.57	\$21.78	\$0.00	\$78.59
	01/01/2026	\$41.24	\$16.17	\$21.78	\$0.00	\$79.19
	06/01/2026	\$42.24	\$16.17	\$21.78	\$0.00	\$80.19
	12/01/2026	\$42.24	\$16.17	\$23.52	\$0.00	\$81.93
01/01/2027	\$42.24	\$16.77	\$23.52	\$0.00	\$82.53	
VOICE-DATA-VIDEO TECHNICIAN <i>ELECTRICIANS LOCAL 96</i>	09/03/2023	\$34.49	\$13.00	\$17.22	\$0.00	\$64.71
	09/01/2024	\$35.29	\$13.99	\$17.57	\$0.00	\$66.85
	09/07/2025	\$36.12	\$14.98	\$17.91	\$0.00	\$69.01
	09/06/2026	\$37.04	\$15.96	\$18.27	\$0.00	\$71.27

Classification

Effective Date Base Wage Health Pension Supplemental Unemployment Total Rate

Apprentice - VOICE-DATA-VIDEO TECHNICIAN - Local 96

Effective Date - 09/03/2023

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$17.25	\$13.00	\$4.31	\$0.00	\$34.56
2	55	\$18.97	\$13.00	\$4.36	\$0.00	\$36.33
3	60	\$20.69	\$13.00	\$16.81	\$0.00	\$50.50
4	65	\$22.42	\$13.00	\$16.86	\$0.00	\$52.28
5	70	\$24.14	\$13.00	\$16.91	\$0.00	\$54.05
6	75	\$25.87	\$13.00	\$16.97	\$0.00	\$55.84
7	80	\$27.59	\$13.00	\$17.02	\$0.00	\$57.61
8	85	\$29.32	\$13.00	\$17.07	\$0.00	\$59.39

Effective Date - 09/01/2024

Step	percent	Apprentice Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
1	50	\$17.65	\$13.99	\$4.41	\$0.00	\$36.05
2	55	\$19.41	\$13.99	\$4.46	\$0.00	\$37.86
3	60	\$21.17	\$13.99	\$17.15	\$0.00	\$52.31
4	65	\$22.94	\$13.99	\$17.20	\$0.00	\$54.13
5	70	\$24.70	\$13.99	\$17.25	\$0.00	\$55.94
6	75	\$26.47	\$13.99	\$17.30	\$0.00	\$57.76
7	80	\$28.23	\$13.99	\$17.36	\$0.00	\$59.58
8	85	\$30.00	\$13.99	\$17.41	\$0.00	\$61.40

Notes:

Apprentice to Journeyworker Ratio:1:1

WAGON DRILL OPERATOR LABORERS - ZONE 2	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
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For apprentice rates see "Apprentice- LABORER"

WAGON DRILL OPERATOR (HEAVY & HIGHWAY) LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/01/2023	\$38.11	\$9.65	\$17.14	\$0.00	\$64.90
	06/01/2024	\$39.44	\$9.65	\$17.14	\$0.00	\$66.23
	12/01/2024	\$40.77	\$9.65	\$17.14	\$0.00	\$67.56
	06/01/2025	\$42.16	\$9.65	\$17.14	\$0.00	\$68.95
	12/01/2025	\$43.54	\$9.65	\$17.14	\$0.00	\$70.33
	06/01/2026	\$44.98	\$9.65	\$17.14	\$0.00	\$71.77
	12/01/2026	\$46.42	\$9.65	\$17.14	\$0.00	\$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"

WASTE WATER PUMP OPERATOR OPERATING ENGINEERS LOCAL 4	12/01/2023	\$55.03	\$15.00	\$16.40	\$0.00	\$86.43
	06/01/2024	\$56.33	\$15.00	\$16.40	\$0.00	\$87.73
	12/01/2024	\$57.78	\$15.00	\$16.40	\$0.00	\$89.18
	06/01/2025	\$59.08	\$15.00	\$16.40	\$0.00	\$90.48
	12/01/2025	\$60.53	\$15.00	\$16.40	\$0.00	\$91.93
	06/01/2026	\$61.83	\$15.00	\$16.40	\$0.00	\$93.23
	12/01/2026	\$63.28	\$15.00	\$16.40	\$0.00	\$94.68

Classification	Effective Date	Base Wage	Health	Pension	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- OPERATING ENGINEERS"						
WATER METER INSTALLER	03/03/2024	\$67.74	\$14.32	\$19.11	\$0.00	\$101.17
PLUMBERS & GASFITTERS LOCAL 12	09/01/2024	\$69.54	\$14.32	\$19.11	\$0.00	\$102.97
	03/02/2025	\$71.34	\$14.32	\$19.11	\$0.00	\$104.77
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"						

Additional Apprentice Information:

Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the pre-determined hourly wage rate established by the Commissioner under the provisions of the M.G.L. c. 149, ss. 26-27D. Apprentice ratios are established by the Division of Apprenticeship Training pursuant to M.G.L. c. 23, ss. 11E-11L.

All apprentices must be registered with the Division of Apprenticeship Training in accordance with M.G.L. c. 23, ss. 11E-11L.

All steps are six months (1000 hours.)

Ratios are expressed in allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified.

** Multiple ratios are listed in the comment field.

*** APP to JM; 1:1, 2:2, 2:3, 3:4, 4:4, 4:5, 4:6, 5:7, 6:7, 6:8, 6:9, 7:10, 8:10, 8:11, 8:12, 9:13, 10:13, 10:14, etc.

**** APP to JM; 1:1, 1:2, 2:3, 2:4, 3:5, 4:6, 4:7, 5:8, 6:9, 6:10, 7:11, 8:12, 8:13, 9:14, 10:15, 10:16, etc.

WEEKLY PAYROLL RECORDS REPORT & STATEMENT OF COMPLIANCE

In accordance with Massachusetts General Law c. 149, §27B, a true and accurate record must be kept of all persons employed on the public works project for which the enclosed rates have been provided. A Payroll Form is available from the Department of Labor Standards (DLS) at www.mass.gov/dols/pw and includes all the information required to be kept by law. Every contractor or subcontractor is required to keep these records and preserve them for a period of three years from the date of completion of the contract.

On a weekly basis, every contractor and subcontractor is required to submit a certified copy of their weekly payroll records to the awarding authority; this includes the payroll forms and the Statement of Compliance form. The certified payroll records must be submitted either by regular mail or by e-mail to the awarding authority. Once collected, the awarding authority is required to preserve those records for three years from the date of completion of the project.

Each such contractor and subcontractor shall furnish weekly **and** within 15 days after completion of its portion of the work, to the awarding authority directly by first-class mail or e-mail, a statement, executed by the contractor, subcontractor or by any authorized officer thereof who supervised the payment of wages, this form, accompanied by their payroll:

STATEMENT OF COMPLIANCE

_____, 20_____

I, _____,
(Name of signatory party) (Title)

do hereby state:

That I pay or supervise the payment of the persons employed by

_____ on the _____
(Contractor, subcontractor or public body) (Building or project)

and that all mechanics and apprentices, teamsters, chauffeurs and laborers employed on said project have been paid in accordance with wages determined under the provisions of sections twenty-six and twenty-seven of chapter one hundred and forty nine of the General Laws.

Signature _____

Title _____

MASSACHUSETTS WEEKLY CERTIFIED PAYROLL REPORT FORM



Company's Name:	Address:	Phone No.:	Payroll No.:															
Employer's Signature:	Title:	Contract No.:	Tax Payer ID Number	Work Week Ending:														
Awarding Authority's Name:	Public Works Project Name:	Public Works Project Location:	Min. Wage Rate Sheet Number															
General / Prime Contractor's Name:	Subcontractor's Name:	"Employer" Hourly Fringe Benefit Contributions																
Employee Name & Complete Address	Work Classification:	Employee is OSHA 10 certified (?)	Appr. Rate (%)	Hours Worked							Project Hours (A)	Hourly Base Wage (B)	Health & Welfare Insurance (C)	ERISA Pension Plan (D)	Supp. Unemp. (E)	Total Hourly Prev. Wage (F)	Project Gross Wages (A x F)	Check No. (H)
				Su.	Mo.	Tu.	We.	Th.	Fr.	Sa.								

Are all apprentice employees identified above currently registered with the MA DLS's Division of Apprentices Standards? YES NO

For all apprentices performing work during the reporting period, attach a copy of the apprentice identification card issued by the Massachusetts Department of Labor Standards / Division of Apprentices Standards. No apprentices are identified above

NOTE: Pursuant to MGL c. 149, s. 27B, every contractor and subcontractor is required to submit a **true and accurate** copy of their certified weekly payroll records to the awarding authority by first-class mail or e-mail. In addition, each weekly payroll must be accompanied by a statement of compliance signed by the employer. Failure to comply may result in the commencement of a criminal action or the issuance of a civil citation.

Date Received by Awarding Authority
 / /

SECTION 01 11 00

SUMMARY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 PROJECT IDENTIFICATION AND DESCRIPTION OF WORK

- A. Project Identification: The name of the Project on the Bidding and Contract Documents is

**TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS**

73 Main Street
Hopkinton, Massachusetts 01748

BID #24-05-002IFB

for the Owner/Awarding Authority, the Town of Hopkinton acting by and through its Town Manager and its Select Board.

- B. Project Description: The proposed construction will include HVAC upgrade at Hopkinton Fire Department Headquarters including removal and disposal of rooftop HVAC units and replacing with new units on the roof including related ductwork and including all associated work such as structural reinforcement, electrical, acoustical ceiling work, painting, drywall, roof patching, and associated work as indicated on the Bidding and Contract Documents. This work will be publicly bid through MGL Chapter 149.

1.03 CONDITIONS OF THE CONTRACT

- A. Unless otherwise indicated, the Conditions of the Contract shall be Document 00 80 00, GENERAL CONDITIONS and are hereby incorporated by reference and made a part hereof.

1.04 CONSTRUCTION PERIOD

- A. Construction shall be executed in a timely and orderly manner (105 calendar days from Notice to Proceed) in accordance with the construction period established by the Architect and Owner; refer to Document 00 31 00, FORM FOR GENERAL BID.

1.05 WORK UNDER OTHER CONTRACTS

- A. Contract Coordination: Briefly without limitation, the work of this Contract includes coordination with other contractors performing certain construction operations and work under separate contracts with the Owner.
- B. Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract.

1.06 CONTRACT AND CONDITIONS OF THE CONTRACT

- A. Form of Contract and Conditions of the Contract shall be as follows:
1. Form of Contract between Owner and Contractor: Lump Sum, Stipulated Sum Contract; Refer to Document 00 51 00, AGREEMENT.
 2. Conditions of the Contract: Document 00 80 00, GENERAL CONDITIONS.

1.07 CONTRACTOR'S USE OF PREMISES

- A. Work will be constructed in accordance with the Construction Schedule established by the Owner and the Contractor, in conjunction with the Contractor's proposed work plan. The following are specific conditions that need to be strictly adhered to:
1. Fire Station must remain active and all systems operational at all times.
 2. Speakers and other alerting system components are in the ceilings and must remain operational. Contractors shall be alerted to use extreme caution so as not to damage existing systems.
 3. Current vendors servicing the existing communications and alerting systems must be in readiness to repair any components damaged during construction.
 4. The following is a list of existing vendors and contact information:

System	Vendor	Contact
Speakers and Hue Lights	BRYX 911	Brian Bush (216) 374-4761
IT Security and Cameras	BCM Controls	Matt B. (781) 528-8344 (main line) (781) 897-5178 (cell)
Network / IT	Hopkinton IT	Josh Grossetti jgrossetti@hopkintonma.gov
Fire Alarm / Security Alarm	Custom Alarm	Andy (508) 473-1028
Electrical (other than GC's own)	Egan Electric	Jim Egan (508) 380-1084
Fire Suppression	Heavey Sprinkler and Plumbing	John Heavey (508) 864-0919

- B. Coordinate use of premises under direction of the Owner's Contracting Officer.
1. Active Work areas to be limited in coordination with Hopkinton Fire Department operations; not all areas will be available at one time.
- C. Move any stored Products, under Contractor's control, which interfere with operations of the Owner or separate contractor.
- D. There is very limited space on-site for vehicles, storage of materials, dumpster and waste facilities, and other items.
1. Dumpster Location:
 - a. Owner recommends locating the dumpster against the building along the west side.
 - b. This location requires fire rated protectives at wall openings within 10 feet of the dumpster.
 - c. Refer to Drawings for additional information.

2. Staging of Materials: Very little available space on the Fire Department site.
 3. Field Office: Not allowed to be inside the Fire Station or outside on Town Property; no space is available.
 - a. Contractors can coordinate with the building owners of 77 Main Street or 85 Main Street for available space.
 - b. Weekly construction meetings can be held in the basement at Hopkinton Town Hall at 18 Main Street or at the Hopkinton DPW/Facilities Headquarter at 83 Wood Street.
 4. Fire Watch and Permits/Welding: A "hot" work permit and fire watch must be requested from HFD in a timely fashion if any oxygen induced open flame, welding or torch cutting occurs during the project. A copy of the permit will be given to the Contractor and a copy posted on the jobsite.
 - a. All associated fees are part of the General Contractor's responsibility, unless otherwise agreed in writing.
 - b. A letter from HFD will be required authorizing welding activities.
 - c. The General Contractor shall obtain a permit from the Town regarding storage of gas tanks on-site and provide Owner with a logistics plan.
 - E. Assume full responsibility for the protection and safekeeping of Products under this Contract, stored on the site.
 - F. Obtain and pay for the use of additional storage or work areas needed for operations.
 - G. Portable Toilets On-Site: Portable chemical toilets will be required on-site for duration of construction; refer to Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS.
 1. Construction personnel will not be permitted to use existing building's toilet facilities.
 2. Location of portable toilets shall be acceptable to the Owner.
 - H. Building Conditions and Restrictions: Comply with requirements of the Owner and Owner's Contracting Officer regarding use of site including restrictions and conditions established for the building and adjacent site and conditions of existing building. Comply with all Town of Hopkinton Building Department conditions and restrictions and other Town of Hopkinton requirements including neighborhood restrictions, adjacent properties, and all other municipal restrictions and ordinances.
 - I. Note: Correction of Second Floor Room Names at HFD Headquarters:
 1. FP (Fire Prevention) Officer change to Deputy Fire Chief Office.
 2. Shift Commander change to FP (Fire Prevention) Office.
 3. Conference change to Training Lieutenant.
- 1.08 OWNER-FURNISHED PRODUCTS
- A. Products furnished and paid for by the Owner, described in Specifications Sections:
 1. (TBD).
 - B. Owner's Responsibilities:
 1. Arrange for and deliver necessary shop drawings, product data, and samples to the Contractor.

2. Arrange and pay for Product delivery to the site, in accordance with the construction schedule.
3. Deliver supplier's bill of materials to Contractor.
4. Inspect deliveries jointly with Contractor.
5. Submit claims for transportation damage.
6. Arrange for replacement of damaged, defective, or missing items.
7. Arrange for manufacturer's warranties, bonds, service, inspections, as required.

C. Contractor's Responsibilities:

1. Designate delivery date for each Product in the Construction Schedule.
2. Review shop drawings, product data, and samples.
3. Receive and unload Products at the site.
4. Promptly inspect products jointly with Owner, record shortages, damaged, or defective items.
5. Handle Products at the site, including uncrating and storage.
6. Protect Products from exposure to elements, from damage.
7. Assemble, install, connect, adjust, and finish Products, as stipulated in the respective Section of Specifications.
8. Repair or replace items damaged by Contractor.

1.09 WORK BY OWNER

A. Furniture Moving:

1. The Owner (Hopkinton Fire Department and Town of Hopkinton Facilities Department) will move furniture.
2. Contractor shall provide protection (protective covers) and final cleaning after furniture is reinstalled.
3. Contractor shall provide 72 hours' notice to have work areas readied for work and include a time period the work will require. The Contractor agrees that failure to comply will not result in any schedule delay or increased cost claims.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 23 00

ALTERNATES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 REQUIREMENTS INCLUDED

- A. Definition: "Alternates" are alternate products, materials, equipment, systems, methods, units of work or major elements of the construction, which may, at the Awarding Authority's option and under the terms established by the Contract or Agreement, be selected for the work in lieu of the corresponding requirements of the Contract Documents.
- B. Alternate Requirements: A Schedule of Alternates is included at the end of this Section. Each alternate is defined using abbreviated language, recognizing that the Contract Documents define the requirements. Coordinate related work to ensure that work affected by each alternate is complete and properly interfaced with work of each selected alternate.
- C. Provide written proposals for each alternate on the Form of Proposal for the Awarding Authority's consideration. Each proposal amount shall include the entire cost of the alternate portion of the work including overhead, profit, taxes, insurance, and other costs including cost of interfacing and coordinating the alternate with related and adjacent work.
- D. Selection of Alternates: Selection of alternates to be included in the work will be by the Awarding Authority. Alternates must be taken in order. The first alternate before the second alternate, etc.
- E. Notification: Prepare and distribute to each entity a notification of status of each alternate. Indicate which alternates have been accepted or rejected, or when such decision is anticipated.

1.03 DESCRIPTION OF ALTERNATES

- A. BASE BID – ROOFTOP UNITS [RTU-1, RTU-2, RTU-3, and RTU-4]
 - 1. Base Bid: The Base Bid includes a total of four (4) rooftop units (RTU-1, RTU-2, RTU-3, and RTU-4) as specified in Division 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC) and as indicated on the Drawings. The Base Bid work includes localized HVAC and electrical work along with the associated structural roof reinforcement and ACT replacement.
- B. ALTERNATE NO. 1 – DELETE ROOFTOP UNIT NO. 2 (RTU-2) FROM SCOPE OF WORK (Deduct Alternate):

1. Base Bid: The Base Bid includes a total of four (4) rooftop units (RTU-1, RTU-2, RTU-3, and RTU-4) as specified in Division 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC) and as indicated on the Drawings. The Base Bid work includes localized HVAC and electrical work along with the associated structural roof reinforcement and ACT replacement.
 2. Alternate No. 1 – Deduct RTU-2: Deduct Alternate No. 1 includes deducting RTU-2 from the scope of work along with the localized HVAC and electrical work along with the associated structural roof reinforcement and ACT replacement.
- C. ALTERNATE NO. 2 – DELETE ROOFTOP UNIT NO. 3 (RTU-3) FROM SCOPE OF WORK (Deduct Alternate):
1. Base Bid: The Base Bid includes a total of four (4) rooftop units (RTU-1, RTU-2, RTU-3, and RTU-4) as specified in Division 23 – HEATING, VENTILATING AND AIR CONDITIONING (HVAC) and as indicated on the Drawings. The Base Bid work includes localized HVAC and electrical work along with the associated structural roof reinforcement and ACT replacement.
 2. Alternate No. 2 – Deduct RTU-3: Deduct Alternate No. 2 includes deducting RTU-3 from the scope of work along with the localized HVAC and electrical work along with the associated structural roof reinforcement and ACT replacement.

1.04 BID FORM INSTRUCTIONS

- A. General Contractor – enter amount on Document 00 31 00, FORM FOR GENERAL BID.
- B. Each Sub-bidder – enter amount on Document 00 35 00, FORM FOR SUB-BID.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 26 00

CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing contract modifications.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 01 29 00, PAYMENT PROCEDURES; Administrative procedures governing Applications for Payment.
 - 2. Section 01 32 00, CONSTRUCTION PROGRESS DOCUMENTATION; Requirements for the Contractor's Construction Schedule.
 - 3. Section 01 60 00, PRODUCT REQUIREMENTS: Administrative procedures for handling requests for substitutions made after award of the Contract.

1.03 MINOR CHANGES IN THE WORK

- A. The Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or Contract Time.

1.04 CHANGE ORDER PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: The Owner will issue a detailed description of proposed changes in the Work that will require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal requests issued by the Owner are for information only. Do not consider them as an instruction either to stop work in progress or to execute the proposed change.
 - 2. Within the time specified in the Proposal Request or 20 days (whichever is less) of after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required and unit costs, with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, the Contractor may propose changes by submitting a request for a change.

1. Include a statement outlining the reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with the total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements of Section 01 60 00, PRODUCT REQUIREMENTS if the proposed change requires substitution of one product or system for product or system specified.

- C. Proposal Request Form: Use AIA Document G709, Proposal Request or other form acceptable to Architect.

1.05 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, the Architect will issue a Change Order for signatures of the Owner and the Contractor on AIA Form G701, Change Order or other form acceptable to Architect.

1.06 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: When directed or approved by the Owner, the Architect may issue a Construction Change Directive on AIA G714, Construction Change Directive; this form instructs the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of the change in the Work. It also designates the method to be followed to determine change in the Contract Sum or Contract Time.
2. Form: AIA G714, Construction Change Directive or other form acceptable to Architect.

- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

1. After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Section 01 26 00, CONTRACT MODIFICATION PROCEDURES; Administrative procedures for handling changes to the Contract.
 - 2. Section 01 32 00, CONSTRUCTION PROGRESS DOCUMENTATION; Administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.
- C. Payments shall comply with Massachusetts General Laws.

1.03 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.04 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven (7) days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Sub-schedules: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.

 2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value.
 - 1). Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

 6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
 7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

 9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
- 1.05 APPLICATIONS FOR PAYMENT
- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment or other forms acceptable to Architect and Owner.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit five (5) signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Products list.
 5. Schedule of unit prices.
 6. Submittals Schedule (preliminary if not final).
 7. List of Contractor's staff assignments.
 8. List of Contractor's principal consultants.
 9. Copies of building permits.
 10. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 11. Initial progress report.
 12. Report of preconstruction conference.
 13. Certificates of insurance and insurance policies.
 14. Performance and payment bonds if required.
 15. Data needed to acquire Owner's insurance.

- H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims", or other acceptable form.
 5. AIA Document G706A, "Contractor's Affidavit of Release of Liens", or other acceptable form.
 6. AIA Document G707, "Consent of Surety to Final Payment", or other acceptable form.
 7. Evidence that claims have been settled.
 8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 31 00

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General Project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
 - 1. Section 01 11 00, SUMMARY; Owner occupancy.
 - 2. Section 01 32 00, CONSTRUCTION PROGRESS DOCUMENTATION: Preparing and submitting the Contractor's Construction Schedule.
 - 3. Section 01 77 00, CLOSEOUT PROCEDURES: Coordinating Contract closeout.

1.03 COORDINATION

- A. General Coordination Procedures: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include,

but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.

1.04 SUBMITTALS

- A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities.

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.

- B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

1.05 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and other involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare meeting agenda. Distribute the agenda to all attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within five (5) days of the meeting.

- B. Preconstruction Conference: Schedule a preconstruction conference scheduled and conducted by the Owner and Architect before starting construction. The conference will be held at Project site or another convenient location. Participate in the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.

- c. Critical work sequencing.
 - d. Designation of responsible personnel.
 - e. Procedures for processing field decisions, RFIs, and Change Orders.
 - f. Procedures for processing Applications for Payment.
 - g. Distribution of the Contract Documents.
 - h. Submittal procedures.
 - i. Preparation of Record Documents.
 - j. Use of the premises.
 - k. Responsibility for temporary facilities and controls.
 - l. Parking availability.
 - m. Construction waste management.
 - n. Office, work, and storage areas.
 - o. Equipment deliveries and priorities.
 - p. First aid.
 - q. Security.
 - r. Progress cleaning.
 - s. Working hours.
- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction or where required by a particular technical section.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related Change Orders.
 - d. Purchases.
 - e. Deliveries.
 - f. Submittals.
 - g. Review of mockups.
 - h. Possible conflicts.
 - i. Compatibility problems.
 - j. Time schedules.
 - k. Weather limitations.
 - l. Manufacturer's written recommendations.
 - m. Warranty requirements.
 - n. Compatibility of materials.
 - o. Acceptability of substrates.
 - p. Temporary facilities and controls.
 - q. Space and access limitations.
 - r. Regulations of authorities having jurisdiction.
 - s. Testing and inspecting requirements.
 - t. Required performance results.
 - u. Protection of construction and personnel.
 - 3. Record significant conference discussions, agreements, and disagreements.
 - 4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

- D. Progress Meetings: Attend progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be cured; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time. Provide a weekly two-week look-ahead schedule at each Project meeting.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Construction waste management.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Change Orders.
 - 15) Documentation of information for payment requests.
 - 16) Safety program.
 3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

1.05 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via email.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

Not Used.

END OF SECTION

SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 DESCRIPTION OF WORK

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Preliminary Construction Schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Submittals Schedule.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Field condition reports.
 - 7. Special reports.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 01 11 00, SUMMARY; Description of project, work by Owner, Project phasing.
 - 2. Section 01 29 00, PAYMENT PROCEDURES for submitting the Schedule of Values.
 - 3. Section 01 31 00, PROJECT MANAGEMENT AND COORDINATION for submitting and distributing meeting and conference minutes.
 - 4. Section 01 33 00, SUBMITTAL PROCEDURES for submitting schedules and reports.
 - 5. Section 01 40 00, QUALITY REQUIREMENTS for submitting a schedule of tests and inspections.
 - 6. Section 01 77 00, CLOSEOUT PROCEDURES for submitting photographic negatives as Project Record Documents at Project closeout.
 - 7. Divisions 02 through 28 for specific requirements for particular trades.

1.04 SUBMITTALS

- A. Contractor's Construction Schedule: Submit electronic and printed copies of initial schedule, a blue- or black-line print, large enough to show entire schedule for entire construction period.
 - 1. Submit an electronic copy of schedule, using software indicated, on thumbdrive suitably labeled to comply with requirements for submittals. Include type of schedule (Initial or Updated) and date on label.

- B. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.

1.05 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.
- C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.
- D. Building Occupants and Tenants: Coordinate with Owner regarding tenants and building occupants that are to remain in building throughout construction period. Provide all notifications and communications required to provide safe occupancy of building throughout construction. Maintain egress paths, MAAB accessibility, and utilities at all time. Provide all necessary temporary measures to permit normal operations in the Fire Station and to allow Fire Department personnel access to all required areas.

PART 2 - PRODUCTS

2.01 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning and Scheduling."
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion and Final Completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities so no activity is longer than 45 days, unless specifically allowed by Owner and Architect.

2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include not less than 30 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 11 00, SUMMARY. Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 11 00, SUMMARY. Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 8. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion for each phase.

- F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
1. Refer to Section 01 29 00, PAYMENT PROCEDURES for cost reporting and payment procedures.
- G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall Project Schedule.
- 2.02 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)
- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for the Notice to Proceed.
 2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 3. Use "one workday" as the unit of time.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Purchase of materials.
 - c. Delivery.
 - d. Fabrication.
 - e. Installation.
 2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Principal events of activity.
 4. Immediate preceding and succeeding activities.

5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the Schedule of Values).
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity duration in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.03 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. High and low temperatures and general weather conditions.
 5. Accidents.
 6. Meetings and significant decisions.
 7. Unusual events (refer to special reports).
 8. Stoppages, delays, shortages, and losses.
 9. Emergency procedures.
 10. Orders and requests of authorities having jurisdiction.
 11. Change Orders received and implemented.
 12. Construction Change Directives received.
 13. Services connected and disconnected.
 14. Partial Completions and occupancies.
 15. Substantial Completions authorized.
 16. Number of workers on-site per contractor.

17. Work descriptions and locations.
18. Time and material (T&M) work, if any.
19. Visitors.
20. Inspections.

B. Daily Construction Report Submission: Submit each daily report to the Owner.

2.04 SPECIAL REPORTS

A. General: Submit special reports directly to the Owner within one day of an occurrence. Distribute copied of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Architect and Owner in advance when these events are known or predictable.

2.05 TWO-WEEK LOOK-AHEAD

A. Submit for Project Meeting a two-week look-ahead at each weekly job meeting in bar chart or bullet point format acceptable to the Owner.

PART 3 - EXECUTION

3.01 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before the regularly scheduled progress meeting at which it will be reviewed.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, duration, actual starts and finishes, and activity duration.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

3.02 SUBMISSION OF CONTRACTOR'S CONSTRUCTION SCHEDULE IS A CONDITION FOR PROCESSING OF MONTHLY APPLICATION FOR PAYMENT.

A. Submission of updated Contractor's Construction Schedule monthly is a condition for processing of monthly Application for Payment.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for submittals required for performance of Work, including:
 - 1. Progress schedules.
 - 2. Submittal schedule.
 - 3. Shop drawings.
 - 4. Product data.
 - 5. Samples.
- B. Administrative Submittals: Refer to requirements specified in other Division 01 – GENERAL REQUIREMENTS Specification Sections, and other Contract Documents, for administrative submittals, including:
 - 1. Permits.
 - 2. Applications for payment.
 - 3. Insurance certificates.
 - 4. List of subcontractors.

1.03 RELATED REQUIREMENTS

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
 - 1. Section 01 11 00, SUMMARY; Scope of work, work by Owner, phasing of project.
 - 2. Section 01 77 00, CLOSEOUT PROCEDURES; Closeout submittals.

1.04 SUBMITTAL PROCEDURES

- A. Coordination of Submittals: Coordinate timing of submittals with construction activities. Transmit submittals well enough in advance of performance of Work to avoid delays. Coordinate submittals of related elements of Work.
 - 1. Architect may reject or withhold action on submittals requiring coordination with other submittals until related submittals are received.
- B. Processing of Submittals: Allow sufficient review time to ensure installation will not be delayed because of time required to process submittals. Minimum processing times are as follows:
 - 1. Review by Architect: Allow ten (10) business days for review and processing.

2. Reprocessing of Submittals: For submittals not approved initially, allow five (5) business days for review and reprocessing of submittals by Architect.
 3. No extension of Contract Time will be authorized due to failure to transmit submittals sufficiently in advance of scheduled performance of Work.
- C. Contractor's Preparation of Submittals: Place permanent label or title block on each submittal for identification. Indicate Project Name, Architect's Project Number, Specification Section number and title, date of submittal, name and address of Architect, name and Address of Contractor, name and address of subcontractor and/or supplier, name of manufacturer, Drawing number and detail reference.
1. Contractor's Review and Action Stamp: Provide suitable space on label or title block for Contractor's review and action stamp. Stamp and sign each submittal to show Contractor's review and approval prior to transmittal to Architect. Submittals not signed and stamped by Contractor will be returned without action.
 2. Architect's Review and Action Stamp: Provide minimum 4 in. x 4 in. space on label or title block for Architect's review and action stamp. Deliver submittals to Architect at address listed on cover of Project Manual.
 3. Modify and customize submittals as required to show interface with adjacent work and attachment to building.
- D. Transmittal of Submittals: Transmit each item with Architect-accepted transmittal form. Identify Project, Contractor, subcontractor, major supplier; identify pertinent Drawing sheet and detail number, and Specification section number, as appropriate, on transmittal form.
1. Source: Submittals received from sources other than Contractor will be returned without action.
 2. Deviations from Contract Documents: When products, materials, or systems submitted deviate from Contract Documents, record deviations clearly on transmittal form, or separate attached sheet.
- E. Comply with progress schedule for submittals related to Work progress.
- F. After Architect reviews submittal, revise and resubmit as required. Identify changes made since previous submittal.
- G. Distribute copies of reviewed submittals to concerned persons. Instruct recipients to promptly report inability to comply with provisions.
- 1.05 PROGRESS SCHEDULE
- A. Timing: Submit progress schedule within 10 calendar days of Award of Contract.
 - B. Preparation of Progress Schedule: Prepare construction schedule per Section 01 32 00, CONSTRUCTION PROGRESS DOCUMENTATION.
 - C. Distribution: Print and distribute progress schedule to Architect, Owner, subcontractors, and other parties affected.
 - D. Revisions: Update and reissue progress schedule monthly in conjunction with Application for Payment.
- 1.06 SUBMITTAL SCHEDULE
- A. Timing: Prepare and issue complete Submittal Schedule no later than ten (10) working days after Architect accepts Progress Schedule.

- B. Preparation: Coordinate Submittal Schedule with Progress Schedule, and Schedule of Values.
- C. Content of Submittal Schedule: Prepare schedule in order by Specification Section. Provide the following information for each submittal:
 - 1. Scheduled date of initial submittal.
 - 2. Specification Section number.
 - 3. Submittal type.
 - 4. Name of subcontractor or supplier.
- D. Distribution: Print and distribute Submittal Schedule to Architect, Owner, subcontractors, and other parties affected.
- E. Revisions: Update and reissue Submittal Schedule monthly in conjunction with Application for Payment.

1.07 SHOP DRAWINGS

- A. Provide accurately prepared large scale and detailed shop drawings prepared specifically for this Project on reproducible sheets. Show adjacent conditions and related work. Show accurate field dimensions where appropriate. Identify materials and products shown. Note special coordination required. Standard information prepared without specific reference to Project is not considered shop drawings.
- B. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates, and similar drawings.
- C. Show every component of fabricated item, notes regarding manufacturing process, coatings and finishes, identifying numbers conforming to Contract Documents, (i.e., door numbers, etc.) dimensions, and appropriate trade names. Show anchorage and fastening details, including type, size and spacing. Show material gage and thickness. Indicate welding details and joint types.
- D. Shop Drawing Sheet Size: Except for templates, patterns, and other full-size drawings, submit shop drawings on sheets at least 8-1/2 in. x 11 in., but no larger than 36 in. x 48 in.
- E. Submittal Quantities: Submit shop drawings in following minimum quantities: electronic. Provide one full size color hard copy of approved shop drawings to Architect.

1.08 PRODUCT DATA

- A. Definition: Product data includes manufacturer's standard published literature, such as installation instructions, catalog cuts, color charts, rough-in diagrams and wiring diagrams. When product data must be prepared specifically because standard published data is not suitable for use, submit as shop drawing.
- B. Preparation: Mark each copy of product data to show applicable choices and options. Where published product data includes information on several products and choices, mark copies to clearly indicate information applicable to this Project.
- C. Do not submit product data until compliance with requirements of Contract Documents has been confirmed.
- D. Submittal Quantities: Submit product data in following quantities: electronic. Provide one full size color hard copy of approved product data to OPM.

- E. Installer Copy: Verify that installer of Work possesses a current copy of Architect-approved product data prior to installation.

1.09 SAMPLES

- A. Submit samples identical with materials and products to be installed. Where indicated, prepare samples to match Owner's sample. Label sample with description, source, manufacturer's name, and catalog number. Submit samples along with certifications that products comply with referenced standards.
- B. Architect Review: Architect will review samples for confirmation of visual intent, color, pattern, texture, and type. Architect will not test samples for compliance with other specified requirements, which shall remain exclusive responsibility of Contractor.
- C. Submittal Quantities: When variation in color, pattern, or texture can be expected in finish work, submit multiple samples (minimum of three) to show approximate limits of variations. Submit samples in following quantities:
 - 1. Initial Selection: For initial selection of color, texture, and pattern, submit one (1) full set of manufacturer's available samples.
 - 2. Verification Samples: Submit three sets of samples selected. One set will be returned to Contractor for use at Project Site for quality control comparisons.
- D. Distribution: Distribute additional sets of approved samples to subcontractors, suppliers, installers, and others required for proper performance of Work. Indicate distribution on transmittal forms.

1.10 DAILY PROGRESS REPORTS

- A. Prepare daily construction Progress Reports. Record following information concerning events on Project Site:
 - 1. List of subcontractors at site.
 - 2. General weather conditions.
 - 3. Accidents and unusual events.
 - 4. Meetings and significant decisions.
 - 5. Orders and requests by governing authorities.
 - 6. Change orders received.
 - 7. Equipment or system tests and start-ups.
 - 8. Partial completions and occupancies.
 - 9. Authorized substantial completions.
 - 10. Work by Owner documentation.
 - 11. Number of workers on-site per contractor.
 - 12. Work descriptions and locations.
 - 13. Time and material (T&M) work, if any.
 - 14. Visitors.
 - 15. Inspections.
- B. Distribution: Distribute copies to Architect and the Owner's Representative weekly.

1.10 ARCHITECT'S ACTION

- A. General:
 - 1. The Architect will not review submittals that do not bear Contractor's review stamp and will return them without action.

2. The Architect will review only those submittals explicitly required by the Contract Documents or requested by the Architect as the work proceeds.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken as follows:
1. "NO EXCEPTIONS TAKEN": No corrections, no marks: Resubmission not required.
 2. "MAKE CORRECTIONS NOTED": Minor amount of corrections; all items can be fabricated without further corrections to original submittal; checking is complete and all corrections are deemed obvious without ambiguity. Resubmission not required.
 3. "REVISE AND RESUBMIT": Minor corrections required; items noted shall not be fabricated until further corrections of original submittal is completed and Architect-approval is obtained; checking is complete; clarify details of items noted by checker for approval; items without marks may be fabricated without further submittal. Resubmission required.
 4. "REJECTED": Submittal does not conform to Contract Documents, and requires too many corrections, or is rejected for other justifiable reasons. Architect will state reasons for rejection. Correct and resubmit. Do not fabricate.
- C. Other Action: Submittal for information or record purposes will be returned with no action marked.
- D. Required Resubmittals: Make corrections or changes to submittals required by Architect and resubmit until approved. Revise initial shop drawings or product data, and resubmit as specified for initial submittal. Indicate changes made other than those requested by Architect. Submit new samples as required for initial submittal.
- E. Submittal Procedures:
1. Fabrication or installation of work for which Architect's review is required should not begin until the submittal is acceptable to the Architect. Fabrication or installation begun without Architect's acceptance is undertaken at the Contractor's sole risk.
 2. In resubmitting, comply with requirements specified for the initial submittal. Transmit each resubmittal with a new letter of transmittal and note the transmittal number of the first submission on the transmittal form.
 3. Informational Submittals: The Architect will review each submittal and will not return it or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- F. Description of Actions:
1. If submittal is stamped "No Exceptions Taken" items covered by the submittal are in conformance with requirements of the Contract Documents and may be incorporated in the Work. The submittal (shop drawings, product data or samples) need not be resubmitted.
 2. If submittal is stamped "Make Corrections Noted" subject to corrections noted, items covered by the submittal are in conformance with requirements of the Contract Documents and may be incorporated in the Work. Resubmit corrected submittal for Record only. The submittal (shop drawings, product data or samples) need not be resubmitted. Make changes noted to the actual item prior to fabrication and installation.

3. If submittal is stamped "Revise and Resubmit" make corrections or changes required by the Architect in the submittals and resubmit submittal for review. Items covered by the submittal are not approved for incorporation into the Work.
 4. If submittal is stamped "Rejected" the submittal does not conform to the requirements of this Section, or deviates from the requirements of the Contract. A conforming submittal must be submitted, and the items covered by the incorporated work.
- G. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 35 16

ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 REQUIREMENTS INCLUDED

- A. Coordinate Work and schedule elements of alterations and renovation work by procedures and methods that expedite completion of the Work.
- B. In addition to demolition specified in Section 02 41 19, SELECTIVE DEMOLITION, and indicated on Drawings, cut, move and remove miscellaneous existing work as necessary to provide access and to allow alterations and new work to proceed. Include but do not limit work to:
 - 1. Repair and removal of hazardous and unsanitary conditions and materials.
 - 2. Removal of abandoned items and items that serve no useful purpose, such as abandoned piping, conduit and wiring.
 - 3. Removal of unsuitable and extraneous materials not marked for salvage, such as abandoned furnishings and equipment, and debris such as rotted wood, rusted metals and deteriorated concrete.
 - 4. Cleaning of surfaces, and removal of surface finishes as needed to install new work and finishes.
- C. Patching, repair, and refinishing existing work intended for reuse, to specified condition for each material, with suitable transition to adjacent new items of construction.
- D. Related Sections include the following:
 - 1. Section 01 73 10, CUTTING AND PATCHING for repair and restoration of construction disturbed by testing and inspecting activities.
 - 2. Section 01 76 00, PROTECTING INSTALLED ROOFING.

1.03 ALTERATIONS, CUTTING, AND PROTECTION

- A. Ensure that work is performed by workers qualified for each condition and material encountered.
- B. Cutting of existing construction required to install equipment under various Sections shall be done by coring or sawing method under Section appropriate to materials and construction.
- C. Cut and remove minimum materials necessary and avoid damage to adjacent work intended for reuse.
- D. Cut finish surfaces such as trim and metals by methods that terminate surfaces in a straight line at natural points of division.
- E. Cutting and patching work shall comply with requirements of Section 01 73 10, CUTTING AND PATCHING.

- F. Protect existing finishes, equipment, and adjacent work scheduled to remain from damage from weather and extremes of temperature.
 - 1. Maintain existing interior work above 60°F.
 - 2. Provide weather protection, waterproofing, heat and humidity control as necessary to prevent damage to remaining existing work and to new work.
- G. Provide temporary enclosures to separate work areas from existing building and from areas occupied by Owner and tenants, and to provide weather protection.

PART 2 - PRODUCTS

2.01 SALVAGED MATERIALS FOR REUSE

- A. Salvage sufficient quantities of cut and removed materials to replace damaged work of existing construction when material is not readily obtainable on current markets.
 - 1. Store salvaged items in dry, secure place on site.
 - 2. Items not required for use in repair of existing work shall remain Owner's property.
 - 3. Do not incorporate salvaged or used materials in new construction without Architect's approval and approval of Owner.

2.02 PATCHING, EXTENDING, AND MATCHING

- A. Provide same products or types of construction as those in existing structure, as needed to patch, extend, and match existing work.
- B. Generally, Contract Documents do not define products or standards of workmanship present in existing construction; determine products and workmanship by inspection and testing. Architect will judge workmanship and materials against existing as a sample of comparison.
- C. Provide products, finishes, and types of construction for patching, extending and matching shall be performed as necessary to make work complete and consistent to identical standards of quality.

PART 3 - EXECUTION

3.01 PERFORMANCE

- A. Patching of existing construction to accommodate work of various Sections shall be performed under Sections that specify methods and materials similar to adjacent existing construction, in the following areas:
 - 1. Holes adjacent to penetrations for electrical conduit, plumbing pipes and ductwork where exposed to view.
 - 2. Holes adjacent to penetrations through fire walls for electrical conduit, plumbing pipes and ductwork through fire walls as required by code.
 - 3. Areas adjacent to installation of new doors and windows and other framed wall and partition penetrations.
 - 4. Removal and patching of damaged material where indicated.
- B. Patch areas exposed to view after removal of existing construction and intersecting walls as indicated.

- C. Patch and extend existing work using skilled workers who are capable of matching existing quality of workmanship. Quality of patched or extended work shall be equal to that specified for new work.

3.02 ADJUSTMENTS

- A. Where partitions are removed, patch floors, walls, and ceilings, with finish materials to match existing.

3.03 DAMAGED SURFACES

- A. Patch and replace parts of existing finished surface(s) which is found to be damaged, lifted, discolored, or otherwise imperfect, with matching materials.
 1. Provide adequate support of substrate before patching finish.
 2. Refinish patched portions of painted and coated surfaces to produce uniform color and texture over entire surface.
 3. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

3.04 TRANSITION FROM EXISTING TO NEW WORK

- A. When new work abuts or finishes flush with existing work, make smooth transition. Patched work shall match existing adjacent work in texture and appearance so that patch or transition is not visible from 5 ft. away.
- B. When finished surfaces are cut so that smooth transition with new work is not possible, terminate existing surface in a neat manner along straight line at natural line of division. Provide trim appropriate to finished surface.

3.05 CLEANING

- A. Perform periodic and final cleaning as specified in Section 01 77 00, CLOSEOUT PROCEDURES.
- B. At completion of work of each Section, clean area and prepare surfaces for work of other Sections.
- C. At completion of alterations work in each area, provide final cleaning and return space to condition suitable for use by Owner.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 DESCRIPTION OF WORK

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections include the following:
 - 1. Section 01 73 10, CUTTING AND PATCHING for repair and restoration of construction disturbed by testing and inspecting activities.
 - 2. Section 01 31 00, PROJECT MANAGEMENT AND COORDINATION for developing a schedule of required tests and inspections.
 - 3. Divisions 02 through 28 Sections for specific test and inspection requirements.

1.03 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selections made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockups establish the standard by which the Work will be judged.
- D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

1.04 DELEGATED DESIGN

- A. Performance and Design Criteria: Where professional design services or certification by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to the Architect.

1.05 REGULATORY REQUIREMENTS

- A. Copies of Regulations: Obtain copies of the following regulations and retain at Project site to be available for reference by parties who have a reasonable need:
1. Massachusetts State Building Code.
 2. Massachusetts Fire Protection Code.
 3. Massachusetts State Plumbing and Gas Code.
 4. United States disabled access regulations, "Americans with Disabilities Act (ADA)", ANSI Guidelines for Accessibility.
 5. Mechanical, plumbing, and electrical codes, current edition, as adopted by the Commonwealth of Massachusetts.

1.06 SUBMITTALS

- A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Delegated Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by a responsible design professional, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include lists of codes, loads, and other factors used in performing these services.
- C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
 2. Description of test and inspection.
 3. Identification of applicable standards.
 4. Identification of test and inspection methods.
 5. Number of tests and inspections required.
 6. Time schedule or time span for tests and inspections.
 7. Entity responsible for performing tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- D. Reports: Prepare and submit certified written reports that include the following:
1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.

8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

- E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.07 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar to those indicated for this Project in material, design, and extent.
- F. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.
- G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 548, and that specializes in types of tests and inspections to be performed.
- H. Preconstruction Testing: Testing agency shall perform preconstruction testing for compliance with specified requirements for performance and test methods.

1.08 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.
 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.
1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Special Tests and Inspections: Owner will engage a testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner.
1. Testing agency will notify Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
 2. Testing agency will submit a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
 3. Testing agency will submit a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
 4. Testing agency will interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
 5. Testing agency will retest and reinspect corrected work.
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
 5. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field-curing of test samples.
 5. Delivery of samples to testing agencies.
 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 30 days of date established for the Notice to Proceed.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Sections of these Specifications. Restore patched areas and extend restoration into adjoining areas in a manner that eliminates evidence of patching.
 2. Comply with the Contract Document requirements for Section 01 73 10, CUTTING AND PATCHING.
- B. Protect construction exposed by or for quality-control service activities.

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- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 42 00

REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 DEFINITIONS

- A. General: Basic Contract definitions are included in the CONDITIONS OF THE CONTRACT,
- B. "Reviewed": When used to convey Architect's action on General Contractor's submittals, applications, and requests, "reviewed" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities subject to Owner's approval. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.03 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source, and have available on site for reference.

1.04 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale Research's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."

AA	Aluminum Association, Inc. (The)
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABAA	Air Barrier Association of America
ACI	ACI International (American Concrete Institute)
AGC	Associated General Contractors of America (The)
AIA	American Institute of Architects (The)
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALSC	American Lumber Standard Committee, Incorporated
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
APA	APA - The Engineered Wood Association
ARMA	Asphalt Roofing Manufacturers Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	ASME International (The American Society of Mechanical Engineers International)
ASTM	ASTM International (American Society for Testing and Materials International)
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association (The)
CDA	Copper Development Association
CISCA	Ceilings & Interior Systems Construction Association
CSI	Construction Specifications Institute (The)
DHI	Door and Hardware Institute
EPA	Environmental Protection Agency (United States)
FM	Factory Mutual
FMRC	Factory Mutual Research (Now FM Global)
FSC	Forest Stewardship Council

GA	Gypsum Association
GANA	Glass Association of North America
GS	Green Seal
HPVA	Hardwood Plywood & Veneer Association
ICRI	International Concrete Repair Institute, Inc.
IESNA	Illuminating Engineering Society of North America
ILI	Indiana Limestone Institute of America, Inc.
ISO	International Organization for Standardization
ISSFA	International Solid Surface Fabricators Association
ITS	Intertek Testing Service NA
LEED	Leadership in Energy & Environmental Design (USGBC)
MassDOT	Massachusetts Department of Transportation
MFMA	Maple Flooring Manufacturers Association, Inc.
MHD	Massachusetts Highway Division
NAAMM	National Association of Architectural Metal Manufacturers
NAIMA	North American Insulation Manufacturers Association
NBGQA	National Building Granite Quarries Association, Inc.
NCMA	National Concrete Masonry Association
NeLMA	Northeastern Lumber Manufacturers' Association
NEMA	National Electrical Manufacturers Association
NFPA	NFPA (National Fire Protection Association)
NFRC	National Fenestration Rating Council
NOFMA	NOFMA: The Wood Flooring Manufacturers Association (Formerly: National Oak Flooring Manufacturers Association)
NRCA	National Roofing Contractors Association
NSF	NSF International (National Sanitation Foundation International)
NTMA	National Terrazzo & Mosaic Association, Inc. (The)
NWWDA	National Wood Window and Door Association (Now WDMA)
SDI	Steel Deck Institute
SGCC	Safety Glazing Certification Council
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPRI	Single Ply Roofing Institute Inc.
SSINA	Specialty Steel Industry of North America
SSPC	SSPC: The Society for Protective Coatings
UL	Underwriters Laboratories Inc.
USGBC	U.S. Green Building Council
WCLIB	West Coast Lumber Inspection Bureau
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association)
WWPA	Western Wood Products Association

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of current edition of Codes in the Commonwealth of Massachusetts.

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PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SECTION INCLUDES

- A. This section specifies procedures for measuring and reporting the quality and performance of construction, including:
 1. Supporting services provided during tests and inspections performed by an independent testing agency employed by the Owner and by governing authorities.
 2. Tests and inspections provided by the Contractor or by an independent testing agency employed by the Contractor.
 3. Mock-ups and field samples.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
 1. Section 01 40 00, QUALITY REQUIREMENTS; Inspection and testing.
 2. Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS; Temporary enclosures.
 3. Individual Specification Sections that specify field mock-ups of individual pieces of the Work.

1.04 SUBMITTALS

- A. Test Reports: For tests and inspections which are required to be performed by the Contractor, submit certified written reports.

1.05 TESTING BY OWNER

- A. Where inspections, tests, and other requirements of the Contract Documents are specifically indicated to be the Owner's responsibility, the Owner will employ and pay a qualified independent testing agency to perform those services.

1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Scope of Testing Performed by Contractor: The Contractor shall provide all other inspections, tests, and other quality control services specified elsewhere in the Contract Documents or required by authorities having jurisdiction. Include costs for these services in the Contract Sum.

1. Unless the Contract Documents or local authorities permit such testing or inspections to be performed by the Contractor's own forces, the Contractor shall employ and pay a qualified independent testing agency or agencies to perform these services. This agency shall be referred to as "the Contractor's Testing Agency" or "the Contractor's Testing and Inspection Agency".
 - B. Regardless of whether testing and inspection is performed by the Owner's Testing and Inspection Agency or the Contractor's Testing and Inspection Agency, the Contractor shall be responsible for coordination and scheduling of testing, and for associated services, as follows:
 1. Schedule times for inspections, tests, taking samples, and similar activities. Coordinate this schedule with construction activities so that testing does not delay the work, and so that testing is completed before work to be tested is closed in or otherwise made inaccessible.
 2. Associated Services: Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable support services as requested. Notify the agency sufficiently in advance of operations to permit assignment of personnel. Auxiliary services may include, but are not limited to, the following:
 - a. Provide access to the Work.
 - b. Furnish incidental labor and facilities necessary to facilitate inspections and tests.
 - c. Take adequate quantities of representative samples of materials that require testing or assist the agency in taking samples.
 - d. Provide facilities for storage and curing of test samples.
 - e. Deliver samples to testing laboratories.
 - f. Provide the agency with a preliminary design mix proposed for use for materials mixes that require control by the testing agency.
 - g. Provide security and protection of samples and test equipment at the Project Site.
 - h. Protect construction exposed by or for quality-control service activities.
 - C. Retesting: The Contractor is responsible for retesting where results of inspections, tests, or other quality-control services prove unsatisfactory and indicate noncompliance with Contract Documents, regardless of whether the original test was Contractor's responsibility.
 - D. Do not cover or enclose with permanent construction items or assemblies which are to be tested or inspected until such testing or inspection has been completed and the Work has been accepted in accordance with the Contract Documents. Protect construction exposed by or for testing and inspection until it is covered or enclosed with permanent construction. After inspection and testing is completed, complete the enclosing Work and repair substrates and finishes that have been damaged by the testing.
 - E. Upon completion of inspection, testing, sample taking and similar services, repair damaged construction and restore substrates and finishes. Comply with requirements for cutting and patching specified in Section 01 73 10, CUTTING AND PATCHING.
- 1.07 DUTIES OF THE TESTING AGENCY; REPORTING PROCEDURES
- A. Duties of the Testing Agency:
 1. Provide qualified personnel to perform required inspections and tests.
 2. Furnish equipment, tools and supplies necessary for taking samples and performing tests, except where sampling is indicated to be the responsibility of the Contractor.
 3. Prepare test reports, as specified elsewhere in this Section.
 4. Promptly notify the Architect and the Contractor of irregularities or deficiencies observed in the Work during performance of its services.

- B. The agency is not authorized to release, revoke, alter, or enlarge requirements of the Contract Documents or approve or accept any portion of the Work.
- C. Promptly after completion of each inspection or test performed, the testing agency shall prepare a certified written report of the tests or inspections performed. Submittal of such reports shall be a prerequisite to payment for the work being tested.
- D. Report Data: Include as a minimum, the following information:
 - 1. Date of issue.
 - 2. Project title and number.
 - 3. Name, address, and telephone number of testing agency.
 - 4. Name of individual making the inspection or test. Have this person sign the report after it is completed.
 - 5. Identification of product or assembly and Specification Section.
 - 6. Dates and locations of samples and tests or inspections.
 - 7. Ambient conditions at the time of sample taking and testing.
 - 8. Description of the type of inspection or test method.
 - 9. Complete inspection or test data.
 - 10. An interpretation of test results, including comments or professional opinion on whether inspected or tested Work complies with the Contract Documents.
 - 11. Recommendation for remedial action or retesting.
- E. Submittal: The Testing Agency shall deliver reports to the Architect, Owner and Contractor, as follows:
 - 1. Architect: Two copies, plus additional copies as requested by the Architect for special distribution. The Architect will forward test reports to the local authority having jurisdiction, if required.
 - 2. Owner: One copy.
 - 3. Contractor: Two copies. The Contractor will place one of these copies in the Project Record File.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. Furnish and install temporary services and facilities and controls, including utilities, construction and support facilities, security and protection required for the Work.
- B. Construction facilities and temporary controls which may be required for this Project include, but are not limited to:
 - 1. Temporary electric power.
 - 2. Fire protection during construction.
 - 3. Field offices.
 - 4. Temporary protection of existing building and facilities including providing for safe access to and from building.
 - 5. Environmental controls during construction.
 - 6. Temporary staging, scaffolding, barriers, safety devices, and signs.
- C. Related Work Specified in Other Sections: Refer to Division 01 Specification Sections, including:
 - 1. Section 01 33 00, SUBMITTAL PROCEDURES; procedures for submitting copies of implementation and termination schedule and utility reports.
 - 2. Section 01 73 00, EXECUTION REQUIREMENTS; progress cleaning requirements.
 - 3. Divisions 02 through 33 for temporary heat, ventilation, and humidity requirements for products in those Sections.
 - 4. Section 23 00 01, HEATING, VENTILATING AND AIR CONDITIONING (HVAC).

1.03 QUALITY ASSURANCE

- A. Standards: Comply with ANSI A10.6, NECA "Temporary Electrical Facilities," and NFPA 241.
 - 1. Trade Jurisdictions: Assigned responsibilities for installation and operation of temporary utilities are not intended to interfere with trade regulations and union jurisdictions.
 - 2. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Regulations: Comply with industry standards and applicable laws and regulations of authorities having jurisdiction, including but not limited to:
 - 1. Commonwealth of Massachusetts State Building Code requirements.
 - 2. Health and safety regulations including OSHA Standards and Regulations and NFPA.
 - 3. Utility company regulations.
 - 4. Town of Hopkinton Police, Fire Department and Rescue Squad rules.
 - 5. Environmental protection regulations.

- C. Superintendence: Contractor's superintendent shall be on-site from the beginning of the Work, prior to placing or erecting temporary construction specified in this Section.
- D. Standards: Contractor shall be responsible for identifying and complying with applicable standards and guidelines for safe construction of the Work.
- E. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.04 REFERENCED STANDARDS

- A. National Fire Protection Association (NFPA):
 - 1. NFPA 10, Standard for Portable Fire Extinguishers.
 - 2. NFPA 70, National Electrical Code.
 - 3. NFPA 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.05 JOB SITE CONDITIONS

- A. Locate existing utilities including overhead utility lines before beginning construction.
- B. Existing entries, roads and parking areas: Do not obstruct existing building entrances, doors, driveways, roads, and parking on the site and adjacent sites that are used by the Owner or other tenants and the general public, unless otherwise approved by the Owner.
- C. There is limited areas on-site available for on-site parking and for on-site material storage; Contractor shall make arrangements for off-site parking of construction vehicles and vehicles of construction personnel and for material storage (where required). Comply with parking requirements and regulations as established by the Town of Hopkinton. Coordinate requirements with Owner's Representative.

1.06 SEQUENCING AND SCHEDULING

- A. Install or initiate temporary services in a timely fashion, when they are needed, so that the progress of the work is not delayed. Maintain temporary facilities until the time of Substantial Completion, or until they are no longer required.

1.07 NOISE CONTROL

- A. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.
- B. Execute construction work by methods and by use of equipment which will reduce excess noise.
 - 1. Equip air compressors with silencers, and power equipment with mufflers.
 - 2. Manage vehicular traffic and scheduling to reduce noise.
 - 3. No heavy equipment may be started or idled before 7:00 A.M.

1.08 ACCEPTABLE HOURS OF OPERATION

- A. Contractor shall conduct construction in compliance with applicable municipal ordinances or bylaws relative to acceptable hours of operation. Except where approved by the Owner, no work shall occur prior to 7:00 AM, Monday through Friday.

1. Allowable working hours shall be limited to 7:00 AM to 4:00 PM, Monday through Friday.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. The Contractor shall be responsible for selecting suitable materials and equipment that meet applicable codes and regulations.
- B. Temporary Electrical Service: Comply with NEMA, NECA and UL standards and regulations, and Massachusetts Electrical Code.
- C. Fire Extinguishers: Provide hand-carried, portable UL-rated fire extinguishers conforming to NFPA recommendations. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent and size required by location and class of fire exposure, and location of fire extinguishers.
- D. Tarpaulins: Use only fire-retardant tarpaulins.
- E. Field Offices and Storage Sheds: Prior to installation of field offices and storage sheds (where required for Contractor's use only), consult with Architect and Owner on location, access, and related facilities. Owner's field offices are not required.

2.02 TEMPORARY TOILETS

- A. The Contractor shall provide and service an adequate number of toilet booths with chemical type toilets.
- B. The toilets shall be erected in a location approved by the Architect and Owner and shall be maintained by the Contractor in a clean and orderly condition in compliance with all local and state health requirements.
- C. Toilets shall be maintained throughout construction period including all maintenance and cleaning and all cost associated with temporary toilet facilities shall be paid by the Contractor.

2.03 TEMPORARY STAGING AND SCAFFOLDING

- A. The General Contractor shall furnish, erect, and maintain in safe condition all exterior and interior staging and scaffolding required for his own use. Where staging and scaffolding over 8 ft. high is required, the Contractor shall provide the entire installation, including the first 8 ft., for the use of all Subcontractors on the project, as required to properly carry out and complete the work, except as may otherwise be specifically provided for in any of the trade sections of this Specification. This staging and scaffolding thus provided shall be without charge to the trades using same.
- B. Each of the Subcontractors shall furnish, erect, and maintain in safe condition all exterior staging and scaffolding which does not exceed 8 ft. height for their own use.
- C. Staging and scaffolding shall comply in all respects to governing laws and codes.

2.04 PROJECT SIGN

- A. [Not Required]

2.05 TEMPORARY HOISTING EQUIPMENT AND MACHINERY

- A. The General Contractor shall furnish, install, operate, and maintain in safe condition all hoisting equipment and machinery required for his own use and for the use of all Subcontractors on the project to properly carry out and complete the work, except as may otherwise be specifically provided for in any of the trade sections of the Specifications (See Section 23 00 01, HEATING, VENTILATING AND AIR CONDITIONING (HVAC).
- B. All hoisting thus provided shall be without charge to the trades using same.
- C. All hoisting equipment and machinery, and operation shall comply in all respects to the governing laws and codes.

PART 3 - EXECUTION

3.01 TEMPORARY WATER SERVICE

- A. Water service is available at the building and may be used as source of water for construction purposes provided that the Contractor assumes full responsibility for water distribution, operation, and restoration of the system.
- B. All temporary water service connections shall comply with the Town of Hopkinton Water Department requirements.

3.02 ELECTRICAL POWER

- A. Electrical service is available at building. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - 1. Provide circuit and branch wiring, with area distribution boxes located so power and lighting is available throughout construction by use of construction-type power cords.
 - 2. Provide adequate artificial lighting where natural light is not adequate for work, and for areas accessible to public.
 - 3. Work shall meet applicable requirements of the Massachusetts Electrical Code and NFPA 70.
 - 4. The Owner will pay costs of power used.

3.03 FIRE PROTECTION DURING CONSTRUCTION

- A. Applicable Standards: Comply with NFPA 10 and NFPA 241.
- B. Temporary Fire Protection: Locate fire extinguishers where required and effective for their intended purpose.
- C. Precaution: Institute controls to minimize or eliminate risk of fires. As a minimum:
 - 1. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairs, and other access routes for fighting fires and for emergency vehicles.
 - 2. Prohibit smoking in all areas.
 - 3. Store combustible materials in containers in fire-safe locations.
 - 4. Supervise torching and welding operations to prevent accidental ignition.
 - 5. Supervise installations which involve flammable materials or processes capable of starting combustion.

6. Keep the area within the limits of the Project orderly and clean and promptly remove combustible rubbish from the site.
 - D. Comply with all reasonable recommendations regarding fire protection made by the representative of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal.
 - E. Fire Watch: Where required by Hopkinton Fire Department, maintain a fire watch of the facility in accordance with Fire Department requirements. In lieu of these requirements, provide suitable fire watch for at least one hour after the following activities have ceased for the day: torching, welding, installation, or other activities capable of starting combustion.
- 3.04 TEMPORARY PROTECTION OF EXISTING BUILDING
- A. Protect the Work against damage from normal day-to-day construction activities including, without limitation, movement of materials and personnel, traffic of all kinds, weather hazards, spillages and other reasonably foreseeable danger.
 1. Specific protections (masking or covering, for example) are specified in the Section covering the trade doing the work. However, the Contractor shall be responsible for protecting the Work against general hazards.
 2. Typical Situations: Without limiting the generality of this Article, protect the Work against the following hazards and abuses:
 - a. Protect stored materials against weather damage.
- 3.05 ENVIRONMENTAL CONTROLS
- A. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result.
 - B. Consistent with safe and reasonable construction practices, employ equipment, machinery and techniques of a kind which will minimize detrimental impact on the environment. Avoid excessive noise, unnecessary air pollution from dust, demolition, machinery exhaust, and the use of sprayed-on materials. Do not employ open burning on the construction site. Dispose of waste material only at authorized disposal sites.
 - C. Air-Borne Dust Control: Provide adequate means for containing dust caused by construction operations. Wet down demolition debris and cover dumpsters with tarps, if necessary to prevent dust and debris from blowing around.
 - D. There shall be no smoking on the property.
 - E. Temporary electrical heat and cooling in areas where heat is removed as needed for phased winter construction and/or cooling is removed as needed for phased summer construction shall be provided by the Mechanical Contractor.
- 3.06 TEMPORARY BARRIERS, SAFETY DEVICES, AND SIGNS
- A. Security Enclosure and Lockup: Secure areas of construction to prevent unauthorized entrance, vandalism, and theft.

1. Storage: Provide a secure lock-up for materials and equipment which are of significant value or attractive for theft. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.
 - B. Barricades, Warning Signs: Provide as required to warn and keep people away from hazards on the site. Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against.
 1. Where required, illuminate barricades and warning signs with appropriate lighting.
 - C. Informational Signs: Post signs as required to provide directional information to construction personnel and visitors. Construct signs in an attractive manner, of materials and of a size acceptable to the Architect.
- 3.07 TERMINATION AND REPAIR
- A. Termination and Removal: Remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion.
 - B. Repair or replace Work damaged by installation and removal of temporary facilities. Comply with requirements for cutting and patching specified in Section 01 73 10, CUTTING AND PATCHING.
 - C. Repair public right-of-way where disturbed by construction or removal of temporary facilities, including paving, plantings, and improvements, in accordance with the standards and requirements of authorities having jurisdiction, as applicable, and leave public property in as good condition after completion as before operations started.

END OF SECTION

SECTION 01 57 00

CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section specifies requirements for the Contractor's implementation of waste management controls and systems for the duration of the Work.
- B. Related Sections include the following:
 - 1. Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS.
- C. Comply with the Commonwealth of Massachusetts regulations regarding construction waste disposal.

1.03 INTENT

- A. The Owner and Architect have established that this Project shall divert at least 50% of non-hazardous construction and demolition debris and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
- B. Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. waste disposal in landfills shall be minimized to the greatest extent practical.
- C. With regard to these goals the Contractor shall develop, for the Owner's and Architect's review, a Waste Management Plan for this Project.
- D. Each subcontractor shall be responsible for segregating their own waste into different dumpsters as directed by the Contractor.
- E. The Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities.

1.04 WASTE MANAGEMENT PLAN

- A. Waste Management Plan: Within 21 calendar days after receipt of Notice to Proceed, the Contractor shall provide a plan containing the following:
 - 1. Analysis of the proposed jobsite waste to be generated, including types and rough quantities.
 - 2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.

3. Landfill Certification: Contractor's statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.
 4. Alternatives to Disposal at Landfill: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:
 - a. Cardboard.
 - b. Clean dimensional wood.
 - c. Beverage containers.
 - d. Land clearing debris.
 - e. Concrete.
 - f. Masonry and mortar.
 - g. Asphalt.
 - h. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - i. Mechanical and electrical equipment.
 - j. Building components which can be removed relatively intact from existing construction.
 5. Meetings: A description of the regular meetings to be held to address waste management.
 6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
 7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.
- B. Summary Report: Prior to Substantial Completion, the Contractor shall submit a written Waste Management Report summarizing the types and quantities of materials recycled and disposed of under the Waste Management Plan. Also include the name and location of disposal facilities.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 RECYCLING

- A. Metal, including but not limited to steel beams and sections, aluminum, and reinforcing steel shall be recycled.
- B. Wood that is not painted and does not contain preservatives (i.e. creosote, arsenic, and chromium-containing preservatives) shall be segregated and recycled.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.

- B. Distribution: The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each subcontractor, the Owner, and the Architect.
- C. Instruction: The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.
- D. Separation Facilities: The Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location of separation areas shall be acceptable to the Owner.

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. This Section includes the following administrative and procedural requirements: selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Section 01 42 00, REFERENCE STANDARDS AND DEFINITIONS for applicable industry standards for products specified.
 - 2. Section 01 77 00, CLOSEOUT PROCEDURES for submitting warranties for contract closeout.
 - 3. Divisions 02 through 28 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.03 DEFINITIONS

- A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

- D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
- E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.04 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use CSI Form 13.1A or the form included in Specification Section 01 63 10, SUBSTITUTION REQUEST FORM, or other form acceptable to Architect.
 - 2. Substitution Identification: Mark submittal clearly to identify products for which it is being substituted.
 - 3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified material or product cannot be provided.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
 - i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
 - j. Cost information, including a proposal of change, if any, in the Contract Sum.
 - k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
 - l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 - 4. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

- a. Form of Acceptance: Change Order; as for other submittals, as covered in Section 01 33 00, SUBMITTAL PROCEDURES.
- b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.
- c. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00, SUBMITTAL PROCEDURES. Show compliance with requirements.

1.05 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given the option of selecting between two or more products for use on the Project the product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
 5. Store products to allow for inspection and measurement of quantity or counting of units.
 6. Store materials in a manner that will not endanger Project structure.
 7. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 8. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 9. Protect stored products from damage.
- B. Storage: Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.07 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Refer to Division 02 through Division 27 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 77 00, CLOSEOUT PROCEDURES.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS OF SPECIFIED PRODUCTS AND SYSTEMS

- A. Substitutions of specified products and systems shall comply with requirements of Chapter 30, Section 39M of General Laws and additional requirements and procedures specified herein.
- B. The Contract Documents are intended to produce a building of consistent character and quality of design. All components of the building including visible materials and equipment have been selected to have a coordinated design in relation to the overall appearance of the building. The Architect will judge the design, functionality, and appearance of proposed substitutes on the basis of their suitability in relation to the overall design of the project, as well as for their intrinsic merits. The Architect will not approve, as equal to materials specified, proposed substitutes which, in the Architect's opinion, would be out of character, obtrusive, or otherwise inconsistent with the character or quality of design of the Work. With respect to exterior finishes value or effect, the Architect may not approve as equal any proposed substitute which, in the Architect's sole opinion, would not produce the same artistic or aesthetic value or effect. In order to permit coordinated design of color and finishes the General Contractor shall, if required by the Architect, furnish the substituted material in any color, finish, texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the Owner.
- C. Specific reference in the Specification to any product, material, or process by name, make, or catalog number shall be interpreted as establishing a standard of quality. An item will be considered equal to the item so named or described if (1) it is at least equal in quality, durability, appearance, strength and design; (2) it will perform at least equally the function imposed by the general design for the work; and (3) it conforms substantially, even with deviations to the detailed requirements for the item in the Specification. [M.G.L. Chapter 30, Section 39M (b).] The Architect shall be the sole judge of whether and proposed substitute product, material, process, or method is equal to that specified according to this standard, and his decision shall be final and binding on the General Contractor and any Subcontractor or Sub-Subcontractor.
 - 1. If the General Contractor proposes to use a material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the General Contractor shall inform the Architect in writing of the nature of such deviations at the time the material is submitted for approval, and shall request written approval of the deviation from the requirements of the Contract Documents.
 - 2. In requesting approval of deviations of substitutions, the General Contractor shall provide, upon request, evidence leading to a reasonable certainty that the proposed substitution or deviation will provide a quality or result at least equal to that otherwise attainable. If in the opinion of the Architect, the evidence presented by the General Contractor does not provide a sufficient basis for such reasonable certainty, the Architect may reject such substitution or deviation without further investigation.
 - 3. Any additional cost, loss, or damage arising from the substitution of any material or any method for those originally specified shall be borne by the General Contractor, notwithstanding approval or acceptance of such substitution by Owner or the Architect, unless such substitution was made at the written request or direction of Owner or the Architect.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 01 63 10
SUBSTITUTION REQUEST FORM

No substitutions will be considered without this completed Substitution Request Form and supporting documentation.

Substitutions made without completion of this form will be considered defective work as stated in the CONDITIONS OF THE CONTRACT. Refer to the Document 00 80 00, GENERAL CONDITIONS.

Date: _____ Number: _____

PROJECT: **TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS**
73 Main Street
Hopkinton, Massachusetts 01748

BID **#24-05-002IFB**

TO: **GORMAN RICHARDSON LEWIS ARCHITECTS, INC.**
239 South Street
Hopkinton, Massachusetts 01748

RE: **REQUEST FOR SUBSTITUTION**

The Contractor proposes the following substitution in accordance with the requirements of the Contract Documents:

Scope of Substitution: _____

Specification Reference: _____

Drawing Reference: _____

Reason for Proposed Substitution: _____

Impact on Project Cost: _____

Impact on Project Schedule: _____

Impact on Guarantees and Warranties: _____

Response Date: List date by which response by Architect is requested to maintain project schedule and allow sufficient time for inclusion of proposed substitution.

Response Date: _____

Submitted By: _____

Firm and Address: _____

Signature below signifies acceptance of responsibility for accuracy and completeness of information included in this Substitution Request Form.

Authorized Signature: _____

ARCHITECT'S RESPONSE

Notations listed below shall have same meaning as on Architect's approval stamp. Clarifications to or changes in project schedule or time shall be processed using standard project forms.

1. NO EXCEPTIONS TAKEN
2. REJECTED
3. MAKE CORRECTIONS NOTED
4. REVISE AND RESUBMIT
5. SUBMIT SPECIFIED ITEM

Remarks:

Date: _____

Signed: _____

END OF SECTION

SECTION 01 73 00
EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 DESCRIPTION OF WORK

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. General installation of products.
 - 3. Coordination of Owner-installed products.
 - 4. Progress cleaning.
 - 5. Disposal requirements.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.

1.03 RELATED REQUIREMENTS

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 01 73 10, CUTTING AND PATCHING for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
 - 2. Section 01 76 00, PROTECTING INSTALLED ROOFING.
 - 3. Section 01 77 00, CLOSEOUT PROCEDURES for submitting Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.
 - 1. Before construction, verify the location and points of connection of utility services.

- B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
- C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
 - 2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than two (2) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- C. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- D. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a RFI to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on a standard RFI form, numbered sequentially with date of request and space for Architect's reply. Form for RFI shall be the following, as approved by Owner and Architect:
 - 1. AIA G716, "Request for Information" form.

3.03 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 10 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.
- F. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
- G. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- H. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.04 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 80 deg F
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.

2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
 - G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
 - H. Waste Disposal: Burying or burning waste material on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
 1. Comply with the provisions of Section 01 57 00, CONSTRUCTION WASTE MANAGEMENT.
 - I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
 - J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
 - K. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.
- 3.05 PROTECTION OF INSTALLED CONSTRUCTION
- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - B. Comply with manufacturer's written instructions for temperature and relative humidity.
- 3.06 CORRECTION OF THE WORK
- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Section 01 73 10, CUTTING AND PATCHING.
 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
 - B. Restore permanent facilities used during construction to their specified condition.
 - C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

SECTION 01 73 10

CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section specifies administrative and procedural requirements for cutting, fitting, and patching work required to complete the Work or to:

- 1. Make its several parts fit together properly.
- 2. Uncover portions of the Work to provide for installations of ill-timed work.
- 3. Remove and replace defective work.
- 4. Remove and replace work not conforming to requirements of Contract Documents.

- B. The General Contractor shall be responsible for all cutting and patching, including all cutting and patching required by subcontractors unless otherwise noted.

- 1. Before cutting existing surfaces examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.
- 2. Before proceeding, meet at the site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

- C. Penetrations:

- 1. Penetrations up to 5 inches shall be by the respective Subcontractor performing the work.
- 2. Penetrations greater than 5 in. diameter shall be the responsibility of the General Contractor.

1.03 RELATED REQUIREMENTS

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

- 1. CONDITIONS OF THE CONTRACT; Document 00 80 00, GENERAL CONDITIONS.
- 2. Section 01 11 00, SUMMARY.

1.04 QUALITY ASSURANCE

- A. Permission to patch any items of work does not imply a waiver of the Architect's right to require complete removal and replacement in said areas and of said items if, in Architect's opinion, patching does not satisfactorily restore quality and appearance of work.

- B. Requirements for Structural Work: Do not cut-and-patch structural work in a manner resulting in a reduction of load-carrying capacity or load/deflection ratio.
- C. Operational and Safety Limitations: Do not cut-and-patch operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in the manner intended or resulting in decreased operational life, increased maintenance, or decreased safety.
- D. Visual Requirements: Do not cut-and-patch work that is exposed on exterior or in occupied spaces of building, in a manner resulting in reduction of visual qualities or resulting in substantial evidence of cut-and-patch work, both as judged solely by the Architect. Remove and replace work judged by the Architect to be visually unsatisfactory.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Except as otherwise indicated or authorized by the Architect, provide materials for cutting-and-patching which will result in equal-or-better work than the work being cut-and-patched, in terms of performance characteristics and including visual effect where applicable. Comply with the requirements and use materials identical with the original materials where feasible and where recognized that satisfactory results can be produced thereby.
- B. Comply with specifications and standards for each specific product involved.

PART 3 - EXECUTION

3.01 INSPECTION

- A. Inspect existing conditions of Project, including elements subject to damage or to movement during cutting and patching.
- B. After uncovering work, inspect conditions affecting installation of Products, or performance of work.
- C. Report unsatisfactory or questionable conditions to Architect in writing; do not proceed with work until Architect has provided further instructions.

3.02 PREPARATION

- A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of Work.
- B. Provide devices and methods to protect other portions of Project from damage.
- C. Provide protection from elements for that portion of the Project which may be exposed by cutting and patching work.

3.03 PERFORMANCE

- A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.
 - 1. Provide openings in the Work for penetration of mechanical and electrical work. Cut holes and slots as small as possible, nearly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover opening when not in use.

2. Employ skilled and experienced workers to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
 3. Cut rigid materials using power saw or core drill. Cut through concrete and masonry using a cutting machine, such as a carborundum saw or a diamond-core drill. Pneumatic tools shall not be allowed without prior approval.
 4. Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.
- B. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances, and finishes.
- C. Restore work which has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.
- D. Patch with seams which are durable and as invisible as possible. Comply with specified tolerances for the work.
- E. Restore exposed finishes of patched areas; and, where necessary extend finish restoration onto retained work adjoining, in a manner which will eliminate evidence of patching.
- F. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:
1. For continuous surfaces, refinish to nearest intersection.
 2. For an assembly, refinish entire unit.
- G. All exposed penetrations through walls, floors, or ceilings shall have escutcheons finished to match adjacent surface.

END OF SECTION

SECTION 01 76 00

PROTECTING INSTALLED ROOFING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDES

- A. General: This Section specifies administrative requirements and construction procedures to be employed by all project personnel working on or adjacent to installed roofing in order to protect the existing roof from damage as a result of construction operations and to maintain existing roof warranties.

1. The term 'Installed Roofing' as used herein shall mean any or all of the following:

- a. Pre-existing roofing, in place prior to the start of this project.
- b. Newly installed roofing and flashing that is placed as part of this project and located where new work of the project must be performed.
- c. Where new roofing and existing roofing is integrated.

2. The means and methods chosen by the General Contractor and sub-contractor are to be detailed and summarized in an enforceable "Roof Protection Program" which shall be presented in a "*Roof Protection Method Statement*" and submitted to Architect for review and approval.

- a. The "*Roof Protection Method Statement*" shall include a copy of the initial roof condition evaluation.
- b. The approval of the "*Roof Protection Method Statement*" is a required prerequisite prior to the processing of the first Requisition for Payment by the Architect.
- c. Provide a minimum of two weeks for review of the "*Roof Protection Method Statement*" prior to submission of the first Requisition for Payment.

- B. Scope: Requirements specified in this Section include the following:

1. Documentation of the existing roof condition.
2. Protection requirements for all traffic on roof.
3. Requirements to maintain roof warranties.

- C. The General Contractor to prepare and enforce a program for protection of installed roofing during construction operations for the duration of the Project. In addition to the detailed requirements identified in Division 07, the General Contractor shall submit to the Architect the following:

1. At the completion of the Work the Contractor shall certify that all pre-existing warranties (if any) remain intact.

- D. Existing Roof System: Prior to the start of any work on or above an existing roof, the Contractor shall obtain from the Owner and submit to the Architect the following is data on the existing roofing; unless otherwise indicated, it is the responsibility of the General Contractor to verify it and ensure that all existing warranties on roof are maintained.
1. Roof Construction
 2. Date of Acceptance of Roof System
 3. Roofing System Manufacturer
 4. Roofing Contractor
 5. Roof System Description
 6. Wind Uplift Classification
 7. Date of Last Inspection
 8. Roof Manufacturer's Warranty
- E. The cost of any and all inspections by any third party shall be the responsibility of the General Contractor.
- F. Enforcement: The procedures and protocol specified in this section and in the Roofing Protection Method Statement are to be adhered to by all persons on the roof.

1.03 RELATED REQUIREMENTS

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
1. CONDITIONS OF THE CONTRACT; Document 00 80 00, GENERAL CONDITIONS.
 2. Section 07 53 00, ROOFING OF ROOF PENETRATIONS AND EQUIPMENT; Roof work associated with HVAC upgrade.

1.04 QUALITY ASSURANCE

- A. Protection of Installed Roofing Meeting: Before beginning work on roof areas, schedule and conduct a meeting at the site to review the roof protection construction procedures and coordination among the trades. Require the attendance of representatives of each Sub-Contractor who will have labor working on or above existing roofing, including mechanical and electrical sub-contractors and equipment vendors.
1. Inform the Architect and Owner in advance of the scheduled meeting time.
 2. Attendance by the Architect and Owner is at their discretion.
 3. Schedule this meeting immediately following the Pre-Roofing Meeting referred to in Division 07.
 4. Take minutes and attendance. Circulate same to all who attend and submit same to Architect.
- B. Restrict roof access to personnel and those people specifically designated by the Architect and/or Owner as requiring such access.
- C. Where required, provide physical protection of existing and new roofing.
- D. Roof protection shall comply with all applicable codes and standards and shall conform to all applicable safety standards including OSHA and Department of Labor and Industries.

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

Not Used.

END OF SECTION

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Inspection procedures.
 - 2. Operation and maintenance manuals.
 - 3. Warranties.
 - 4. Instruction of Owner's personnel.
 - 5. Final cleaning.

1.03 RELATED REQUIREMENTS

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 01 29 00, PAYMENT PROCEDURES for requirements for Applications for Payment for Substantial and Final Completion.
 - 2. Section 01 32 00, CONSTRUCTION PROGRESS DOCUMENTATION for submitting Final Completion construction photographs and negatives.
 - 3. Section 01 73 00, EXECUTION REQUIREMENTS for progress cleaning of Project site.
 - 4. Divisions 02 through 26 Sections for specific closeout and special cleaning requirements for products of those Sections.

1.04 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, damage or settlement surveys, property surveys, and similar final record information.
 - 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.

7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
11. Advise Owner of changeover in heat and other utilities.
12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touch-up painting.
14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.05 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to Section 01 29 00, PAYMENT PROCEDURES.
2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.06 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A Preparation: Submit four (4) copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A, or other form acceptable to Owner and Architect.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.

2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:
 1. Maintenance Data:
 - a. Manufacturer's information, including list of spare parts.
 - b. Name, address, and telephone number of Installer or supplier.
 - c. Maintenance procedures.
 - d. Maintenance and service schedules for preventive and routine maintenance.
 - e. Maintenance record forms.
 - f. Copies of warranties and bonds.
- B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.08 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-inch by 11-inch (115-mm by-280-mm) paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.01 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - d. Clean exposed exterior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - e. Remove debris and surface dust from limited access spaces, including roofs, balconies, terraces, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - f. Leave Project clean and ready for occupancy.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

END OF SECTION

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Selectively demolish and remove materials, systems, equipment, and structures indicated on the Drawings and specified herein as required to construct the HVAC Upgrade work included as part of this Contract.

- B. Work Included:

1. Demolition and removal of selected portions of interior and exterior equipment and finishes as required for the HVAC upgrade work. Refer to the Drawings for additional requirements.
2. The Mechanical Contractor shall disconnect and transfer to floor all interior HVAC equipment and components for removal and disposal by the General Contractor.
3. The Mechanical Contractor shall remove and legally dispose of roof-top HVAC equipment and components and provide temporary hoisting equipment and machinery and other equipment and vehicles required to remove and legally dispose of roof-top HVAC equipment and components.
4. Salvage of existing items to be reused or turned over to the Owner.
5. Removal and legal disposal of demolished materials off site.
6. Demolition and removal work shall properly prepare for alteration work and new construction to be provided under the Contract.
7. Scheduling and sequencing operations without interrupting utilities serving occupied areas. If interruption is required, obtain written permission from the utility company and the Owner. Schedule interruption when the least amount of inconvenience will result.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Document 00 23 00, EXISTING CONDITIONS; Existing conditions,
2. Section 01 73 10, CUTTING AND PATCHING.
3. Section 01 76 00, PROTECTING INSTALLED ROOFING.
4. Section 07 53 00, ROOFING OF ROOF PENETRATIONS AND EQUIPMENT; Flashing and patching of existing roof as required for new rooftop equipment including rooftop units, curbs, ductwork, and accessories.
5. Section 09 51 00, ACOUSTICAL CEILINGS; Replacement of ACT ceilings.
6. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

1.04 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 the Owner ready for reuse, at a location designated by the Owner. Protect from weather until accepted by Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated. Protect from weather until reinstallation.
- 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.

1.05 SUBMITTALS

- A. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with early and late starting and finishing dates for each activity. Ensure Owner's on-site operations are uninterrupted if applicable.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of stairs. Note – elevator use for construction is prohibited.
 - 5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other occupants affected by selective demolition operations.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - 7. Means of protection for items to remain and items in path of waste removal from building.
 - 8. Scheduling and coordinating of any cranes or hoisting equipment for removal (and replacement) of rooftop units.
- B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged, and turned over to the Owner.
- C. Pre-demolition Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 – GENERAL REQUIREMENTS. Submit before Work begins.
- D. Landfill Records: Provide trip tickets (receipts) indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
- E. Construction Dust and Odor Control Plan: Submit proposed Construction Dust and Odor Control Plan per 310 CMR 7.09.
- F. Noise Control Plan: Submit proposed Noise Control Plan per 310 CMR 7.10.

1.06 QUALITY ASSURANCE

- A. Examination of Existing Conditions: The Contractor shall examine the Contract Drawings for demolition and removal requirements and provisions for new work. Verify all existing conditions and dimensions before commencing work. The Contractor shall visit the site and examine the existing conditions as he finds them and shall inform herself/himself of the character, extent and type of demolition and removal work to be performed. Submit any questions regarding the extent and character of the demolition and removal work in the manner and within the time period established for receipt of such questions during the bidding period.
- B. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.
- C. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- E. Standards: Comply with ANSI A10.6 and NFPA 241.
- F. Predemolition Conference: Conduct conference at Project site. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.
 - 2. Review structural load limitations of existing structure.
 - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - 5. Review areas where existing construction is to remain and requires protection.

1.08 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.
 - 1. Special note is made of the roofing system which was replaced and warranted to the Owner. Refer to Contract Documents.

1.10 PROTECTION

- A. Do not interfere with use of adjacent occupied spaces. Maintain free and safe passage to and from.
- B. Prevent movement or settlement of adjacent structures. Provide and place bracing or shoring and be responsible for safety and support of structures. Assume liability for such movement, settlement, damage, or injury.
- C. Cease operations and notify Owner and Architect immediately if safety of adjacent facilities or structures appears to be endangered. Take precautions to properly support structures. Do not resume operations until safety is restored.

- D. Weather Protection Standard: The following weather protection standards pursuant to Chapter 597 of the Acts of 1980, modifying Sections 44F and 44G of Chapter 149 of the General Laws, are hereby incorporated into this specification, and shall be considered supplementary to the above temporary heating and temporary enclosure requirements. Under the provisions of Chapter 149, Section 44F(l) and Section 44G, Para. D, of the General Laws, General Contractors are required to provide weather protection to allow building construction to be carried on during the months of November through March. These standards do not require enclosures for heat for operations that are not economically feasible to protect in the judgment of the Awarding Authority; including for example, roofing and the like.
1. The General Contractor shall provide and install weather protection.
 2. Weather protection shall be provided during the months of November through March.
 3. Temperature at the working surface shall be at least forty degrees Fahrenheit (40° F.). This provision does not supersede any specific greater requirements for methods of construction or curing of materials.
 4. Weather protection materials, equipment, and the installation thereof, shall comply with all safety rules and regulations including provisions for adequate ventilation and fire protection devices.
 5. At completion of work, the General Contractor shall remove temporary weather protection and restore all surfaces to first class condition.
- E. Temporary Covers and Enclosures:
1. Except as otherwise specified hereinbelow, all costs of closing openings in the exterior of the existing building where opened to the weather, including temporary covers and enclosures, shall be borne by the General Contractor.
 - a. Where roof or other elements of existing building or structure providing weather protection are to be temporarily opened to the weather, they shall be fully enclosed or covered with securely attached and well draining enclosures whenever inclement weather is at and or is threatening, to assure absolute weather protection. Any and all damage to existing buildings or structures, including all materials and finishes thereon, caused by inadequate protection shall be made good by the General Contractor without further cost to Owner.
- F. Weather Protection by Subcontractors: The General Contractor shall provide at his own expense all Weather Protection as defined above except as follows.
1. Each Subcontractor shall pay for and be responsible for the weather protection of his tools, devices, equipment, appliances and appurtenances to be used in the accomplishment of his work and for the weather protection of materials furnished by him until such materials are incorporated as a physical part of the Project.
- G. Temporary Protections: Provide temporary barricades and other forms of protection as required to for protection of building occupants, fire department personnel, Town employees, and the general public from injury due to selective demolition operations.
1. Protect existing finish work that is to remain from damage from demolition operations.
 2. Construct temporary barricades where required to separate areas where demolition is occurring.
 3. Remove temporary protections at completion of the work.
 4. Comply with applicable requirements specified in Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS.

- H. Utility Services: Maintain existing utilities serving occupied or used facilities and other areas occupied by the Owner. Any interruptions to service shall be coordinated with the Owner so as to minimize disruption of building services, Owner's daily operations, and related services.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 INSPECTION

- A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Note or photograph existing conditions which could be misconstrued as damaged resulting from selective demolition work.

3.02 PREPARATION

- A. Cover and protect existing finishes, fixtures and equipment to remain. Protect from soiling, dust, or damage during demolition work.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Section 01 50 00, TEMPORARY FACILITIES AND CONTROLS.
 - 2. Maintain adequate passage to and from all exits at all times. Before any work is done which significantly alters access or egress patterns, consult with the Architect and obtain approval of code required egress. Under no condition block or interfere with the free flow of people at legally required exits, or in any way alter the required condition of such exits.
- 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.
 - 2. Remove temporary shoring, bracing and structural supports when no longer required.
 - 3. Post warning signs and place barricades as applicable during placement and removal of temporary shoring.
- D. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area(s).
 - 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction. Provide temporary barricades as required to limit access to demolition areas.
 - 2. Protect existing site improvements, appurtenances, and landscaping to remain.
- E. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

3.03 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during and after flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to storage area designated by the Owner's Project Manager.
 5. 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. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- 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 cleaned and reinstalled in their original locations after selective demolition operations are complete.
- E. Items for Re-use and Preservation of Existing Surfaces to Remain:

1. The Contractor shall inspect closely each item specifically designated to be relocated, re-used, or turned over to the Owner prior to its removal, and immediately report damages and defects to the Architect and Owner's Project Manager. The Contractor shall be responsible for any subsequent damage to the same other than latent defects not readily apparent from close inspection and shall bear responsibility for its repair or same replacement as directed by the Architect, to the satisfaction of the Owner's Project Manager.
2. Unless special surface preparation is specified under other Specification Sections, leave existing surfaces that are to remain in a condition suitable to receive new materials and/or finishes.

3.04 DISPOSAL OF MATERIALS

- A. Material resulting from selective demolition and not identified for salvaging shall become the property of the Contractor and shall be legally transported and disposed of off-site.
- B. Disposal shall be performed as promptly as possible and not left until the final clean up.
- C. Comply with requirements of Section 01 57 00, CONSTRUCTION WASTE MANAGEMENT.
- D. If hazardous materials, such as chemicals, asbestos-containing materials, or other hazardous materials are discovered during the course of the work, cease work in affected area only and immediately notify the Architect and the Owner's Contracting Officer of such discovery. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Provide all labor, materials, and equipment necessary to complete the work of this Section. The work of this Section includes, but is not limited to the following:
 - 1. Steel reinforcement as indicated on Structural Drawings.
 - 2. Safety rail system (non-penetrating type) at roof for roof edge fall protection including pipe fittings and accessories.
 - 3. Miscellaneous framing, platforms, and supports for equipment.
 - 4. Replacement support brackets (galvanized steel) and straps (stainless steel) for existing stainless steel boiler flue
 - 5. Miscellaneous rough hardware.
 - 6. All other metal fabrications indicated.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 01 76 00, PROTECTING INSTALLED ROOFING.
 - 2. Section 07 53 00, ROOFING OF ROOF PENETRATIONS AND EQUIPMENT.
 - 3. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC); Hangers, brackets, troughs, guards, and other steel items for support or protection of mechanical work.

1.04 SUBMITTALS

- A. Shop Drawings: Submit shop drawings of work showing size and thickness of each member, type of material, method of connection and assembly. Show dimensions, clearances, anchorages, relationships to surrounding work, coatings, and other pertinent details of fabrication and installation.
 - 1. Show profiles, reinforcing, fasteners, and any accessories.
 - 2. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
- B. Product Data: Provide manufacturer's product data, installation instructions, use limitations, and recommendations for each material used including preparation instructions and recommendations, storage and handling requirements and recommendations and installation methods. Provide certifications that materials comply with requirements.

- C. Calculations: Where installed metal fabrication work is indicated to comply with certain design loadings, provide professionally prepared calculations, material properties, certification, and other information required for structural analysis of performance of work.
- D. Welders Certification: Provide certifications, signed by Contractor, certifying that welders employed at project comply with requirements specified under AWS D1.1 and AWS D1.3.

1.05 QUALITY ASSURANCE

- A. Engineering: Provide services of a professional engineer, registered in the State of Massachusetts to design and certify that work of this Section meets or exceeds performance requirements specified. Include design requirements for steel column supports, equipment supports, and all other items indicated.
- B. Shop fabricate work to greatest extent possible. Label each piece in shop to facilitate field assembly.
- C. Welding: Perform welding in conformance with AWS D1.1, AWS D1.2, and AWS D1.3, as applicable.
- D. Exterior use and exterior applications, for the purposes of this Section, mean those materials or assemblies used in areas in exterior walls, roofs, foundations or exposed to weather. Interior use, for the purposes of this Section, means materials or assemblies in enclosed, conditioned spaces.
- E. References (Safety Rail System for Roof Edge Fall Protection):
 - 1. Occupational Safety and Health Administration (OSHA):
 - 29 CFR 1910.28 - Duty to Have Fall Protection and Falling Object Protection.
 - 29 CFR 1910.29 - Fall Protection Systems / Criteria and Practices.
 - 29 CFR 1926.500 - Scope, Application, and Definitions Applicable to this Subpart.
 - 29 CFR 1926.501 - Duty to Have Fall Protection.
 - 29 CFR 1926.502 - Fall Protection Systems Criteria and Practices.
 - 29 CFR 1926.503 - Training Requirements.
 - 2. OSHA Warning Line Interpretations dated January 3, 2005, Part 1926 Subpart M.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in good condition and adequately protected against damage as handrails are a finished product.
- B. Inspect materials for damage before signing the receipt from the trucking company. Truck driver must note damaged goods on the bill of lading if damaged product is found.
- C. Store products in manufacturer's unopened packaging until ready for installation.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

1.08 WARRANTY

- A. Warranty: Provide manufacturer's two (2) year warranty.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
 1. Provide products and materials of new stock, free from defects, and of best commercial quality for each intended purpose.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.
- C. Bolts and Fasteners: ASTM A 307 and A 325.
- D. Replacement Support Brackets and Straps for Support of Existing Stainless Steel Boiler Flue:
 1. Provide three (3) pair of galvanized steel angle brackets and Type 316 stainless steel straps to replace existing corroded brackets and straps supporting flue. Provide stainless steel fasteners. Provide all adjustments and attachments required for complete replacement of support brackets and straps.
- E. Provide anchors, bolts, sockets, sleeves, and other parts required for securing each item of work to other construction.
- F. Provide exposed fastenings of same material and finish as metal to which applied, unless otherwise noted.
- G. Welding Rods: Conform to AWS Standards and recommendations of welding rod manufacturer.
- H. Grout for Interior Applications: Pre-mixed, non-staining, non-corrosive, non-shrink, non-metallic complying with CE CRD-C-621, Type D.
- I. Grout for Exterior Applications: Provide Factory-packaged, non-shrink, non-staining, hydraulic controlled expansion cement formulation for mixing with water at project site. Provide formulation that is resistant to erosion from water exposure without need for protection by a sealer or waterproof coating. Provide Super Por-Rok, Erosion-Resistant Anchoring Cement, manufactured by Minwax Construction Products Division, or equal as approved by Architect.

2.02 FABRICATION - GENERAL

- A. Fabricate work of this Section to be straight, plumb, level and square, and to sizes, shapes and profiles indicated on approved shop drawings. Ease exposed edges. Cut, reinforce, drill and tap metal work as required for proper assembly.

1. Fabricate steel reinforcement as indicated on Structural Drawings.
2. Fabricate miscellaneous supports, brackets, braces and the like required to fully complete the work.
3. Obtain loading requirements from suppliers of work to be supported. Design and support systems with a safety factor of at least 6 unless otherwise indicated.
4. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed metal assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.
 - a. Temperature Change (Range): plus or minus 50 degrees F, total range 100 degrees F.
5. Shear and punch metals accurately. Remove burrs.
6. Ease exposed edges to a radius of approximately 1/32 in., unless indicated otherwise. Form bent corners to smallest radius possible without causing grain separation or impairing work.
7. Remove sharp or rough areas on exposed traffic surfaces.
8. Weld seams continuously. Spot welding is permitted for temporary welding only.
9. Weld corners and seams continuously to comply with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
- B. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- C. Provide for anchorage of type shown; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support required loads.
- D. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- E. Cut, reinforce, drill, and tap metal fabrications as shown to receive finish hardware, screws, and similar items.
- F. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.
- G. Work Exposed to View: For work exposed to view, select materials with special care. Provide materials which are smooth and free of blemishes such as pits, roller marks, trade names, scale and roughness. Fabricate work with uniform hairline joints. Form welded joints and seams continuously. Grind welds flush to be smooth after painting. For exposed fasteners, use hex head bolts or Phillips head machine screws.

- H. Miscellaneous Framing and Supports: Fabricate miscellaneous framing and supports to adequately support live and dead loads with a safety factor of 5. Provide necessary anchors, inserts, and fasteners. Fabricate support system to carry entire load of work being supported to structure above. Do not transfer any loads to ceiling systems.
1. Cut, drill, and tap units to receive hardware, hangers and similar items.
 2. Coordinate loading and attachment requirements for miscellaneous framing and supports with manufacturers of items being supported.

2.03 SAFETY RAIL SYSTEM AT ROOF

- A. Acceptable Manufacturer (Basis of Design): Tractel Ltd. Swingstage Division, which is located at: 1615 Warden Ave.; Scarborough, ON, Canada M1R 2T3; Tel: 416-298-8822; Fax: 416-298-1053. Email: [request info \(marketing.swingstage@tractel.com\)](mailto:request info (marketing.swingstage@tractel.com)); Web: <http://www.tractel.com/en/home.php>

- B. Safety Rail System (Basis of Design); Basis of Design: SafetyRail 2000 Roof Edge Protection: Provide non-penetrating guard rail system.

1. Approved Product: SafetyRail 2000.
2. Standards: System shall have top and mid rail in accordance with OSHA Standards - 29 CFR 1910.29 (b)(1)(2).
3. Structural Load: 200 lb. (90.7 kg), minimum, in any direction to all components in accordance with OSHA Regulation 29 CFR 1926.502.
4. Height: 42 inches (1067 mm), minimum.
5. Railings: 1-5/8 inch (41 mm) O.D. hot rolled pickled electric weld tubing, free of sharp edges and snag points.
6. Mounting Bases: Class 30 gray iron material cast with four receiver posts. Provide rubber pads on bottom of bases.
7. Receiver Posts: Shall have a positive locking system into slots that allow rails to be mounted in any direction. Friction locking systems are not allowed. Receiver posts shall have drain holes.
8. Accessories:
 - a. Toe Board Brackets: Provide brackets and hardware as manufactured by BlueWater Mfg. Inc.
 - b. Hardware: Securing pins shall be 1010 carbon steel, zinc plated and yellow chromate dipped. Pins shall consist of collared pin and lanyard that connects to lynch pin.
 - c. Adapters: As manufactured by BlueWater Mfg. Inc., for SafetyRail 2000 rail sections as required.

C. Fittings

1. Pipe Fittings:
 - a. Approved Product: Kwik-Fit.Type: Provide fittings required for a complete operational system that meets OSHA requirements.
 - a. Material, Structural Pipe Fittings: Malleable iron, in accordance with BS EN 1562.
 - b. Material, Fitting Types 26, 27 and 90: Weldable cast steel, in accordance with BS 3100.
 - c. Finish: Pipe fittings shall be galvanized in accordance with BS EN ISO 1461.
 - d. Fitting, Inside Diameter: 1.73 inch (44 mm); 1.97 inch (50mm).
3. Hardware: Stainless steel set screws, in accordance with BS 970 Grade 420. Each set

screw shall support axial load of 900 kg when tightened to torque of 40Nm.

D. Accessories

1. Safety/Caution Signage: Cushioned foam strip with self-adhesive backing; UL- rated for indoor/outdoor use.
 - a. Approved Product: Safety Strip.
 - b. Thickness: 3/8 inch (9.5 mm).
 - c. Length: 36 inches (914 mm).
 - d. Width: 4 inches (102 mm).
 - e. Color: Safety yellow with black stripes.
2. Roof Pads: Provide the following pad under each base to protect roof membrane.
 - a. Approved Product: EPDM Roof Pad.

E. Finishes

1. Finish: Factory finished powder coat paint.
2. Color: Safety yellow.

F. Fabrication

1. Assemble components with joints tightly fitted and secured. Accurately form components to suit installation.

2.04 BITUMINOUS PAINT:

- A. Bituminous-based paint for electrolytic isolation shall be cold applied black asphaltic mastic conforming to SSPC Paint 12, with no asbestos fibers.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate and furnish anchorage devices, setting drawings, diagrams, templates, instructions, and directions for installation of concrete inserts, sleeves, anchor bolts, and miscellaneous items to be embedded or attached to concrete work or structure.

3.02 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners necessary for securing work of this Section to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other
- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Erect work square, plumb and true, accurately fitted, and with tight joints and intersections. All anchors, inserts and other members to be set in concrete or masonry shall be furnished loose by this trade to be built-into concrete and masonry by those trades. Avoid field cutting or drilling to greatest extent possible.

- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.
- F. Field Welding: Comply with AWS D1.1 for procedures of manual metal-arc welding, appearance and quality of welds, and correction methods for defective welds Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and contour of welded surface matches those adjacent.
 - 5. Needle gun surfaces of welded connections which will be painted to restore surface profile.
- G. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.
- H. Where members other than expansion bolts or inserts are fastened into concrete, set such members in proprietary-type expanding grout manufactured specifically for such purpose. Use grouts strictly in accordance with manufacturer's directions. Form to receive members with galvanized metal sleeves, or other approved method to provide at least 1/2 in. clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 in. from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.
- I. Electrolytic Isolation: Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

3.03 INSTALLATION

- A. Safety Railing System at Roof: Install in accordance with manufacturer's instructions and approved shop drawings. Provide all accessories required.
- B. Structural Reinforcement at Roof Structure: Install in accordance with Contract Drawings including Structural Drawings and approved shop drawings.
- C. Replacement Support Brackets and Straps for Support of Existing Stainless Steel Boiler Flue: Install three (3) pair of galvanized steel angle brackets and Type 316 stainless steel straps to replace existing corroded brackets and straps supporting flue. Provide stainless steel fasteners. Provide all adjustments and attachments required for complete replacement of support brackets and straps.
- D. Miscellaneous Framing and Supports: Fabricate miscellaneous framing and supports to adequately support live and dead loads with a safety factor of 5. Provide necessary anchors, inserts, and fasteners. Fabricate support system to carry entire load of work being supported to structure above. Do not transfer any loads to ceiling systems.

1. Cut, drill, and tap units to receive hardware, hangers and similar items.
 2. Coordinate loading and attachment requirements for miscellaneous framing and supports with manufacturers of items being supported.
- 3.04 REPAIRING, CLEANING, AND PROTECTION
- A. Protect installed products until completion of project.
 - B. Touch-up, repair or replace damaged products before Substantial Completion.
 1. For damaged and field-welded metal coated surfaces, clean welds, bolted connections and abraded areas.

END OF SECTION

SECTION 06 10 50

MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. This Section includes miscellaneous carpentry work including the following:
 - 1. New wood framing for reinforcement of existing wood roof framing as noted on the Structural Drawings.
 - 2. Wood blocking and nailers.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
 - 1. Section 02 41 19, SELECTIVE DEMOLITION.
 - 2. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

1.04 DEFINITIONS

- A. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association.
 - 2. NLGA - National Lumber Grades Authority.
 - 3. SPIB - Southern Pine Inspection Bureau.
 - 4. WCLIB - West Coast Lumber Inspection Bureau.
 - 5. WWPA - Western Wood Products Association.

1.05 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials, both before and after exposure to elevated temperatures when tested according to ASTM D 5516 and ASTM D 5664.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
5. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
 - a. Preservative-treated wood.
 - b. Fire-retardant-treated wood.
 - c. Power-driven fasteners.
 - d. Powder-actuated fasteners.
 - e. Expansion anchors.
 - f. Metal framing anchors.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
 1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA C2 (lumber) except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWWA C31 with inorganic boron (SBX).
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and one of the following:
 - a. Ammoniacal, or amine, copper quat (ACQ).
 - b. Ammoniacal copper citrate (CC).
 - c. Copper azole, Type A (CBA-A).
- B. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
 1. Application: Treat items indicated on Drawings, and the following:
 - a. Wood sills, sleepers, blocking, furring, strapping, and similar concealed members in contact with masonry or concrete.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWPA C20 (lumber). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D 5664, for lumber.
 2. Use treatment that does not promote corrosion of metal fasteners.
 3. Use exterior type for exterior locations and where indicated.

2.04 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
1. Grade: Construction, Stud, or No. 2 grade.
 2. Species: Provide any of the following species:
 - a. Mixed southern pine; SPIB.
 - b. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
 - c. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.

2.05 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.
- B. Power-Driven Fasteners: CABO NER-272.
- C. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- D. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- E. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.06 METAL FRAMING ANCHORS

- A. General: Provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.
 - 1. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

- A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Apply field treatment complying with AWP A M4 to cut surfaces of preservative-treated lumber and plywood.
- D. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.
- E. Countersink fastener heads on exposed carpentry work and fill holes with wood filler.
- F. Use fasteners of appropriate type and length. Pre-drill members when necessary to avoid splitting wood.

3.02 WOOD FRAMING AND SUPPORTS, WOOD BLOCKING AND NAILER INSTALLATION

- A. Provide new wood framing and connections for reinforcement of existing wood roof framing as noted on the Structural Drawings.
- B. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- C. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. This Section includes thermal insulation including the following:
 - 1. Roof insulation at renovated roof areas as required to replace damaged insulation and as indicated.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 01 73 10, CUTTING AND PATCHING.
 - 2. Section 05 50 00, METAL FABRICATIONS.
 - 3. Section 06 10 50, MISCELLANEOUS CARPENTRY; Wood nailers and blocking.
 - 4. Section 07 53 00, ROOFING OF ROOF PENETRATIONS AND EQUIPMENT; Flashing and patching of existing roof as required for new rooftop equipment including rooftop units, curbs, ductwork, and accessories.
 - 5. Section 09 51 00, ACOUSTICAL CEILINGS; Replacement of ACT ceilings.
 - 6. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units for each type of insulation indicated.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulation products.
- D. Research/Evaluation Reports: For foam-plastic insulation.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
1. Protect plastic insulation as follows:
 2. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 3. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 4. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATING MATERIALS

- A. General: Provide insulating materials that comply with requirements and with referenced standards.
- B. Roof Insulation: Provide insulation to replace any damaged insulation. Insulation shall match existing and shall comply with roof manufacturer's warranty requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ROOF INSTALLATION

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated. Comply with roof manufacturer's requirements pertaining to roof warranty.

3.03 CLEANING

- A. Keep surrounding surfaces clean as work progresses.
- B. Remove cartons, debris, emptied containers, and other rubbish as work progresses, and at completion of work of this Section. Legally dispose of rubbish off site.

END OF SECTION

SECTION 07 53 00

ROOFING OF ROOF PENETRATIONS AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Provide single ply membrane roofing work for all roof work associated with new roof penetrations, rooftop equipment, and roof modifications required as part of this Contract.
1. Comply with the requirements of the roof manufacturer's Specifications, the technical Project Specifications, and/or Industry Standards; in the case of conflict, the more stringent shall apply. Refer to Construction Drawings for detailed requirements.
- B. The existing single ply membrane roof system is a Sika Sarnafil Roof system installed in June, 2015 and currently under warranty (25 year warranty - warranty period 06/24/2015 through 06/23/2040). Provide all necessary documentation and field inspections as required to maintain warranty for roof. The following information is provided for required coordination:

1. Existing warranted roof system is by Sika Sarnafil Roofing System. Closeout Documents – Roof Replacement - Hopkinton Fire Station (7 pages total) regarding the June 2015 installed roof immediately follows this Section.
2. Roofing contractor shall be a Sarnafil approved, trained, and certified applicator. A list of Sika Sarnafil Authorized Applicators in the State of Massachusetts (two pages total) immediately follows this Section.
3. Warranted Roof System Installer: Original roof contractor/applicator for 2015 roof installation is the following:

MDM Roofing
51 Sawmill Road
Dudley, Massachusetts 01571
Telephone: 508-949-1616

4. Following completion of roofing, the roof manufacturer (Sarnafil) requires that their area field technician, Joel Clouthier clouthier.joel@us.sika.com; telephone 508-431-0847; be contacted to arrange for an inspection of the completed work to maintain warranty.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
1. Section 01 76 00, PROTECTING INSTALLED ROOFING.
2. Section 02 41 19, SELECTIVE DEMOLITION.

3. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, material specifications, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials comply with requirements.
- B. Provide large scale shop drawings for layout, installation, and fabrication of all parts of the work. Provide plans and details of anchorage, connections and accessory items.
 - 1. Show slope- of roof insulation. Indicate slopes, valleys, crickets, and details.
 - 2. Submit shop drawings showing layout.
 - 3. Show all flashing and roof edge details.
- C. Test Reports: Provide certified reports for all specified tests.
- D. Field Measurements: Take all necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of the job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.
- E. Certification: Upon completion of work of this Section, submit certification by roof manufacturer acknowledging that all work performed is acceptable and that the roof work meets their approval and maintains all existing roof warranties.

1.05 QUALITY ASSURANCE

- A. Materials and installation shall conform to the manufacturer's standard specifications as modified herein and the requirements of the Commonwealth of Massachusetts State Building Code.
- B. Installer: A firm which has a minimum of five years' experience in work of the type required by this Section and which is certified and trained by the manufacturer of the primary materials (refer to Paragraph 1.02B., above).
- C. Source: For each type of material required for the work of this Section, provide primary materials which are the products of one manufacturer who has a minimum of five years' experience in manufacturing the type of roofing required by this Section. Provide secondary materials which are acceptable to the manufacturer of the primary materials.
- D. Roofing Conference: Convene a pre-installation roofing conference at the project site to establish schedules and procedures to maintain optimum working conditions, and to coordinate this work with related and adjacent work. Conference shall include all necessary preparations and work associated with maintaining existing roof warranty.
- E. Fire Resistance Classifications: Unless otherwise indicated, provide single ply membrane roofing system certified as UL Class A for external fire exposure, and FM Class 1 for Internal fire exposure.
- F. FM Uplift Criteria: Design and construct roof systems for the FM uplift criteria for 40 psf.
- G. The Owner reserves the right to retain independent testing laboratory to inspect the work specified herein as specified in Section 01 40 00, QUALITY REQUIREMENTS. Neither presence of the testing laboratory, nor any observations and testing performed by the laboratory shall diminish responsibilities for Work of this Section.

- H. Thermal Movement: Provide systems and connections which allow for thermal movement resulting from ambient temperature range of 120°F.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from all possible damage.
- B. Sequence deliveries to avoid delays but minimize on-site storage.
- C. Adhesives, cements, mastics and sealers shall be stored between 60°F. and 80°F. should they be exposed to lower temperatures, restore to room temperature for three to five days prior to use. Do not use materials damaged in handling or storage.

1.07 PROJECT CONDITIONS

- A. Weather: Perform work when existing and forecasted weather conditions are within the limits established by the manufacturers of products and materials used.
- B. Substrates: Proceed with work only when substrate construction and penetrating work is complete.
- C. Existing installed roof shall be suitably protected from damage during the work of this Contract; refer to Section 01 76 00, PROTECTING INSTALLED ROOFING.

1.08 WARRANTY

- A. Maintain all existing warranties following acceptance of all roof work as described in this Section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE ROOF SYSTEM MANUFACTURERS/SYSTEMS

- A. Acceptable Manufacturer: Roof system shall be the following, meeting the requirements of these specifications:
 - 1. Sika Sarnafil; or approved equal.
- B. Materials and installation shall conform to manufacturer's standard specifications, and work of this Section shall be executed by roofing installer licensed by roof manufacturer.
- C. Provide elastomeric roofing system matching existing roofing.

2.02 ROOFING MATERIALS

- A. Roof Membrane: Elastomeric sheet membrane shall be ultraviolet and ozone resistant matching existing membrane.
- B. Flashing: Elastomeric sheet flashing shall be ultraviolet and ozone resistant matching existing.
- C. Roof Insulation: To match existing.

- D. Roof Underlayment Board: To match existing.
- E. Bonding Adhesive: Provide bonding adhesive as recommended by manufacturer. Provide adhesive compatible with all materials and substrates.
- F. Splicing Cement: Provide splicing cement and splice cleaners as recommended by membrane manufacturer.
- G. Lap Sealant: Provide lap sealant for sealing exposed edge of splices of trowel on gun consistency, and as recommended by membrane manufacturer.
- H. Mechanical Fasteners: Provide corrosion resistant, FM-approved mechanical screw and plate fasteners as recommended by the roof manufacturer and conforming to FM requirements.
 - 1. Provide 3 in. diameter stress distribution plates for all fasteners.
 - 2. Provide fastener length as required to penetrate deck by 1 in. minimum.
- I. Seaming Tape and Primer: Provide 3 in. wide seam tape for use at seams in membrane, as recommended by the roofing material manufacturer. Seam primer shall be as recommended by the roof manufacturer.
- J. Roof Edge: To match existing.
- K. Miscellaneous Materials:
 - 1. Provide water cutoff mastic, night sealer, and pourable sealer as recommended by roof membrane manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION OF SURFACES

- A. Carefully check roof areas for conditions affecting application and performance. Report defects in writing to Architect. Do not proceed with roofing work until defects have been corrected.
 - 1. Verify level (or pitch) of roof substrate in conformance with Contract Documents. Identify obstructions or conditions which will affect the slope, pitches, and roof design.
- B. Beginning work shall constitute acceptance of its conditions and any defects in roofing work resulting from such accepted surfaces shall be corrected without further expense to the Owner.

3.02 GENERAL REQUIREMENTS

- A. Surfaces to receive roofing materials shall be rigid, tight, clean, dry, smooth, free of scale, dust, oil, or other foreign matter, and also free of frost or the effects of freezing. Thoroughly clean surfaces to remove loose particles immediately before application of subsequent materials. Do not apply roofing materials over wet subsurfaces.
- B. Where surface joints at roof and wall substrates exceed 1/4 in. width, fill flush with surface with pourable sealer before proceeding with the installation.
- C. Do not leave unfinished roof areas uncovered overnight or during inclement weather.

- D. Work shall conform to manufacturer's published specifications, and the published standards of UL and Factory Mutual. Roof shall be made permanently weatherproof in continuous operation, including flashing and roof edge system.
- E. Provide manufacturer's required weatherproofing method at all special conditions, such as at connections to sheet metal roof edge, flashings, etc. to maintain "Roof Warranty".
- F. Special Cautions:
 - 1. Do not use oil-based or plastic roof cement.
 - 2. Do not subject elastomeric materials to contact with petroleum, grease, oil, solvents, vegetable or mineral oil, nor animal fat.
 - 3. Cements and bonding adhesive contain petroleum distillates and are extremely volatile and flammable. Avoid breathing vapors and do not use near fire or flame.
 - 4. Ensure that splicing and bonding surfaces are dry during installation.
- G. Do not damage or stain surrounding work. Remove stains and repair damage immediately, as work progresses, as part of work of this Section.

3.03 ELASTOMERIC ROOFING

- A. Surfaces to receive roofing materials shall be rigid, tight, clean, dry, smooth, free of scale, dust, oil, or other foreign matter, and also free of frost or the effects of freezing. Thoroughly clean surfaces to remove loose particles immediately before application of subsequent materials. Do not apply roofing materials over wet subsurfaces.
- B. Where surface joints at roof and wall substrates exceed 1/4 in. width, fill flush with surface with pourable sealer before proceeding with the installation.
- C. Do not leave unfinished roof areas uncovered overnight or during inclement weather.
- D. Work shall conform to manufacturer's published specifications, and the published standards of UL and Factory Mutual. Roof shall be made permanently weatherproof in continuous operation, including connection to flashing and roof edge and copings systems.
- E. Provide manufacturer's required weatherproofing method at all special conditions, such as at projections, at connections to sheet metal roof edge, flashings, etc. to maintain "warranty".
- F. Install fully adhered single ply membrane roofing system in conformance with approved Submittals, including manufacturer's published instructions and details.
- G. Extend or reconfigure walkways; where required provide additional walkways to extend to rooftop equipment.

3.04 CLEANING

- A. Keep surrounding surfaces clean as work progresses.
- B. Remove cartons, debris, emptied containers, and other rubbish as work progresses, and at completion of work of this Section. Legally dispose of rubbish off site.

PART 4 – DOCUMENTATION REGARDING EXISTING ROOF WARRANTY / AUTHORIZED APPLICATORS

4.01 EXISTING ROOF WARRANTY/AUTHORIZED SIKA SARNAFIL APPLICATORS (MASSACHUSETTS)

- A. Existing warranted roof system is by Sika Sarnafil Roofing System. Closeout Documents – Roof Replacement, Hopkinton Fire Station (7 pages total, dated September 9, 2015) regarding the June 2015 installed roof follows this Section.
- B. A list of Sika Sarnafil Authorized Applicators in the State of Massachusetts (two pages total) follows this Section.

END OF SECTION



Gale Associates, Inc.

163 Libbey Parkway | P.O. Box 890189 | Weymouth, MA 02189-0004
P 781.335.6465 F 781.335.6467
www.galeassociates.com

September 9, 2015

Mr. David Daltorio
Hopkinton Fire Station
73 Main Street
Hopkinton, MA 01748

Re: Close-Out Documents
Roof Replacement
Hopkinton Fire Station
Hopkinton, MA
Gale JN 828970

Dear Mr. Daltorio:

At the request of MDM Engineering, Inc. (MDM), enclosed please find one (1) original copy of MDM's closeout documents for the above referenced project. The documents enclosed include the following:

- Sarnafil 25 Year System Warranty
 - Warranty Serial No. 0000020881-167815.1
 - Date of Substantial Completion: 6/24/2015
 - Date of Inspection: 6/15/2015
 - Inspected by: Ernie Mendrala
 - Contractor: MDM Engineering, Inc., 51 Sawmill Road, Dudley, MA 01571, phone (508) 949-1616
 - Issued by: Brian J. Whelan; President
 - Warranty effective: 6/24/2015 through 6/23/2040
 - Sarnafil Caution Sign, Semiannual Roofing Maintenance Inspection Checklist, Unconditional Waiver and Release Upon Final Payment, and Owner's Guide
- MDM's notarized Contractor's Affidavit of Payment of Debts and Liens
- MDM's notarized Contractor's Affidavit of Release of Liens
- MDM's 2 year Contractor's Guarantee: Effective 6/15/2015 through 6/15/2017
- Final Application and Certificate of Payment

As you are aware, representatives from Gale Associates, Inc. (Gale) have been to the above referenced site, and based on the work completed to date, consider the roof replacement project and all associated masonry and steel repair work to be complete.

Also enclosed is MDM's final payment requisition. Based on the status of the project, and our understanding that all of the close-out documents have been submitted, Gale has no objection to the Town of Hopkinton considering final payment for this amount.

CELEBRATING 50 YEARS

Mr. David Daltorio
Close-Out Documents
Hopkinton Fire Station Roof Replacement
September 9, 2015
Page 2



We trust this information serves your needs at this time. Should you have any questions or comments, please do not hesitate to contact me at this office.

Very truly yours,

GALE ASSOCIATES, INC.

Dennis J. Basquill/dmk

Dennis J. Basquill
Project Engineer

DJB/dmk
Enclosures

cc: Zbigniew Mroczka – MDM
Brian Neely – Gale

Sika Sarnafil Inc.

World Class Roofing and Waterproofing

Unconditional Waiver and Release Upon Final Payment

The undersigned has been paid in full for all material furnished to:

M.D.M., Inc.

on the project

Hopkinton Fire Department

located at

**73 Main Street
Hopkinton, MA 01748**

and does hereby waive and release any right to a mechanic's lien, stop notice, or any right against a material bond on the job, except for disputed claims for extra work in the amount of **\$0.**

Dated: 07/20/2015

Sika Sarnafil

(Company)

Jennifer Ventura

(Signature)

a/k Specialist

(Title)



25 Year System Warranty

Warranty Serial No.: 0000020881-167815.1

SIKA CORPORATION ROOFING WARRANTY FOR COMMERCIAL BUILDING

Building Owner: Town of Hopkinton
 Building Name: Hopkinton Fire Department
 Building Address: 73 Main Street
Hopkinton, MA 01748
 Applicator: M.D.M., Inc., 51 Sawmill Road, Dudley, MA 01571 Telephone: (508) 949-1616
 Date of Substantial Completion: 6/24/2015 Date of Inspection: 6/15/2015 By: Ernie Mendrala

Building/Area Name: Wood Deck
 Used As: CIVIL DEFENCE - FIRE STATIONS Area Warranted: 4,000 sq. ft.

Building/Area Name: Metal Deck
 Used As: CIVIL DEFENCE - FIRE STATIONS Area Warranted: 3,000 sq. ft.

Building/Area Name: Concrete Deck
 Used As: CIVIL DEFENCE - FIRE STATIONS Area Warranted: 3,000 sq. ft.

Sika Corporation warrants to the owner of the building described above ("Owner"), that subject to the terms, conditions, and limitations, including the limitations set forth in section 10 below, stated herein, Sika Corporation will repair roof leaks originating from the Sarnafil Roofing Membrane, Sarnatherm Insulation or Sika Corporation Roofing Accessories installed according to Sika Corporation's Technical instructions by a Sika Corporation Authorized Roofing Applicator for a period of 25 (twenty five) years commencing with the date of substantial completion of the installation of the Roofing Membrane with no monetary limit with respect to roof repair costs.

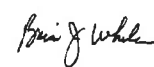
TERMS, CONDITIONS, LIMITATIONS

- Owner shall notify Sika Corporation on the first business day immediately following the discovery of each leak in the Roofing System and confirm in writing within one week.
- If on Sika Corporation's inspection, Sika Corporation determines that the leak is caused by a defect in Sarnafil Roofing Membrane, Sarnatherm Insulation or Accessory provided by Sika Corporation to the Applicator for this building or from a defect in the Sika Corporation Authorized Applicator's workmanship applied to that Sarnafil Membrane, except as provided in the following paragraph three (3) Owner's remedies and Sika Corporation's liability shall be limited to Sika Corporation's repair of the Roofing Membrane, Sarnatherm Insulation or Accessory.
- This warranty does not apply and may be null and void if any of the following occur:
 - The Roofing Membrane, Sarnatherm Insulation or Accessory is damaged by a natural disaster including, but not limited to, earthquake, lightning, hail, peak wind gust in excess of 75 mph (121 km/h), hurricane, or tornado, as defined by The National Weather Service, or other acts of God, or;
 - The Roofing Membrane, Sarnatherm Insulation or Accessory is damaged by any act of negligence, accident, or misuse including, but not limited to, vandalism, falling objects, civil disobedience, or act of war, or;
 - A deficient pre-existing condition or equipment is causing water entry, or;
 - Metal work or other accessories or equipment is used in the Roofing and causes leaks, or;
 - There are any alterations or repairs made on or through the completed roof, or objects such as but not limited to fixtures, equipment, or structures are placed on or attached to the completed roof without first obtaining written authorization from Sika Corporation, or;
 - Failure by the Owner or his lessee to use reasonable care in maintaining the roof as described in the Owner's Guide provided with this warranty, including that of sealants and caulking, or;
 - Loss of integrity of the building envelope and, or structure including, but not limited to partial or complete loss of roof decking, wall siding, windows, doors or other envelope components or from roof damage by wind blown objects, or;
 - Condensation accumulates in the roof assembly due to incorrect design or due to a reduction in the vapor barrier effectiveness, or;
 - A significant change in the use of the building by the Owner or his lessee expected by Sika Corporation to effect the Roofing Membrane as originally installed, or;
 - The Roofing Membrane is damaged by contaminates and/or spills, or;
 - Deficient design applied to the Roofing Membrane such as membrane contact with incompatible materials and/or substrates, or;
 - The Owner fails to comply with every term and condition stated herein.
- During the period of this warranty, Sika Corporation, its agents and employees, shall have free access to the roof during regular business hours.
- Should the Roofing Membrane be concealed, the cost of exposure of the Roofing Membrane for purposes of Sika Corporation's investigation and/or repair, such as removal and replacement of any paving or overburden, shall be the Owner's responsibility.
- Sika Corporation shall have no obligation under this warranty until all invoices for materials, installation, and services provided by Sika Corporation and the Sika Corporation Authorized Applicator have been paid for in full.
- Sika Corporation's failure at any time to enforce any of the terms or conditions stated herein shall not be construed to be a waiver of such provision.
- This warranty may be transferred to a subsequent Owner of the Building if approved in advance and in writing by Sika Corporation and the cost to process the transfer and to inspect and repair the Sika Corporation Roofing System, if necessary, such as but not limited to, removal and replacement of overburden, shall be the Owner's responsibility.
- The Owner and Sika Corporation hereby agree that any and all claims (contractual, statutory, common law or otherwise), disputes, or suits that in any way, directly or indirectly, arise out of or relate to this Warranty, or the alleged breach thereof, or to any contracts between the owner and Sika Corporation, or the alleged breach thereof, or to the design, manufacture, sale, distribution, installation, and/or inspection of the Sika Corporation Roofing System, shall first be submitted to non-binding mediation before a neutral mediator jointly selected by the parties or, in the absence of agreement, as designated by the American Arbitration Association. In the absence of resolution by mediation, all such claims shall be settled by arbitration by the American Arbitration Association in accordance with the Construction Industry Arbitration Rules. Any such mediation and/or arbitration shall take place in Boston, Massachusetts. This Warranty, and any claims, disputes or suits between the parties hereto shall be governed by, and construed and enforced in accordance with, the laws of the Commonwealth of Massachusetts.
- THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. THERE ARE NO WARRANTIES THAT EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF. THE REMEDIES STATED HEREIN ARE EXCLUSIVE REMEDIES AND SIKA CORPORATION SHALL NOT BE RESPONSIBLE OR LIABLE FOR ANY INDIRECT, CONSEQUENTIAL OR INCIDENTAL DAMAGES INCLUDING THE PRESENCE OF MOLDS, FUNGI, BACTERIA, SPORES, MYCOTOXINS OR THE LIKE OR FURTHER LOSS OF ANY KIND WHATSOEVER, INCLUDING BUT NOT LIMITED TO, DAMAGE TO THE BUILDING ON WHICH THE COMPONENTS OF THE ROOF ARE SITUATED, DAMAGE TO THE CONTENTS THEREOF, LOSS OF USE OF THE BUILDING OR ANY COMPONENT PART THEREOF, OR DAMAGE TO ANY OTHER PROPERTY OR PERSONS.**

NO REPRESENTATIVE OF SIKA CORPORATION HAS AUTHORITY TO MAKE ANY REPRESENTATIONS OR PROMISES EXCEPT AS STATED HEREIN.

This Warranty Is Effective From: 6/24/2015 through: 6/23/2040


 Luz Adorno-Boria
 Warranty Coordinator
 Date: 7/6/2015


 Brian J. Whelan
 Executive Vice President
 Date: 7/6/2015



CAUTION



PROTECT YOURSELF!

**ROOF AND WALKWAYS MAY BE SLIPPERY WHEN ICY,
SNOW-COVERED OR WET. WHEN THESE CONDITIONS EXIST:**

- NOTIFY SUPERVISORY PERSONNEL
- LIMIT ROOF-TOP ACCESS TO EMERGENCIES
- PROCEED WITH UTMOST CAUTION

PROTECT YOURSELF!

THIS ROOF MEMBRANE MAY BE ADVERSELY AFFECTED BY:

- ASPHALT AND TAR PRODUCTS
- OILS AND GREASE
- CHEMICAL SPILLS
- SHARP OBJECTS

**CONFINE ROOF-TOP TRAFFIC TO WALKWAYS WHENEVER POSSIBLE.
IF DAMAGE, LEAKAGE OR CONTAMINATION OCCURS, IMMEDIATELY CONTACT:**

**WARRANTY SERVICE DEPARTMENT
CANTON, MA 02021 • TEL: (800) 451-2504**

Sarnafil

BUILDING TRUST





Semiannual Roofing Maintenance Inspection Checklist

Building Name _____ Date _____

Address _____ Inspector _____

Location	Type	Sq. Footage
----------	------	-------------

ITEM	CONDITION			LOCATION	ACTION	DATE
	OK	Problem				
		Minor	Major			
I. REGULAR MAINTENANCE ITEMS						
A. Pitch pans						
B. Caulking						
II. CONDITION OF STRUCTURE (Observe from both interior and exterior of building)						
A. Walls						
1. Movement						
2. Settling						
3. Water staining						
4. Open mortar joints						
5. Poor laps in siding						
6. Spalling						
7. Efflorescence						
B. Roof Deck						
1. Rusting						
2. Spalling						
3. Cracking						
4. Buckling						
5. Open joints						
6. Additional equipment						
7. New penetrations						
C. Building Usage	Record any changes. (Include interior temperature, relative humidity, chemical processing, machine vibration, etc.)					

- D. Summary and General Evaluation
- There are no observable problems
- The following conditions could present problems:
- The following conditions require immediate attention:

III. CONDITION OF ROOFING						
A. General Appearance						
1. Discoloration						
2. Cracking						
3. Ponding water						
4. Debris						
5. Physical damage						
6. Punctures						

ITEM	CONDITION			LOCATION	ACTION	DATE
	OK	Problem				
		Minor	Major			
B. Seams						
1. Open joints						
2. Fishmouths						
3. Ridges						
C. Fully Adhered Membranes						
1. Unadhered areas						
2. Insulation fasteners backing out						
3. Other (describe)						
D. Mechanically Fastened Membranes						
1. Loose fasteners						
2. Fasteners backing out						
3. Other (describe)						
E. Ballasted Membrane						
1. Displacement of stone						
2. Other (describe)						
IV. CONDITION OF FLASHING						
A. Base Flashing						
1. Deterioration						
2. Punctures						
3. Attachment						
4. Ridging/Sagging/Wrinkling						
5. Other (describe)						
B. Counterflashing						
1. Punctures						
2. Attachment						
3. Rusting						
4. Other (describe)						
C. Coping						
1. Open fractures						
2. Punctures						
3. Attachment						
4. Drainage						
5. Other (describe)						
D. Walls						
1. Mortar joints						
2. Spalling						
3. Movement cracks						
4. Other (describe)						
V. MISCELLANEOUS						
A. Expansion Joint Covers						
B. Walkways						
C. Penetrations						
D. Drains						
E. Other (describe)						

Massachusetts Authorized Applicators:

A & M Roofing & Sheet Metal Co. **Andover, MA** 978-475-4500
Craig Brecht

AMK **Beverly, MA** 978-927-7765
Matt Oliphant

Boston Roofing & Design **Millbury, MA** 508-865-5800
Richard Foley

Commonwealth Building Systems **Rockland, MA** 781-792-0032
Mike Hillcoat

Corolla Contracting **Winthrop, MA** 617-561-1333
Dave Ginivan

Capeway Roofing Systems **Westport, MA** 508-674-0800
Dion Calheta

Douglas J. Wooliver **Lanesboro, MA** 413-442-0192
Mike Wooliver

Feeley McAnespie, Inc. **Chelmsford, MA** 978-441-2300
Jay McAnespie

Gibson's Roofs, Inc. **Hanover, MA** 781-826-6344
Joe Meade

Gilbert & Becker Company, Inc. **Dorchester, MA** 617-265-4343
John Marccone

Greenwood Industries **Worcester, MA** 508-865-4040
Matt Brown

J.D. Rivet & Company, Inc. Indian **Orchard, MA** 413-543-5660
Matthew Theberge

John F. Shea **Mattapan, MA** 617-298-0356
Josh David

SIKA CORPORATION • ROOFING

225 Dan Road · Canton, MA 02021 · USA

Phone: 800-768-1940 · Fax: 781-821-9205 · usa.sarnafil.sika.com

Massachusetts Authorized Applicators:

Marshall Roofing & Sheet Metal **Peabody, MA** 781-324-3332
Robert Marshall

Merrick Engineering **Brockton, MA** 508-583-0940
Skip Merrick

MK Specialties Inc. **Lakeville, MA** 508-946-1999
Mark Knox

Northstar Construction Service, Corp. **Leominster, MA** 978-840-8877
John Lastella

RCH Roofing Corp. **Marshfield, MA** 781-834-9000
Rick Hollstein

Rockwell Roofing **Leominster, MA** 978-537-7825
Joe Iaccarino

Silktown Roofing, Inc. **South Grafton, MA** 508-887-8908
Jason Woz

Stanley Roofing Co., Inc. **Ipswich, MA** 978-356-7958
Jason Stanley

Tecta America New England LLC **North Billerica, MA** 978-436-9990
Peter Owens

Titan Roofing Company, Inc. **Chicopee, MA** 800-929-0413
Fred Pazmino

W.S. Aiken, Inc. **Chelsea, MA** 617-889-0665
Bob Conway

SECTION 07 84 00

THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Provide all labor, materials, and equipment necessary to complete the work of this Section. The work of this Section includes providing through-penetration firestop systems consisting of a material, or combination of materials, installed to retain the integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, or gases through penetrations in fire-rated barriers.

1. Firestops shall be used in locations including, but not limited to, the following:
 - a. Penetrations for the passage of duct, cable, cable trays, conduit, piping, electrical busways, and electrical raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor slabs and floor/ceiling assemblies), and vertical service shafts.
 - b. Construction joints between structurally separate sections of walls or floors.
 - c. Between stories unless within a fire-rated shaft.
 - d. Above walls or partitions extending to underside of ceiling or roof assemblies above.
 - e. Concealed furring spaces behind finishes.
 - f. Where pipes, conduits, ducts, and other items pass through fire-rated assemblies.
 - g. Openings for items mounted on or within fire-rated assemblies.
 - h. Replacing of any firestopping damaged as part of the renovation work.
2. Where specific firestop system is not indicated on the Drawings for a through penetration, the Contractor shall include proposed firestop system designs in submittals.
3. Where there is no specific UL Firestop System available for a particular application, the firestopping contractor shall obtain from the firestop manufacturer a system drawing to be submitted to the Architect for approval prior to installation.
4. All firestopping work required or indicated shall comply with requirements of the Commonwealth of Massachusetts State Building Code and local authorities having jurisdiction.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
1. Section 06 10 50, MISCELLANEOUS CARPENTRY; Wood framing and blocking.
 2. Section 07 21 00, THERMAL INSULATION.
 3. Section 07 92 00, JOINT SEALANTS; Sealants except firestopping sealants.
 4. Section 09 21 16, GYPSUM BOARD.
 5. Section 09 51 00, ACOUSTICAL CEILINGS.

6. Division 23 - HVAC; Pipe and duct insulation.
7. Division 26 - ELECTRICAL; Conduit, wiring, etc.

1.04 SUBMITTALS

- A. Submit product data and MSDS for each type of firestop products to be used.
 1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- B. Submit Shop drawings detailing materials, installation methods, and relationships to adjoining construction for each through-penetration firestop system, and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.
 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop configuration for construction and penetrating items.
 2. Submit in accordance with recommendations contained in IFC 'Firestopping Manual of Practice'.
 3. Where project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration approved by firestopping manufacturer's fire protection engineer with modifications marked.
- C. Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- D. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.
- E. Schedule: Submit a schedule of through penetrations which indicates the firestop system to be utilized for each different firestopping application.
 1. Schedule shall indicate construction of the wall or floor assembly; size, number, and material of penetrating items; firestop system designation; required F-rating, T-rating, and remarks, where applicable.
- F. Submit complete list of all firestop systems and materials to be utilized, including documentation of UL Classifications or approved third party testing.
 1. Include all of the individual materials required for each complete system.
 2. Indicate manufacturer's product name and number for each material.
- G. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of engineers and owners, and other information specified.

1.05 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated, and the passage of smoke and other gases. Include the following:

1. Firestop all penetrations passing entirely through fire resistance rated wall and floor assemblies and other locations as indicated on the Drawings.
 2. Provide and install complete through-penetration firestopping systems which have been tested and approved by UL, FM, or third party testing agency.
 3. Provide and install complete through-penetration firestopping systems which are designed and approved for the specific through-penetrations to be firestopped.
 4. Provide and install firestop materials of thickness, width, and density, as required for the fire resistive ratings specified herein and/or as indicated on the Drawings.
 5. The installation of the correct firestop system is as important as the firestop system itself.
- B. F - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding the fire-resistance rating of the constructions penetrated.
- C. T - Rated Through-Penetration Firestop Systems: Provide through-penetration firestop systems with T ratings, in addition to F ratings, as determined per ASTM E 814, where indicated and where systems protect penetrating items exposed to contact with adjacent materials in occupiable floor areas. T-rated assemblies are required where the following conditions exist:
1. Where firestop systems protect penetrations located outside of wall cavities.
 2. Where firestop systems protect penetrations located outside fire-resistive shaft enclosures.
 3. Where firestop systems protect penetrations located in construction containing doors required to have a temperature-rise rating.
 4. Where firestop systems protect penetrating items larger than a 4 in. diameter nominal pipe or 16 sq. in. in overall cross-sectional area.
- D. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E 119 or UL 2079, but not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.
- E. For firestopping exposed to view, traffic, moisture, and physical damage, provide products that do not deteriorate when exposed to these conditions.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 2. For floor penetrations with annular spaces exceeding 4 in. or more in width and exposed to possible loading and traffic, provide firestop systems capable of supporting the floor loads involved either by installing floor plates or by other means.
 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- F. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E 84.
1. For firestopping exposed to view, provide systems which result in a finished appearance similar to adjacent surfaces.
- 1.06 QUALITY ASSURANCE
- A. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey, or another agency performing testing and follow-up inspection services for firestop systems that is acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814 under conditions where positive furnace pressure differential of at least 0.01 inch of water is maintained at a distance of 0.78 inch below the fill materials surrounding the penetrating items in the test assembly. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey, or by another qualified testing and inspecting agency.
 3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E 119 or UL 2079, under conditions where the positive furnace pressure differential is at least 0.01 inch of water, as measured 0.78 inch from the face exposed to furnace fire. Provide systems complying with the following requirements:
 - a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
 - b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Engage an experienced Installer who is certified by and listed in the FM Directory. Submit qualifications of individuals certified by FM testing as "Designated Responsible Individual".
1. The installer shall have the necessary experience, staff, and training to install classified firestopping systems with documented experience and references.
 2. It is the intent that all firestopping be performed by one contractor as a sole source.
- C. Single-Source Responsibility: Obtain through-penetration firestop systems for each kind of penetration and construction condition indicated from a single manufacturer.
1. Materials of different manufacture shall not be intermixed.
- D. Field-Constructed Mockup: Prior to installing firestopping, erect mockups for each different through-penetration firestop system indicated to verify selections made and to demonstrate qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for final installations.
1. Locate mockups on site in locations indicated or, if not indicated, as directed by Architect.
 2. Notify Architect one week in advance of the dates and times when mockups will be erected.
 3. Obtain Architect's acceptance of mockups before start of final unit of Work.
 4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging completed unit of Work.
 - a. Accepted mockups in an undisturbed condition at time of Substantial Completion may become part of completed unit of Work.
- E. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

- F. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.
 - B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.
- 1.08 PROJECT CONDITIONS
- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
 - B. Ventilation: Ventilate firestopping per firestopping manufacturer's instructions by natural means or, where this is inadequate, by forced air circulation.
- 1.09 SEQUENCING AND SCHEDULING
- A. Notify Owner's inspection agency at least one week in advance of firestopping installations; confirm dates and times on days preceding each series of installations.
 - 1. Do not cover up those firestopping installations that will become concealed behind other construction until Owner's inspection agency and authorities having jurisdiction, if required, have examined each installation
- 1.10 DEFINITIONS
- A. "Through-Penetration Firestop" is a material, device, or construction installed to resist, for a prescribed time, the passage of flame, heat, and gases through openings which penetrate the entire fire resistive construction in order to accommodate penetrating items. Incorporating the use of specific products installed in a specific manner, they shall only be installed in configuration for which they have been specifically tested and listed by Underwriters Laboratories (UL) and/or Factory Mutual (FM) as per UL 1479 and/or ASTM E 814.
 - B. "F-Rating" is the time period that a through penetration firestop limits the spread of flame and hot gases through the fire resistive construction, including the penetrating elements, when tested in accordance with the time-temperature curve defined in ASTM E 119.
 - C. "T-Rating" is the time period that a through-penetration firestop limits temperature rise through the fire resistive construction, including the penetrating elements, when tested in accordance with the time-temperature curve defined in ASTM E 119.
- 1.11 ENVIRONMENTAL REGULATIONS
- A. All materials shall be asbestos free and non-carcinogenic.

- B. Firestop materials shall contain no flammable or toxic solvents and shall not produce toxic or flammable outgassing during the drying or curing process.
- C. Firestop materials used shall not require solvent based chemicals for clean-up purposes.
- D. If required, hazardous disposal of firestop materials shall be strictly observed as noted on the individual MSDS.
- E. Water-based firestop materials shall be considered preferable over silicone or solvent based materials.

PART 2 - PRODUCTS

2.01 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semi-refractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.
- C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.
- D. Materials shall conform to UL 1479 AND ASTM E 814.
- E. Self-extinguishing damming materials shall be used, as specified by the manufacturer, as part of the designated firestop system.
- F. Firestop materials used shall be suitable and compatible with the penetrating item(s) including the surrounding materials.
- G. Firestop material which contains solvents that would attack plastics are not to be used.

2.02 FIRE-SAFING BOARD INSULATION

- A. Provide material tested, listed and labeled by UL and listed by UL in designs similar to

applications indicated. Provide semi-rigid, non-asbestos mineral fiber board, rated noncombustible when tested according to ASTM E 136:

1. k-Value: 0.25 at 75°F.
2. Thickness: 4 in., unless otherwise indicated, and not less than thickness necessary to obtain required fire-rating.
3. Density: Nominal 4 pcf.
4. Product: Thermafiber, Thermafiber Safing Insulation; Partek Insulation, Inc., Paroc Safing Insulation; Fibrex, Inc., FBX Fire Safing Insulation; or approved equal.

- B. Intumescent Tape: Pemko Hot Smoke Seal, adhesive-backed intumescent, Item HSS2000, manufactured by Pemko Mfg. Co., Memphis, TN, or equivalent manufactured by Dow Corning or Bio Fireshield.
- C. Light Gage Bent Metal Retainer: Provide 14 gage galvanized steel bent angle with 1 in. upturned leg set, continuous, as indicated to retain safing insulation and intumescent tape.

2.03 MINERAL WOOL

- A. Provide loose mineral wool, rated noncombustible when tested in accordance with ASTM E 136, free of asbestos and glass fiber, and suitable for in-place density of 6 pcf to 12 pcf.
1. Hilti Mineral Wool; Hilti Corp.

2.04 CAULK AND PUTTY

- A. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
1. Biostop 500+; Bio Fireshield.
 2. Fire-Barrier Series; 3M Fire Protection Products.
 3. Flamesafe; W.R. Grace.
 4. CLK Adhesive Firestop; Nelson Firestop.
 5. STI SpecSeal S100.
 6. Hilti FS – One High Performance Sealant, Hilti CP 617 Firestop Putty Pad, or Hilti CP 618 Firestop Putty Stick; Hilti Corp.

2.05 FIRESTOP MORTAR

- A. Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
- B. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
1. Novasit K-10; Rectorseal Corp.
 2. KBS Mortar Seal; International Protective Coatings Corp.
 3. CMP Firestop Compound; Nelson Firestop.
 4. STI SpecSeal Mortar.
 5. Hilti CP 637 Firestop Mortar; Hilti Corp.

2.06 FIRESTOP COLLARS

- A. Provide premanufactured fire protective pipe sleeves equal to one of the following products, or Architect approved equal, that meet or exceed specified requirements:

1. Bio-Fireshield Firestop Collars; Rectorseal Corp.
2. STI SpecSeal Firestop Collars.
3. Hilti CP 643N Firestop Collar or CP 644 Firestop Retaining Collar for Plastic Pipe; Hilti Corp.

2.07 FIRESTOP BAGS/PILLOWS

- A. Pillows/Bags: Re-usable, heat-expanding pillows/bags composed of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- B. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
 1. Firestop Pillows; Rectorseal Corp.
 2. KBS Sealbags; W.R. Grace.
 3. PLW Firestop Pillow; Nelson Firestop.
 4. STI SpecSeal Pillows.
 5. Hilti FS 657 – Fire Block; Hilti Corp.

2.08 WRAP STRIPS

- A. Single-component, elastomeric sheet with aluminum foil on one side. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
 1. Biostop Wrap Strip; Bio Fireshield.
 2. SpecSeal Wrap Strip; STI.
 3. Fire Barrier FS195 Wrap Strip; 3M.
 4. Hilti CP 648E Endless Wrap Strip or CP 648S Single Wrap Strip; Hilti Corp.

2.09 COMPOSITE BOARDS

- A. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
 1. Barrier Sheet Material; 3M or equivalent product by Johns Manville or Firetemp.
 2. Hilti CP 675T Firestop Board; Hilti Corp.

2.10 FIRE FOAM SEALANT

- A. Provide the following products that meet or exceed specified requirements:
 1. Hilti CP 620 Fire Foam; Hilti Corp.

2.11 DAMMING/FORMING MATERIALS, FASTENERS, AND ANCHORAGE ACCESSORIES

- A. Provide damming/forming materials in accordance with manufacturer's recommendations.
- B. Provide fasteners and anchorage accessories complying with UL designs and other components and accessories as needed and as recommended by the firestopping material manufacturer.

2.12 MIXING

- A. For those products requiring mixing prior to application, comply with firestopping

manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.

3.03 INSTALLING THROUGH-PENETRATION FIRESTOPS

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and drawings pertaining to products and applications indicated.
 - 1. Coordinate with fire protection and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire rated construction have been permanently installed prior to installation of firestops and smoke seals.
 - 2. Schedule and sequence the work to assure that partitions and all other construction which would conceal penetrations are not erected prior to the installation of firestop and smoke seals.
 - 3. 1 hr. and 2 hr. rated columns and beams and wall assemblies enclosed in gypsum board shall be firestopped where gypsum board meets structure above.
 - 4. Provide minimum 1 hour rating for penetrations, expansion joints, and slab edge conditions at non-rated floor slabs.
 - 5. Comply with manufacturer's requirements regarding maximum size for annular spaces and materials to be used.
- B. Install forming/damming materials and other accessories of types required to support fill

materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C 1193, and with the sealant manufacturer's installation instructions and drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
- D. Tool non-sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beads of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets, and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.05 FIELD QUALITY CONTROL

- A. Inspecting agency employed and paid by Owner will examine completed firestopping to determine, in general, if it is being installed in compliance with requirements.
- B. Inspecting agency will report observations promptly and in writing to Contractor and Architect.
- C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.
- D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.06 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping complying with specified requirements.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. This Section includes sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

- a. Joints between different materials indicated.
- b. Perimeter joints between materials listed above and frames.
- c. Control and expansion joints in ceiling and overhead surfaces.
- d. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

- a. Perimeter joints of exterior openings where indicated.
- b. Perimeter joints between interior wall surfaces and frames of interior doors.
- c. Other joints as indicated.

- B. The work of this Section contains remedial work which necessitates compatibility of new materials to adhere or otherwise attach to existing building envelope materials. It is the Contractor's responsibility to test or otherwise ensure compatibility of materials used as part of the joint sealant work with existing construction.

- C. Areas which require separate barriers or isolation from dissimilar materials shall be identified and these areas shall be specifically reviewed and approved by the Architect prior to remedial work.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:

1. Section 06 10 50, MISCELLANEOUS CARPENTRY; Wood framing and blocking
2. Section 07 53 00, ROOFING OF ROOF PENETRATIONS AND EQUIPMENT.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each sealant material used including all primers, joint backing, and bond breaker tapes. Provide certifications that sealant materials comply with specified requirements.

- B. Initial Selection Samples: Submit samples manufacturer's color charts showing complete range of colors, textures, and finishes available for each material used.
 - C. Verification Samples: Submit actual representative samples of each sealant material that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide sealant manufacturers standard cured sealant samples having minimum size of 4 in. long.
 - D. Test Reports: Provide certified reports for all specified tests.
 - E. Surface Preparation and Sealant Recommendations: Prior to starting the work, the Contractor shall submit the following additional data:
 - 1. Recommendations for proper surface preparation for each substrate, type of primer if required, and sealant(s) to be used for each joint to be sealed.
 - 2. Sealant manufacturer's approval of materials to be used and surface preparation procedures.
- 1.05 COMPATIBILITY
- A. Provide sealant and sealant joint backing materials suitable for the use intended and compatible with the materials with which they will be in contact. Compatibility of sealant and accessories shall be verified by the sealant manufacturer.
- 1.06 QUALITY ASSURANCE
- A. Source: For each sealant material type required for the work of this section, provide primary materials which are the product of one manufacturer. Provide secondary or accessory materials which are acceptable to the manufacturers of the primary materials.
 - B. Installer: A firm with a minimum of five years' experience in type of work required by this Section and which is acceptable to the manufacturers of the primary materials.
 - C. Mock-Ups: Prior to commencing the primary work of this Section, provide mock-ups at locations acceptable to Architect. Obtain Architect's acceptance of visual qualities. Protect and maintain accepted mock-ups throughout the remainder of the work of this section to serve as criteria for acceptance of the work. Mock-ups shall include the following:
 - 1. Surface preparation of joint to be sealed based on approved recommendations.
 - 2. Location, size shape, color, and depth of joints complete with back-up material, primer, and new sealant. Mock-up may be part of finished work.
 - 3. Joint width conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application intended.
 - 4. Joint substrate conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.
 - D. Alternate Materials: Should the Contractor wish to use alternate sealant types, sealant compositions, or other materials other than those specified, the Contractor shall submit product data of alternative material or products indicating location of use, reason for recommending the material, advantages of material over that specified, and other criteria to evaluate proposed substitution(s).

- E. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact or affect joint sealants to joint-sealant manufacturers for testing according to ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - F. Preconstruction Field-Adhesion Testing: Prior to installing elastomeric sealants, field test their adhesion to Project joint substrates according to the method in ASTM C 1193 that is appropriate for the types of Project joints.
 - G. Preconstruction Testing: for Staining (Stain Resistance): ASTM D 2203, ASTM C 510, or ASTM C 1248; determine sealants will not stain joint substrates.
- 1.07 PROJECT CONDITIONS
- A. Perform work of this Section only when existing or forecasted weather conditions are within the limits established by manufacturers of the materials and products used.
 - 1. Do not install primers or sealants when atmospheric temperatures or joint surface temperatures are less than 40 degrees F (4 degrees C).
 - B. Substrates: Proceed with work only when substrate construction and penetration work is complete.
 - C. Coordinate sealant work and preparation of substrate to receive sealants and backing with work of other trades providing remedial or replacement work.
- 1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Materials under this Section shall be delivered to, and stored at, the job site in unbroken factory sealed containers with labels intact.
- 1.09 WARRANTY
- A. Furnish joint sealant manufacturer's written single-source performance warranty that joint sealant work will be free of defects related to workmanship or material deficiency for seven (7) years from date of Final Completion of the Project.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Before installation check each sealant for compatibility with adjacent materials and surfaces and with indicated exposures. Select sealers which are recommended by manufacturer for each application indicated. Where exposed to pedestrian or vehicular traffic, provide sealants which are non-tracking and are strong enough to withstand the traffic without damage.
- B. Provide colors as selected by Architect from manufacturer's standard and special colors. Where specifically requested, provide custom color matches.

2.02 SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

- B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Single-Component Neutral-Curing Silicone Sealant:
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. Dow Corning Corporation; 790.
 - b. GE Silicones; SilPruf LM SCS2700.
 - c. Bondaflex Technologies Sil 290
 - d. Pecora Corporation; 864.
 - e. Tremco Inc.; Spectrem 1.
 - f. Or equal.
 2. Extent of Use: Joints in exterior vertical and soffit surfaces.
- D. Multi-component Pourable Urethane Sealant:
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. Bostik Findley; Chem-Calk 550.
 - b. Bondaflex Technologies PUR 2 SL
 - c. Meadows, W. R., Inc.; POURTHANE.
 - d. Pecora Corporation; Urexpan NR-200.
 - e. Tremco Inc.; THC-901, multi-component.
 - f. Or equal.
 2. Extent of Use: Joints in exterior horizontal surfaces.
- E. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant:
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. Dow Corning Corporation; 786 Mildew Resistant.
 - b. GE Silicones; Sanitary SCS1700.
 - c. Bondaflex Technologies Sil 100 WF.
 - d. Pecora 898NST.
 - e. Tremco Inc.; Tremsil 200.
 - f. Or equal.
 2. Extent of Use: Sanitary joints at interior toilet rooms and other wet areas.
- F. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
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. Bostik Findley; Chem-Calk 600.
 - b. Bondaflex Technologies Sil-A 700.
 - c. Pecora Corporation; AC-20+.
 - d. Tremco Inc.; Tremflex 834.

- e. Or equal.
 - 2. Extent of Use: Joints at non-moving interior surfaces, except where indicated to be sanitary joints.
- G. Butyl Sealant, ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- I. Butyl-Rubber-Based Solvent-Release Joint-Sealant, ASTM C 1085. Provide one of the following:
- 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. Bostik 300; Bostik Inc.
 - b. PTI 707; H.B. Fuller Company.
 - c. NuFlex 232; NUCO Industries, Inc.
 - d. BC-158; Pecora Corporation.
 - e. PSI-301: Polymeric Systems, Inc.
 - f. Sonneborn Multi-Purpose Sealant; Sonneborn Building Products Div., ChemRex, Inc.
 - g. Tremco Butyl Sealant; Tremco.
- 2.03 PREFORMED JOINT FILLER
- A. If and when required, provide preformed, pre-compressed, self-expanding, open-cell foam sealant manufactured from high-density urethane foam impregnated with a non-drying, water repellent agent; and factory produced in pre-compressed sizes in roll to fit joint covered with a protective wrapping; develops a watertight and airtight seal when compressed to degree specified by manufacturer, equal to one of the following:
- 1. Illmod 600 by Tremco Inc.
 - 2. Emseal Backerseal by Emseal Joint Systems Ltd.
 - 3. Willseal 600 by Willseal USA.
- 2.04 MISCELLANEOUS MATERIALS
- A. Primer: Provide primer recommended by sealant manufacturer for surfaces to be adhered to. Provide all testing required for compatibility of primer and sealants and primer to substrate applications.
- B. Bond Breaker Tape: Provide polyethylene or other plastic tape recommended by sealant manufacturer to prevent three-sided adhesion.
- C. Backer Rod: Provide compressible rod of durable non-absorptive material recommended by sealant manufacturer for compatibility with sealant. Provide products of one of the following manufacturers:
- 1. Backer Rod Manufacturing and Supply Co.
 - 2. Dow Chemical Co.
 - 3. W. R. Meadows, Inc.
 - 4. Williams Products, Inc.

- D. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- E. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
- F. Provide miscellaneous materials of type that will not bleed through sealant, discolor surface, or produce other deleterious effects. Select size to provide compression to approximately 2/3 original width when in place. Provide backing material profile concave to the rear of the sealant and equipped with a bond-breaking film.

PART 3 - EXECUTION

3.01 INSPECTION

- A. The Installer shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of sealant work means Installer's acceptance of joint surfaces and conditions.

3.02 PREPARATION

- A. Strictly comply with sealant manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this Section.
 - 1. Unless otherwise indicated, use of sealants shall conform to ASTM C 962.
- B. Clean joint surfaces immediately before installation of sealants, primers, tapes and fillers.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
 - a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
 - b. Remove laitance and form-release agents from concrete.
 - c. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - d. Remove paints from joint surfaces except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.
 - e. Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.
 - 2. Blow out dust, loose particles, and debris with moisture and oil-free compressed air. Remove any pieces of caulk and backer rod lodged in joint.
- C. Tape or mask adjoining surfaces to prevent spillage and migration problems.

1. Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears.
 2. Apply tape so as not to shift readily.
 3. Remove tape immediately after tooling without disturbing joint seal.
- D. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- 3.03 BACKER ROD AND BOND BREAKER - INSTALLATION
- A. Backer Rod: Provide joint backer material uniformly to depth required by sealant manufacturer for proper joint design using a blunt instrument.
1. Fit securely by compressing backer material 25 percent to 50 percent so no displacement occurs during tooling.
 2. Avoid stretching or twisting joint backer.
- B. Bond Breaker: Provide bond-breaker where indicated or recommended by sealant manufacturer, adhering strictly to the manufacturers installation requirements.
- 3.04 INSTALLATION OF SEALANTS
- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape to surfaces not intended to bond with the sealant in accordance with the manufacturer's recommendation.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 4. Provide sealant joints with minimum depth and width of 1/4 inch, and an appropriate depth to width ratio for the given application.

- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not damage or discolor sealants or adjacent surfaces.
 3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.06 CURING

- A. Cure sealants in strict compliance with manufacturers' instructions and recommendations to obtain highest quality surface and maximum adhesion. Make every effort to minimize accelerated aging effects and increase in modulus of elasticity.

3.07 CLEANING AND PROTECTION

- A. Remove smears from adjacent surfaces immediately, as the work progresses. Exercise particular care to prevent smearing or staining of surrounding surfaces which will be exposed in the finished work, and repair any damage done to same as result of this work without additional cost to Owner.
- B. Remove and replace work that is damaged or deteriorated.
- C. Clean adjacent surfaces using materials and methods recommended by sealant manufacturer. Remove and replace work that cannot be successfully cleaned.
- D. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protection immediately before final acceptance.

END OF SECTION

SECTION 09 21 16

GYP SUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Furnish and install gypsum drywall work, as indicated on the Drawings and as specified. Include, but do not limit to:
 - 1. Gypsum wallboard finish at areas where HVAC upgrade work and equipment replacement requires new gypsum finish or patching of gypsum board at areas as indicated.
 - 2. Patching of gypsum board walls and ceilings to remain, as indicated on the Drawings.
 - 3. Other gypsum drywall work called for on the Drawings or reasonably required to complete the Project intent.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 02 41 19, SELECTIVE DEMOLITION.
 - 2. Section 06 10 50, MISCELLANEOUS CARPENTRY; Wood framing, wood blocking, furring, and grounds.
 - 3. Section 09 51 00, ACOUSTICAL CEILINGS.
 - 4. Section 09 91 00, PAINTING; Painting.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each system component used. Provide certifications that materials and systems comply with specified requirements.
- B. Samples: Submit samples of all finish materials specified under this Section to the Architect for selection and approval.
 - 1. Gypsum Board, each type: 12 in. x 12 in. sample.

1.05 QUALITY ASSURANCE

- A. Reference Standards: Conform to governing laws, building code and manufacturer's printed standards.
- B. Fire Resistance Ratings: Where indicated provide materials and assemblies identical to those tested and rated for fire resistance per ASTM E 119 by testing and inspecting organization acceptable to authorities that have jurisdiction.

1. Fire Resistance Ratings: As indicated by reference to GA File Numbers in GA-600 "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
 - C. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA-505 for definitions of terms related to gypsum board assemblies not defined in this Section or in other referenced standards.
 - D. Mock-Up: Provide mock-ups as indicated to demonstrate quality of installation and finishing.
- 1.06 COORDINATION
- A. Work of this Section shall be coordinated with the work of other Sections to assure the steady progress of all the work of the Contract. Obtain complete information regarding wall and ceiling mounted fixtures, grilles, registers, equipment, accessories, etc. to be used on the work from other trades. In no case shall work of other Sections be concealed until it has been inspected.
- 1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING
- A. Deliver all manufactured materials to site in original packages, containers, or bundles bearing the manufacturer's name and brand names, type of material, and contents.
 - B. Store materials in interior spaces, above floors, under cover, away from sweating walls and other damp surfaces, and with good ventilation.
 - C. Handle gypsum boards to prevent damage to edges, ends, or surfaces. Protect metal corner beads, casing beads, and trim from being bent or damaged.
- 1.08 PROJECT CONDITIONS
- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.
 - B. Room Temperatures: For non-adhesive attachment of gypsum board to framing, maintain not less than 40 deg F. For adhesive attachment and finishing of gypsum board, maintain not less than 50 deg F for 48 hours prior to application and continuously after until dry. Do not exceed 95 deg F when using temporary heat sources.
 - C. Ventilation: Ventilate building spaces, as required, for drying joint treatment materials. Avoid drafts during hot dry weather to prevent finishing materials from drying too rapidly.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Gypsum Boards and Related Products: Provide materials, products, and systems from one of the following manufacturers that meet or exceed specified requirements:
 1. United States Gypsum Co.
 2. Georgia-Pacific Corp.
 3. Gold Bond Building Products Div., National Gypsum Co.

2.02 GYPSUM BOARDS

- A. Gypsum Wallboard: Provide gypsum board 48 in. width by lengths as required, tapered edge, paper finish, conforming to ASTM C 36.
 - 1. Unless otherwise indicated, gypsum board shall be 1/2 in. thick.
 - 2. Where used in fire-rated assemblies, provide Type X fire resistant type.
- B. Glass Mat, Moisture-Resistant Wallboard: Coated glass mat-faced, moisture-resistant, treated core gypsum wallboard with physical properties conforming to applicable sections of the following: ASTM C 1177 and ASTM C 630.
 - 1. Product: Subject to compliance with requirements, provide DensArmor Plus Interior Panels manufactured by G-P Gypsum Corp., or approved equal.
- C. Joint Treatment Materials: Joint treatment materials shall conform to ASTM C 475.
 - 1. Laminating Adhesive and Joint Finishing Compound: As recommended by gypsum wallboard manufacturer, interior type for interior general use, exterior type for use at water resistant gypsum backer board.
 - 2. Joint Tape: 2 in. to 2-1/2 in. wide paper tape, as recommended by gypsum wallboard manufacturer.

2.03 FASTENERS

- A. Screws for Attachment of Gypsum Wallboard to Wood Blocking: Self-drilling Type W screws conforming to ASTM C 1002, with bugle-type Phillips-head. Screw length and size in each case shall be as recommended by gypsum wallboard manufacturer.
- B. Provide stainless or zinc coated fasteners at toilet room walls and ceilings, as applicable.

2.04 METAL TRIM AND ACCESSORIES

- A. General: Provide metal trim and accessories conforming to ASTM C 840.
- B. Control Joint: 26 gauge, galvanized steel, "Vee" type, with perforated flanges, for compound finishing.
- C. Corner Bead: 1 in. by 1 in. perforated flange, standard type, 26 gauge, galvanized steel, for compound finishing.
- D. Metal Trim: 24 gauge, galvanized steel, with perforated flanges, for compound finishing.
 - 1. Include J moldings, L beads and curved L beads, as indicated on Drawings.

2.05 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum panels.
- C. Spot Grout: ASTM C 475, setting-type joint compound recommended for spot grouting hollow metal door frames.

- D. Fastening Adhesive for Wood: ASTM C 557.
- E. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum panels to steel framing.
- F. Sound Attenuation Insulation: Provide mineral wool type insulation, minimum 2.5 pcf density, equal to Thermafiber Insulation, manufactured by Thermafiber LLC, or approved equal.
- G. Acoustical Sealant for Concealed Applications: Manufacturer's standard, non-drying, non-hardening, non-skinning, non-staining, gunnable synthetic rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission, and where STC ratings are required to provide an assembly which will result in attaining the specified STC rating. Acoustical sealant for concealed applications shall be one of the following, or approved equal:
 - 1. Tremco Acoustical Sealant.
 - 2. USG Sheetrock Brand Acoustical Sealant.
 - 3. Quiet Solution QuietSeal Acoustical Sealant.
 - 4. Pecora BA-98.
- H. Acoustical Sealant for Exposed Applications: Manufacturer's standard, paintable, non-staining, gunnable latex complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90. Acoustical sealant for exposed applications shall be one of the following, or approved equal:
 - 1. Pecora AC-20+ or AC-20 FR.
 - 2. Tremco Tremflex 834.
 - 3. USG Sheetrock Brand Acoustical Sealant.

PART 3 - EXECUTION

3.01 INSPECTION AND COORDINATION

- A. Inspect job conditions and related work and report to Architect in writing, all conditions interfering with the proper installation of work of this Section. Commencement of work in any given area shall constitute acceptance of conditions in that area as acceptable to receive work of this Section.
- B. Change and adjust work of this Section to accommodate work of other Sections, providing cutting and patching until it has been inspected.

3.02 GENERAL REQUIREMENTS

- A. Provide work conforming to published specifications and installation instructions of each manufacturer, the approved shop drawings, above-referenced quality assurance standards, the governing laws and code. Refer to Drawings to determine location of fire-resistive, fire-protective, and acoustically-rated work, and construct this work to conform to the specifications and installation instructions of UL or other testing agency(ies). Also refer to the Drawings to determine the number of layers of gypsum board, thickness of board, etc., for each of the installations.
- B. Erect gypsum drywall work, rigidly supported, and securely fastened in place, in such a manner that plumb, level, and true finished lines and surfaces will result in the finished work in accordance with the requirements of ASTM C 754 and ASTM C 840.

- C. Construct gypsum drywall work only after all windows and door openings are enclosed and a temperature of not less than 55°F. is maintained during and up to completion of the drywall work.

3.03 APPLYING AND FINISHING GYPSUM BOARD, GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
- B. Apply thicknesses and layers of gypsum wallboard at soffits, ceilings, walls, partitions, as indicated. Stagger joints in each layer. Locate joints in first layer on opposite sides of partitions to occur on different studs. Apply wallboard at ceilings with long dimension perpendicular to furring channels, with each end occurring over a framing member. Install wallboard at walls and partitions with long dimension vertical, and with each end and edge lying over a framing member.
 - 1. At double layer installations apply second layer by combination of laminating adhesive and mechanical fastenings (through first layer into the steel framing and/or furring member behind), in strict accordance with manufacturer's printed recommendations for each project condition.
 - 2. Except where concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 3. Fit gypsum panels around ducts, pipes, and conduits.
- C. To minimize end joints, use maximum practical lengths. Bring gypsum wallboard panels into contact, but do not force into place. Fit abutting ends and edges neatly. Provide slots for sealant at top, bottom, ends, and corners of wallboard at all walls and partitions indicated to receive acoustical insulation, as indicated. Also provide slots for sealant where wallboard abuts other finish materials, as specified hereinbelow.
- D. Spacing and installation of drywall screws for the various applications and fire-rating requirements shall conform to the printed standards of the manufacturer.
- E. Set heads of fasteners flush with surface of the paper, but not breaking the paper. Where attached loosely to a framing or furring member, a second fastener shall be installed within 1-1/2 in.
- F. Cut gypsum wallboard neatly at corners, edges, etc., and for pipes, electrical outlets, electrical conduit and raceway, recessed cabinets, and other projections.

3.04 INSTALLATION OF WALLBOARD ACCESSORIES

- A. Install accessories at gypsum wallboard installations, as follows, in strict accordance with manufacturer's instructions.
 - 1. Install joint reinforcement tape at all joints, and at all internal corners where abutting surfaces are both gypsum wallboard construction.
 - 2. Install corner beads at all external wallboard corners.
 - 3. Install casing bead wherever finish wallboard abuts dissimilar materials and other places where specifically called for on the Drawings.

4. Install control joints generally over (and under) centers of all major wall openings (those greater than 40% of wall height, measured floor to ceiling), over all door frames, over control joints in back-up materials, and at maximum distance of 30 ft. in walls, 60 ft. or to limit areas to not more than 2400 sq. ft., at ceilings (except where lesser distance is indicated), and other places specifically called for on the Drawings. Interrupt furring and/or framing behind the control joints. Specific locations of control joints shall be as indicated or as directed by Architect; submit proposed locations of control joints to Architect for approval before beginning work.
5. Install metal edge trim and metal reveal trim where indicated in accordance with the manufacturer's recommendations.

3.05 JOINT FINISHING

- A. Finish all corners, joints, and edges of gypsum wallboard and gypsum soffit board work, and all corner beads, casing beads, control joints and other trim to provide complete finishing of all exposed wallboard surfaces, in strict accordance with manufacturer's printed instructions and ASTM C 840. Finish to absolutely flush, true surface showing no irregularity when tested by light source parallel to the plane of the nominal wallboard face.
- B. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
 1. Provide Level 4 for all gypsum board surfaces.

3.06 PROTECTION AND CLEANING

- A. Protect the work of other Sections and work of this Section already installed against soiling and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged or soiled.

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Provide suspended acoustical ceilings as indicated on Drawings and as specified. Work of this Section includes, but is not limited to:
 - 1. Acoustical panel lay-in ceiling with exposed suspension system.
 - 2. Removal and reinstallation of ACT as indicated and as required to construct the proposed renovations including reinstallation of existing panels and grid suitable for reuse and providing new acoustical panels to match for replacement of existing panels damaged or otherwise unsuitable for reinstallation.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 02 41 19, SELECTIVE DEMOLITION.
 - 2. Section 09 21 16, GYPSUM BOARD; Gypsum drywall ceilings and acoustical batt insulation.
 - 3. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) and Division 26 - ELECTRICAL; Mechanical and electrical fixtures and appurtenances at acoustical ceilings, including independent suspension.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials comply with requirements.
- B. Shop Drawings: Submit shop drawings of ceiling system including all components and special conditions including soffit construction and perimeter molding.
- C. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.
- D. Verification Samples: Submit representative samples of each material to be exposed in the finish work, showing full range of color and finish work, showing full range of color and finish variations expected. Provide minimum 12 in. x 12 in. samples of each panel type. Provide minimum 12 in. long samples of each exposed suspension systems.

- E. Test Reports: Submit certified reports for tests required.
- F. Fire Rated Assemblies: Where UL Design Assemblies are indicated as part of floor/ceiling or roof ceiling construction, provide substantiating data and certifications from the ceiling system manufacturer that the acoustical ceiling system components provided as part of that assembly have been tested and meet the requirements contained in UL Fire Resistance Directory or are otherwise suitable as part of the indicated Design Assembly.

1.05 QUALITY ASSURANCE

- A. Comply with governing laws and building codes and the requirements of CISCA Handbook and ASTM C 636.
- B. Installer: A firm with minimum three years' experience in work of type required by this Section, and which is authorized, certified or licensed by the manufacturers of the primary materials.
- C. Source: For each type of material required for the work of this Section, provide primary materials which are the products of a single manufacturer. Provide secondary materials which are acceptable to the manufacturers of primary materials.
- D. All ceiling panels shall be from the same run at production facility and shall be manufactured within acceptable tolerances for color consistency.

1.06 TESTS

- A. Fire Resistance: Where fire-resistance ratings are indicated or required by authorities having jurisdiction, provide materials and construction which are identical to assemblies whose fire-resistance ratings have been tested in compliance with ASTM E 119 by independent agencies acceptable to the Architect and authorities having jurisdiction.
- B. Surface Burning Characteristics: Provide materials whose surface burning characteristics, when tested in compliance with ASTM E 84 are Class A.
- C. Noise Reduction Coefficient (NRC): Where NRC ratings are indicated or required by authorities having jurisdiction, provide materials and construction which are identical to assemblies whose NRC ratings have been tested in compliance with ASTM C 423 by independent agencies acceptable to the Architect and authorities having jurisdiction.
 - 1. All acoustical ceiling systems shall provide a NRC of 0.70 or higher.
- D. Ceiling Attenuation Class (CAC): Where CAC ratings are indicated or required by authorities having jurisdiction, provide materials and construction which are identical to assemblies whose CAC ratings have been tested in accordance with ASTM E 1414 by Underwriters Laboratories, Inc.
- E. Light Reflectance (LR): Where LR rating is indicated or required by authorities having jurisdiction, provide materials and construction which are identical to assemblies whose LR rating has been tested in compliance with ASTM C 523 by independent agencies acceptable to the Architect and authorities having jurisdiction.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing manufacturer's name, brand names, type of material, and contents.

- B. Store materials in interior spaces, above floors, under cover, away from sweating walls and other damp surfaces. Provide ventilation.
- 1.08 PROJECT CONDITIONS, SEQUENCING, AND SCHEDULING
- A. Environment: Perform work only when temperature and humidity conditions are within the limits established by manufacturers of the materials and products used.
 - B. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
 - 1. Proceed with installation of ceiling only when construction above ceilings and penetrating work is complete. Delay installation of ceiling tiles or panels until near time of Substantial Completion.
 - 2. Perform work of this Section coordinated with the layout of light fixtures, HVAC equipment and fixtures, fire suppression system components and all other related work. In general, every penetration shall occur at the center of a ceiling tile or panel.
- 1.09 EXTRA MATERIAL
- A. Provide packaged, wrapped and labeled maintenance stock equal to 2% of the actual quantity installed (minimum of one box of panels) for the following items of work:
 - 1. Each type of ceiling panel.
 - 2. Each type of suspension system component.
 - 3. Each type of trim component.
- PART 2 PRODUCTS
- 2.01 SUSPENSION SYSTEM
- A. Provide products of the following manufacturer that meet or exceed requirements specified:
 - 1. Armstrong World Industries, Inc. (Armstrong).
 - 2. Chicago Metallic Corp.
 - 3. USG Interiors, Inc. (USG).
 - B. Exposed Suspension Systems - General
 - 1. Where fire rated assembly is indicated, provide a fire-rated ceiling suspension system manufactured by one of the above-named manufacturers.
 - 2. Provide grid modules to match ceiling panel sizes.
 - 3. Unless otherwise indicated, provide manufacturer's standard white baked enamel finish on steel exposed surfaces.
 - C. Suspension System Types: Provide the following suspension system types:
 - 1. Exposed Grid Suspension System Type 1a (GR-1a) – Non-rated interior grid system indicated for 2 ft. x 4 ft. grid: Standard non-rated, 15/16 in. exposed "tee" 2 ft. x 4 ft. double-web hot dipped galvanized steel suspension system, equal to Armstrong 'Prelude XL Suspension System', 15/16 in. Exposed Tee, manufactured by Armstrong World Industries.
 - a. Main grid shall be Armstrong 7300 Series Main Grid.
 - b. Cross tees shall be Armstrong XL-7342 Cross Tees.

2. Exposed Grid Suspension System Type 1b (GR-1b) – Non-rated interior grid system indicated for 2 ft. x 2 ft. grid: Standard non-rated, 15/16 in. exposed "tee" 2 ft. x 2 ft. double-web hot dipped galvanized steel suspension system, equal to Armstrong 'Prelude XL Suspension System', 15/16 in. Exposed Tee, manufactured by Armstrong World Industries.
 - a. Main grid shall be Armstrong 7300 Series Main Grid.
 - b. Cross tees shall be Armstrong XL-7342 Cross Tees.
 3. Exposed Grid Suspension System Type 2a (GR-2a) – Fire-rated interior grid system indicated for 2 ft. x 4 ft. grid: Fire rated 15/16 in. exposed "tee" 2 ft. x 4 ft. double-web hot dipped galvanized steel suspension system, equal to Armstrong 'Prelude XL Fire Guard Suspension System', 15/16 in. Exposed Tee, manufactured by Armstrong World Industries.
 - a. Main grid shall be Armstrong 8300 Series Main Grid.
 - b. Cross tees shall be Armstrong XL-8340 Cross Tees.
 4. Exposed Grid Suspension System Type 2b (GR-2b) – Fire-rated interior grid system indicated for 2 ft. x 2 ft. grid: Fire rated 15/16 in. exposed "tee" 2 ft. x 2 ft. double-web hot dipped galvanized steel suspension system, equal to Armstrong 'Prelude XL Fire Guard Suspension System', 15/16 in. Exposed Tee, manufactured by Armstrong World Industries.
 - a. Main grid shall be Armstrong 8300 Series Main Grid.
 - b. Cross tees shall be Armstrong XL-8340 Cross Tees.
- D. Attachment Devices: Provide attachment devices sized for five times design load indicated by ASTM C 635, Table 1, for Direct Hung.
- E. Hanger Wire: ASTM A 641, galvanized, soft temper, prestretched, Class 1 Coating, minimum 12 gage. Size wire so that stress at three times hanger design load given in ASTM C 635, Table 1, Direct Hung, will be less than the yield stress of the wire.
- F. Moldings and Trim: Provide manufacturer's standard profiles to suit edge conditions, panel profile and penetrations.
1. At ceiling perimeters provide Armstrong's 'Shadow Molding' finished to match suspension system finish.
- 2.02 ACOUSTICAL PANEL
- A. Provide ceiling panel products of the following manufacturer that meet or exceed requirements specified:
1. Armstrong.
 2. USG Interiors.
- B. Interior Ceiling Panels: Provide the following ceiling panel products:
1. Acoustical Ceiling Panel Type 1 (ACT-1): Panel shall match existing.
 2. Acoustical Ceiling Panel Type 2 (ACT-2): 24 in. x 48 in. panel x 3/4 in. thick, square edge, lay-in wet-formed mineral fiber ceiling panel with DuraBrite acoustically transparent membrane and fine texture, equal to Armstrong World Industries "Ultima Square Lay-In Edge, Item No. 1913. Panel shall have the following characteristics:

- a. Light Reflectance: LR 0.75 according to ASTM E 1477.
 - b. Flame Spread Rating: Class A (UL Labeled) according to ASTM E 84.
 - c. Noise Reduction Coefficient (NRC): 0.70, according to ASTM C 423.
 - d. CAC: 35.
 - e. Color: White.
3. Acoustical Ceiling Panel Type 3 (ACT-3): 24 in. x 24 in. panel x 3/4 in. thick, beveled regular edge, lay-in wet-formed mineral fiber ceiling panel with DuraBrite acoustically transparent membrane and fine texture, equal to Armstrong World Industries "Ultima Square Lay-In Edge, Item No. 1910. Panel shall have the following characteristics:
- a. Light Reflectance: LR 0.75 according to ASTM E 1477.
 - b. Flame Spread Rating: Class A (UL Labeled) according to ASTM E 84.
 - c. Noise Reduction Coefficient (NRC): 0.70, according to ASTM C 423.
 - d. CAC: 35.
 - e. Color: White.

PART 3 EXECUTION

3.01 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work will be performed and notify Contractor in writing, of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.02 PREPARATION AND INSTALLATION - GENERAL

- A. General: Strictly comply with manufacturer's recommendations and instructions.
- B. Conditioning: Condition acoustical ceiling materials to temperature and humidity conditions which approximate those that will be present when spaces are occupied by unpackaging and separating material at least 24 hours prior to installation.
- C. Exterior doors and windows shall be in place and glazed prior to ceiling installation. Cleaning, concrete, masonry, plaster, and other "wet-work" shall be complete and dry. A minimum temperature of 65°F. shall be maintained before, during, and after the installation of acoustical work.
- D. Coordination: Coordinate installation with other work to ensure proper locations of related work such as light fixtures, mechanical fixtures, fire protection systems and the like.
- E. Layout: Measure each area and layout ceilings to balance panel widths on opposite edges of each ceiling in both directions. Avoid use of less than 1/2 width ceiling units wherever possible.
- F. Suspension Installation: Erect suspension system in accordance with ASTM C 636, supported only from building structure. Level main suspension members to within tolerance of 1/8 in. in 10 ft. Splay hangers where necessary and countersplay to balance resulting horizontal forces. Cross brace suspension to prevent lateral sway and displacement during full seismic loads prescribed by code.
- G. Install acoustical units flush and level with joints in perfect alignment. Maintain direction of pattern and "mill-run" of acoustical units in one direction.

- H. Finish acoustical ceilings and decorative trim shall be level to within 1/8 in. in 10 ft. with total accumulated error not to exceed 1/2 in. or L/960 of overall ceiling dimension, whichever is smaller, in any room or area.
 - I. Use white, clean gloves when handling ceiling materials.
- 3.03 INSTALLATION OF SUSPENDED EXPOSED "TEE" LAY-IN PANEL SYSTEM
- A. Install exposed "Tee" suspension system where indicated, in accordance with ASTM C 635
 - B. Secure hanger anchors symmetrically to structure above areas to receive "Narrow 9/16 in. Tee" suspension grid, locating the hangers in rows directly above exposed main "Tees". Install main "Tees" at proper elevation with manufacturer's recommended ties. Install cross "Tees" 2 ft. on center, developing a 2 ft. x 4 ft., or a 2 ft. x 2 ft. grid as indicated. Install wall moldings at perimeter walls and columns where main or cross "tees" do not occur, or as otherwise called for on the Drawings. Miter corners where wall molding intersect or install corner caps.
 - C. Perimeter Molding: Install Shadow Molding at perimeter as indicated in accordance with manufacturer's recommendations.
 - D. After installation of the exposed "Tee" suspension system, install acoustical panels flush and level, with panel grain in single direction. Where ACT is cut to fit, provide cut edge to match profile of factory edge; field finish cut edge with manufacturer's recommended touch-up.
 - E. Where existing ceiling grid and acoustical panels are to be removed to allow for renovation work and for work above ceiling system; existing grid and panels shall be removed and replaced following renovation. Where panels or grid system are damaged, replace with new to match.
- 3.04 CLEANING
- A. Protect the work of other trades and work of this Section already installed against soiling and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged or soiled.

END OF SECTION

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Division 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.02 WORK INCLUDED

- A. Work Included: Provide all labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Provide painting and finishing work throughout interior of Project as indicated and scheduled on the Drawings and as specified. Include all required touch up painting of painted surfaces and new penetrations exposed to view and as required to restore painted finished surfaces to original condition to adjacent surfaces. Generally the following are areas where painting will be required:
 - a. Any recoating or touch up required due to the removal of the existing HVAC equipment, ductwork, and ceiling grid and subsequent new installations including recoating of any wall, ceiling, and soffit areas and surfaces damaged to match.
2. Examine Contract Documents to determine full extent of painting and finishing work required. Materials provided under other Sections that need painting or finishing and are left unfinished under requirements of other Specification Sections, shall be painted and finished to completion under work of this Section, unless specifically scheduled herein to be left unfinished.
3. Preparatory work of materials and surfaces to receive paint beyond that specified to be done as work of other Sections, shall be included as work of this Section.

- B. Painting Contractor shall be responsible for insuring that all coatings and the application of all coatings conform to all federal, state, and local regulations, including VOC/VOS rules at the time of application.

- C. Unless otherwise indicated, all paint materials, paint colors, and paint finishes (gloss), etc. shall match existing Town of Hopkinton Building Standards.

1.03 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 01 73 10, CUTTING AND PATCHING.
2. Section 02 41 19, SELECTIVE DEMOLITION.
3. Section 06 10 50, MISCELLANEOUS CARPENTRY; Wood nailers and blocking.
4. Section 07 53 00, ROOFING OF ROOF PENETRATIONS AND EQUIPMENT; Flashing and patching of existing roof as required for new rooftop equipment including rooftop units, curbs, ductwork, and accessories.

5. Section 09 51 00, ACOUSTICAL CEILINGS; Replacement of ACT ceilings.
6. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).

1.04 QUALITY ASSURANCE

- A. Source: Provide primers and undercoat paint produced by same manufacturer of finish coats for each substrate.
- B. Coordination: Review other Specification Sections where primers are provided to ensure compatibility with finish coatings provided under this Section.
- C. The painting subcontractor shall submit qualifications indicating his experience as a painting contractor. These qualifications shall include a list of projects successfully completed, similar in size and scope to this Project.

1.05 PROJECT CONDITIONS

- A. Maintain indoor temperature at 65°F. during application and drying of paints.
- B. Substrates: Proceed with work only when substrate construction and penetration work is complete.
- C. Lighting: Since lighting conditions can alter appearances of finish painting work, perform work of this Section under lighting conditions simulating permanent lighting system to the greatest extent possible.
- D. Where painting operations require the use of interior paints and coatings which are not latex or acrylic based materials (i.e. solvent-based materials) or paint or coating materials which when applied will produce fumes or vapors which may adversely affect the occupants of the building, the Contractor shall schedule this painting work (applying solvent-based or oil-based paints and coatings) during premium time (overtime), at no additional cost to the Owner, so as not to affect other contractors working on-site.
- E. A room shall be assigned for the storage of painting tools and materials. The floor shall be properly protected with drop cloths or building paper. Paint shall be mixed in suitable containers, and necessary precautions shall be taken to prevent fire. This room shall be locked at the completion of each day's work. The Contractor shall have duplicate keys.
- F. Protect all adjacent surfaces from damage by paint and provide all drop cloths and masking to accomplish the same.
- G. Do not use any plumbing fixture or pipe for the disposal of waste materials. Carry all water required to the mixing room and dump all waste materials in containers outside the building. Remove oily rags and other combustible waste materials from the building daily.
- H. Removal of Accessories
 1. The General Contractor will remove and replace all finished hardware applied to doors, except butts, and shall be responsible for the removal and replacement of all accessories, plates and fixtures of other trades, as necessary for the satisfactory completion of work under this Section.
 2. Doors already in place shall be removed and the top and bottom edges finished with two coats of specified finish applied prior to finishing face of doors. Doors shall be replaced after edges are dry.
 3. In no case shall there be any attempt to paint around finish hardware or other new or existing removable items which are already in place.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products in accordance with Section 01 60 00, PRODUCT REQUIREMENTS.
- B. Deliver materials in unopened original containers bearing manufacturer's labels.
- C. Store materials in fully sealed containers, outside the building, preferably in exterior storage shed, well ventilated, and with a minimum ambient temperature of 45°F. Oily rags and waste must be removed from the building every night, and under no circumstances will be allowed to accumulate. Each space containing stored paint materials shall be provided with UL labeled fire extinguisher of suitable type, class, and capacity.

1.07 COORDINATION

- A. Work under this section shall be properly coordinated with the work of other sections to assure the steady progress of all the work of the Contract.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- B. High Performance Paints/Coatings: Provide products of one of the following manufacturers that meet or exceed specified requirements:
 - 1. DuPont.
 - 2. Tnemec Company, Inc. (Tnemec).
 - 3. International Protective Coatings (IPC).
- B. Architectural Paint Coatings: Provide products of one of the following manufacturers that meet or exceed specified requirements:
 - 1. Benjamin Moore & Co. (Benjamin Moore).
 - 2. ICI Dulux Paint Centers (ICI Dulux Paints).
 - 3. PPG Industries, Inc. (Pittsburgh Paints).
 - 4. Sherwin-Williams Co. (Sherwin-Williams).

2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

- D. Colors: To match existing.
- E. Assume full responsibility for proper performance of materials, for method of application, and for compatibility of materials applied over shop coats or other coats previously applied, including but limited to primers, sealers, preservative treatments, etc.

2.03 INTERIOR FINISH COATS

- A. Interior Semi-Gloss Acrylic Enamel: Factory-formulated semi-gloss acrylic-latex enamel for interior application.
 - 1. Benjamin Moore; Moorcraft Super Spec Latex Semi-Gloss Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils;
 - 2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils;
 - 3. Pittsburgh Paints; 6-500 Series SpeedHide Interior Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.0 mil;
 - 4. Sherwin-Williams; ProMar 200 Interior Latex Semi-Gloss Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.
- B. Interior Eggshell Acrylic Enamel: Factory-formulated eggshell acrylic-latex enamel for interior application.
 - 1. Benjamin Moore; Moorcraft Super Spec Latex Enamel No. 276: Applied at a dry film thickness of not less than 1.2 mils;
 - 2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Eggshell Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils;
 - 3. Pittsburgh Paints; 6-500 Series SpeedHide Interior Eggshell Latex: Applied at a dry film thickness of not less than 1.0 mil;
 - 4. Sherwin-Williams; ProMar 200 Interior Latex Eggshell Enamel B31W200 Series: Applied at a dry film thickness of not less than 1.3 mils.

PART 3 - EXECUTION

3.01 INSPECTION AND GENERAL PREPARATION

- A. Inspect surfaces to receive finishes to ensure they are in proper condition to receive work under this Section.
- B. If surfaces are not thoroughly dry, or if surfaces cannot be put in proper condition to receive paint or other finish by customary cleaning methods, sanding, or spackling, notify Architect in writing.
- C. Commencing work on any surface will be construed as acceptance of the surface as being satisfactory to properly receive the work of this Section.
- D. Furnish and lay drop cloths in all rooms and areas where painting and finishing is being done, to adequately protect flooring and other work from all damage during the painting work.
- E. Remove hardware, accessories, device plates, lighting fixtures, factory finished work, and similar items; or provide ample in-place protection. Use skilled mechanics for removal, resetting, and protection.
- F. Cleaning: Do not paint over dirt, dust, rust, grease, moisture, or other contaminants detrimental to the formation of a durable paint finish. Clean surfaces thoroughly prior to painting in any given area.

- G. Touch up bare or abraded spots on surfaces with shop or existing finishes scheduled to be painted under this Section. Use same material used for shop coat. Substrate shall be smooth, free from raised grain; putty sags, cracks, rust, grease, dirt, or other foreign matter or defect.
- H. Incompatible Shop Primers: Remove incompatible shop primers and reprime surfaces, or provide barrier coats in compliance with finish paint manufacturer's instructions.

3.02 SURFACE PREPARATION

- A. Prepare surfaces to receive work of this Section in strict accordance with manufacturer's instructions applicable to each material, condition, and finish.
- B. Gypsum Wallboard: Fill holes, dents, and similar flaws in gypsum wallboard with joint compound. Cut out and fill cracks. Sand surface of patch smooth and flush with adjacent surfaces. Do not abrade adjacent surfaces. Patched areas shall not be detectable in finished work. Patch and sand all areas requiring finishes.
- C. Wood to be Painted: Sand surfaces smooth and free of marks prior to applying first coat. Wash sap spots and knots with mineral spirits. When dry, touch-up spots and knots with an approved sealer for exterior work, and with two coats of shellac for interior work.
 - 1. Fill nail holes, cracks, open joints, and other defects, with putty or plastic wood filler. Sand smooth when dry.
 - 2. Prime tops, edges, and bottoms, of unprimed wood doors immediately upon delivery. Prime hardware cut-outs in similar manner prior to installation of butts, locks, and closers.
 - 3. Prime wood edges, ends, faces, undersides, backsides, including cabinets, casework, paneling, and moldings and trim.
- D. Masonry: Surface shall be clean, dry, and free of any dust, dirt, or foreign material.
- E. Field-Welded Metal: After installation, field-welding, and grinding, and immediately before painting, remove rust, loose mill scale, dirt, weld flux, weld spatter, weld smoke stains, burnt primer, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP 3. Remove grease and oil by use of solvent recommended by paint manufacturer. Sand exposed surfaces, and between coats, as required to produce smooth, even finishes.
 - 1. Sand smooth and spot prime welded areas, and areas where prime coat has been damaged or abraded, using rust inhibitive primer scheduled in this Section.
- F. Other Ferrous Metal: Remove rust, mill scale, and foreign materials. Wire brush or sand damaged or rusted area to bright metal. Remove grease or dirt with solvents recommended by paint manufacturer just prior to applying paint.
 - 1. Spot prime all areas where shop coat has been damaged or abraded, using same type paint as used for shop coat.
- G. Field-Welded Galvanized Metal: After installation, field-welding, and grinding, and immediately before painting, remove rust, loose mill scale, dirt, weld flux, weld spatter, weld smoke stains, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP 3. Remove grease and oil with solvents recommended by paint manufacturer. Sand exposed surfaces, and between coats, as required to produce smooth, even finishes.

1. Sand smooth welded areas, and areas where galvanized coating has been damaged or abraded. Spot prime using zinc primer scheduled in this Section.
- H. Other Galvanized Metal: Prior to installation, remove corrosion and foreign materials by sanding or other appropriate method. Remove grease or dirt with solvent recommended by paint manufacturer just prior to applying primer.
- I. Other Non-Ferrous Metal: Prepare shop primed non-ferrous metals similarly to ferrous metals, specified above.
 1. Prepare unprimed non-ferrous metals by thoroughly cleaning of oil, grease, and temporary protective coatings using solvent recommended by primer manufacturer. Provide additional pretreatment recommended by primer manufacturer to assure permanent adhesion of paint coats.
- J. Other Materials: Prepare other materials in strict accordance with recommendations of manufacturers of materials to be finished, and primers and finishes to be applied.
- K. Materials Preparation: Mix and prepare paint materials in accordance with manufacturer's printed instructions. Use only thinners approved by paint manufacturer, and only within recommended limits.

3.03 APPLICATION

- A. Painting Schedule in this Section lists minimum number of coats required. If specified minimum number of coats does not completely cover or hide base materials, provide additional coats required for coverage and uniform finish appearance, without additional cost to the Town.
- B. Apply paint in strict accordance with manufacturer's instructions. Use applicators and techniques best suited for substrates and types of materials being applied. No material shall be thinned in any way except as directed by manufacturer.
 1. Workmanship shall be of the highest quality. Only skilled workmen shall be employed. All materials shall be applied under adequate illumination, evenly spread and smoothly flowed on without runs or sags. All work not conforming to the specifications shall be cleaned off and repainted at the expense of the Painting Contractor.
 2. Do not apply initial coating until moisture content of surface is within limitations recommended by manufacturer and surface is prepared in conformance with specifications and manufacturers recommendations.
 3. All materials shall be applied in accordance with the manufacturer's directions as printed on container and any thinning required shall be done in the manner and exclusively with the type of reducer recommended.
 4. No painter's finish shall be applied until the preceding coat is thoroughly dry and in no case less than two (2) days for interior work, unless manufacturer of the paint material in question specifically directs otherwise.
 5. Finishing materials shall be free from skins, lumps or any foreign matter when used and shall be kept well stirred while being applied. Each coat shall be evenly brushed out.
- C. Apply paints and coatings at coverage rates and dry film thicknesses scheduled at the end of this Section. Each coat applied must be inspected and approved by Architect prior to application of succeeding coat, otherwise no credit for the coat applied will be given and work in question shall be recoated without additional expense to the Town. Notify Architect when each coat is ready for inspection.

- D. Additional Coats: Provide additional coats necessary to eliminate show through and bleed through conditions.
- E. Drying Time: Allow manufacturer's recommended drying time between successive coats. However, allow each coat to thoroughly dry prior to application of subsequent coat.
- F. Sanding: Lightly sand finishes between coats using #00 sandpaper.
- G. Finished work shall be free from runs, sags, hairs, defective brushing, and clogging of lines and angles. Flaws visible in the completed work shall be removed and the area satisfactorily repaired.
- H. Mechanical and Electrical Work: Painting of mechanical and electrical items is limited to items exposed to view in the mechanical rooms and in occupied areas.
 - 1. Mechanical items to be painted include, but are not limited to:
 - Insulation
 - Piping, hangers, and supports.
 - 2. Electrical items to be painted include but are not limited to:
 - Conduit and fittings.
- I. Completed Work: Provide finishes that match approved samples and mock-ups for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.04 COMPLETION

- A. Cleaning: At completion of work of this Section, remove paint and varnish spots, and oil, grease, and other stains caused by this work from exposed surfaces. Leave finishes in a satisfactory condition.
- B. At completion of work of this Section, remove masking materials and other debris. Reinstall or replace fixtures, plates, etc., removed to facilitate application of paint.
- C. Retouching: Touch-up and repair applied finishes which, for any reason have been damaged during construction work. All finished work applied under this Section shall have finished surfaces as approved by finish material manufacturer.
- D. Final Inspection: Protect painted surfaces against damage until date of Substantial Completion. Architect will conduct final inspection of painting work. Areas that do not comply with requirements of these Specifications shall be repainted or retouched to satisfaction of Architect at no additional cost to the Owner.
- E. Paint Schedule: Prepare Schedule which includes a schedule identifying paint manufacturer, paint type, paint color, and gloss for each painted surface in each room. Said Schedule shall be sufficiently detailed to permit the Owner to use this Schedule for future maintenance, repainting, and reordering of paints and coatings.

3.05 SURFACES NOT TO BE FINISHED

- A. Finishes for the following items are either included under other appropriate Sections or require no painting, except as otherwise specifically scheduled with subsequent Schedules.

1. Chrome or nickel plating, stainless steel, bronze, brass, and aluminum other than mill finished, unless otherwise specified.
2. Factory finished mechanical and electrical equipment, pumps, and machinery, which occur in mechanical or equipment rooms or areas.
3. Galvanized ducts, pipes, conduits, etc., occurring within mechanical areas or spaces. Also all such items fully concealed from view in the finished work (except items located above open cell ceilings in corridors).
4. Factory finished materials, specialties, and accessories unless otherwise specified.

3.06 PAINT SCHEDULE

- A. Painting of Interior Surfaces: Important Note: Notwithstanding anything in the following schedule to the contrary, interior painting and finishing shall conform to the applicable laws and building code regarding fire hazard classifications of finish materials.
- B. Paint Schedule: Provide primer and finish coats to match existing color, sheen, and finish and to provide full coated surfaces to match adjacent surfaces.
 1. It is the intent that painting is limited to repair of any painted surfaces damaged as a result of the work of this Contract and any new work under this Contract where painting is required for exposed to view surfaces where penetrations were made.

END OF SECTION

SECTION 23 00 01

HEATING, VENTILATING AND AIR CONDITIONING (HVAC)

(Filed Sub-bid Required)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.2 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Time, Manner and Requirements for Submitting Sub-Bids:

- 1. Sub-bids for work under this Section shall be for the complete Work of this Section and shall comply with the requirements of M.G.L., c. 149, §44F. and shall be filed in a sealed envelope with the TOWN OF HOPKINTON at a time and place as stipulated in the "INVITATION FOR BIDS".

The following should appear on the upper left hand corner of the envelope:

Name of Sub-Bidder: _____

Project: TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

Sub-Bid for Section: 23 00 01, HEATING, VENTILATING AND AIR CONDITIONING
(HVAC)

- 2. Each sub-bid submitted for work under this Section shall be on forms furnished by the AWARDING AUTHORITY as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms are included in this Project Manual or may be obtained at the office of the Architect.
- 3. Sub-bids filed with the AWARDING AUTHORITY shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the TOWN OF HOPKINTON in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

1.3 SUB-BID REQUIREMENTS

A. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.

1. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that subtrade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the AWARDDING AUTHORITY that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

CLASS OF WORK	REFERENCE PARAGRAPHS
DIV-23	Section 23 05 93 - Testing, Adjusting, and Balancing
DIV-23	Section 23 25 00 - Chemical Water Treatment
DIV-23	Section 23 07 13 - Duct Insulation
DIV-23	Section 23 07 19 - HVAC Piping Insulation
DIV-23	Section 23 31 00 - Sheet Metal Work and Accessories
DIV-25	Section 25 00 00 - Integrated Automation

1.4 DESCRIPTION OF WORK

A. Furnish, transport, store, install, test, calibrate and mark all materials and equipment required for complete and functional heating, ventilating and air conditioning systems as described in these Specifications and as shown on the drawings for the Hopkinton Fire Department Headquarters, Town of Hopkinton, Fire Station HVAC Upgrade project at 73 Main St, Hopkinton, Ma. 01748.

1. Work Included: Provide labor, materials and equipment necessary to complete the Heating, Ventilating, and Air Conditioning (HVAC) work, including but not limited to the following:

a. Division 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC):

- 1) Section 23 00 01 - General Requirements and Special Conditions
- 2) Section 23 05 00 - Basic Materials and Methods
- 3) Section 23 05 10 - Selected HVAC Demolition
- 4) Section 23 05 13 - Motors and Controllers
- 5) Section 23 05 14 - Variable Frequency Drives
- 6) Section 23 05 16 - Pipe Expansion
- 7) Section 23 05 19 - Hydronic Piping Specialties
- 8) Section 23 05 25 - HVAC Valves and Strainers
- 9) Section 23 05 29 - Hangers and Supports
- 10) Section 23 05 53 - Mechanical Identification
- 11) Section 23 05 93 - Testing, Adjusting, and Balancing
- 12) Section 23 05 99 - Mechanical Vibration Controls
- 13) Section 23 07 13 - Duct Insulation
- 14) Section 23 07 19 - HVAC Piping Insulation
- 15) Section 23 20 02 - HVAC Piping and Joints

- 16) Section 23 20 10 – Refrigerant and Cooling Condensate Piping
- 17) Section 23 25 00 – Chemical Water Treatment
- 18) Section 23 31 00 – Sheet Metal Work and Accessories
- 19) Section 23 37 00 – Registers, Grilles and Diffusers
- 20) Section 23 37 23 - Roof Accessories
- 21) Section 23 39 00 - Fans and Accessories
- 22) Section 23 41 00 - Filters
- 23) Section 23 74 13 - Packaged Rooftop Air Conditioning Units
- 24) Section 23 82 16 - Coils
- 25) Section 23 82 40 - DX Mini-Splits

b. Division 25 – INTEGRATED AUTOMATION:

- 1) Section 25 10 00 – Direct Digital/Automatic Temperature Controls
- 2) Section 25 20 00 - Schedules
- 3) Section 25 50 00 – Instrumentation Terminal Devices
- 4) Section 25 60 00 - Sequences of Operation

A. Alternates:

1. **DEDUCT ALTERNATE No 1**

- a. **Provide a Deduct Alternate Bid Price to remove the new HVAC RTU-2 system costs from the current scope. RTU-2 to be installed later as determined by the "Town of Hopkinton, MA". Deduct Alternate No1 to include demolition, new ductwork, RHC's, piping, valves supports, VFD's, roof adapter curbs, bipolar generator, HWS/R & CD piping systems, insulation systems, power, ATC controls, TAB & Commissioning. Existing RTU-2 system & appurtenances to remain.**

2. **DEDUCT ALTERNATE No 2**

- a. **Provide a Deduct Alternate Bid Price to remove the new HVAC RTU-3 system costs from the current scope. RTU-3 to be installed later as determined by the "Town of Hopkinton, MA". Deduct Alternate No2 to include demolition, new ductwork, RHC's, piping, valves supports, VFD's, roof adapter curbs, bipolar generator, HWS/R & CD piping systems, insulation systems, power, ATC controls, TAB & Commissioning. Existing RTU-3 system & appurtenances to remain.**

C. Items to Be Installed Only: Not Applicable

D. Items To Be Furnished Only: Not Applicable.

E. Reference To Drawings: Work specified in HEATING, VENTILATING, AND AIR CONDITIONING (HVAC) is subject to provisions of Section 44A to 44L inclusive, of Chapter 149 of General Laws of the Commonwealth of Massachusetts, as amended, and are indicated on the following Contract Drawings:

1. HVAC (H- Series and HD- Series) DRAWINGS:

- a. Drawings H-000, H-001, H-002, H-003, H-101, H-102, H-102P, H-103, HD-101, HD-102, HD-102P, HD-103.

2. This Subcontractor shall carefully inspect all Drawings, not just those pertaining particularly to his sub-trade unless specifically called for otherwise, regardless of where among the Drawings it appears.
- F. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. For work related to and to be coordinated with the HVAC work, but not included in this Section, and required to be performed under other designated Sections or Divisions, see the following:
 - 1) Division 01 – General Requirements
 - 2) Division 02 – Existing Conditions
 - 3) Division 05 – Metals
 - 4) Division 06 – Wood, Plastics and Composites
 - 5) Division 07 – Thermal and Moisture Protection
 - 6) Division 09 – Finishes
 - 7) Division 23 – Heating, Ventilating and Air Conditioning
 - 8) Division 25 – Integrated Automation
 - 9) Division 26 – Electrical and Fire Alarm
- G. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
1. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 2. Division 25 - INTEGRATED AUTOMATION
 3. Division 26 – ELECTRICAL AND FIRE ALARM
- H. The following work is not included under this Section and will be performed under the Sections indicated:
- 1) By Others:
 - a. Temporary heating & cooling rental services.
 - b. Finish, seals & painting.
 - c. Cutting and patching.
 - d. Concrete equipment pad & bollards
 - e. Architectural roofing, walls & RCP repairs.
 - f. Hazmat testing & removal.
 - 2) By Division 26 - ELECTRICAL:
 - a. All emergency power connections.
 - b. All electrical power wiring and connections and all disconnect switches not provided with or as integral parts of the HVAC equipment.
 - c. All other line voltage, low voltage, and interlock wiring, including transformers, required for the automatic control system, shall be provided by the ATC Contractor under this Section. All controls shall be provided with emergency battery back-up power.
- 1.5 DESCRIPTION OF SYSTEMS
- A. Systems and equipment to be furnished and installed include, but are not limited to the following:

- 1) Limited demolition of HVAC equipment, ductwork, piping, insulation systems and ATC controls.
- 2) Refrigerant reclamation of existing HVAC systems.
- 3) Hazmat ACM – Asbestos Containing Material testing and ACM removal (by others)
- 4) One 3-ton supplemental heating & cooling refrigerant split system air conditioning unit (AC-1) and exterior roof mounted heat pump (HP-1) condensing unit, with packaged ATC controls, refrigerant piping systems, and supports to serve the Dispatch Command Control Center.
- 5) One 1-ton supplemental heating & cooling refrigerant split system air conditioning unit (AC-2) and exterior roof mounted heat pump (HP-2) condensing unit, with packaged ATC controls, refrigerant piping systems and supports to serve the Fire Chief/Lieutenant's Office.
- 6) Four roof mounted packaged AHU's (RTU-1, RTU-2, RTU-3 & RTU-4) with factory packaged DDC ATC controls, hot gas re-heat coils, supply fans, relief exhaust fans, VFD's, electrical disconnect switches, acoustical treatments, exterior insulated & jacketed ductwork systems, MERV-8 & MERV-13 filters, intake & relief hoods w/screens and supports.
 - a) RTU-1,2, & 3 will be provided with insulated adapter curbs to be mounted onto the existing curbs including all gaskets, galvanized attachments, and flashing water seals.
 - b) RTU-4 will be provided with a new insulated, acoustical treated, spring vibration isolated, roof curb with all gaskets, galvanized attachments, and flashing water seals.
- 7) Seven (7) Glycol Hot Water Heating Coils with flanges, supports, piping, valves, insulation, instrumentation, controls, and 35% inhibited Propylene Glycol charged water systems.
- 8) ATC DDC BAS control systems, programmable thermostats, low voltage wiring electrical panels, controllers, routers etc. New DDC Temperature Controls with BACnet MS/TP capabilities along with Status & Alarm controls, full integration with existing systems, including new communication devices, sequences, start up and commissioning.
- 9) Eight (8) Bipolar Ionization Generators with 120V power, duct mounted & tested.
- 10) RGD's, WMS, ACD control dampers, VD's, vibration controls, ductwork, cooling condensate drainage pumps & piping systems, duct & pipe insulation systems, firestopping & water-proof penetration seals.
- 11) Three (3) Exhaust fans (EF-2, EF-10 & EF-12) with NEMA-3R electrical disconnect switches, insulated roof curbs, dampers, ATC DDC controls and exhaust ductwork systems.
 - a) EF-2 will be provided with a VFD, and inverter duty rated motor.
 - b) EF-10 & EF-12 will be provided with ECM motors.
- 12) HVAC equipment, controls, ductwork & piping support systems.
- 13) Flashing, counterflashing, & roof seals (coordinated with Architect & Roofing Contractor).
- 14) Sheet metal work and accessories. New ductwork and reconnection to existing ductwork systems. Ductwork pressure testing.
- 15) Interior & exterior ductwork & piping insulation & jacketing systems
- 16) DXS/DXL R410A refrigerant piping, instrumentation, valves, fittings & appurtenances. Refrigerant R410A charging.
- 17) Interior HVAC equipment, ductwork, and piping supports.
- 18) Access panels, ACD control dampers, & VD/BDD dampers
- 19) Exterior duct & piping supports and exterior piping insulation & jacketing systems.
- 20) Testing, Adjusting and Balancing services.

- 21) HVAC systems startup and commissioning.
- 22) Electrical equipment, panels, starters, disconnects, transformers, motors, controllers, smoke detectors, carbon monoxide sensors, wiring, lighting, outlets, & conduits. (By Div. 26)
- 23) Owner's Training
- 24) Submittal Shop drawings
- 25) Coordination drawings
- 26) Operating & Maintenance Manuals
- 27) Record drawings
- 28) Warrantees
- 29) Temporary Heating & Cooling Rental Services
- 30) Temporary Crane Lift, Equipment Rigging, Scaffolding, Scissor Lift, Man Lift & Tool Rental Services.
- 31) Security Fencing, Signage, Dust Control & Dumpster Rental Services.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

END OF SECTION

SECTION 23 05 00

BASIC MATERIALS AND METHODS

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 PROVISIONS INCLUDED

- A. Include General Conditions, Supplementary General Conditions Division 0 and applicable parts of Division 01 for conditions and requirements which may affect the work of this Section.
- B. Examine all other Sections of the specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all other Trades affecting or affected by work of this Section. Cooperate with such Trades to ensure the steady progress of all work under the Contract.

1.2 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

Division 23 - HEATING, VENTILATING & AIR CONDITIONING (HVAC)
Division 25 - INTEGRATED AUTOMATION
Division 26 - ELECTRICAL
Division 28 - FIRE ALARM

1.3 DEFINITIONS

- A. Words in the singular shall also mean and include the plural, wherever the context so indicates and words in the plural shall mean the singular, wherever the context so indicates.
- B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
- C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.

- D. Wherever the term "material" is used in the specifications it will mean any product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- E. The terms "approved", or "approval" shall mean the written approval of the Architect.
- F. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- G. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed" and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect. The terms "approved", "acceptable", "satisfactory" and similar words shall mean approved by, acceptable or satisfactory to the Architect. The terms "necessary", "reasonable", "proper", "correct" and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.
- H. "Piping" includes in addition to pipe or mains, all fittings, flanges, unions, valves, strainers, drains, hangers and other accessories relative to such piping.
- I. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.
- J. "Exposed" means not installed underground or "concealed" as defined above.
- K. "Invert Elevation" means the elevation of the inside bottom of the pipe.
- L. "HVAC" shall refer to the Contractor or his Subcontractors responsible for furnishing and installation of all work indicated on the HVAC drawings and specifications, as applicable and or referenced to each Trade in the Architectural and/or Structural documents.
- M. "Mechanical Contractor" shall refer to the HVAC, TAB and ATC Sub-Contractors, as applicable.
- N. "Architect" shall refer to the Architect "Gorman Richardson Lewis Architects" and/or Engineer "R.W. Sullivan Engineering" and/or Owner.
- O. "Owner" shall refer to the designated representatives of the Project Owner.
- P. "General Contractor" shall refer to the General Contractor (GC) "To be named at a later date" for this project.

1.4 CODES, STANDARDS AND REFERENCES

- A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.
- B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the Mechanical Contractor, as applicable, shall promptly notify the Architect in writing of any such difference.

- C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern for budgetary purposes. However, no work will proceed until the Architect determines the correct method of installation.
- D. Should any Contractor, as applicable, perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect.
- E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations and the applicable requirements of the following accepted Codes and Standards, without limiting the number, as follows:
 - 1. National Electrical Code (NEC)
 - 2. Environmental Protection Agency (EPA)
 - 3. MA- Environmental Air Quality Protection Agency
 - 4. MA-Building Code/IBC (Latest Adopted Edition), including all adopted MA-Supplements
 - 5. MA-Energy Code
 - 6. MA Fire Prevention Regulations and Elevator Regulations
 - 7. Local Ordinances, Regulations of the Local Building Department and Fire Department
 - 8. Recommendations of the National Fire Protection Association (NFPA), latest applicable edition adopted, in general and in particular:
 - a. Life Safety, NFPA 101
 - b. HVAC, NFPA 90A, 90B
 - 9. Recommendations of ASHRAE (American Society of Heating, Refrigeration and Air Conditioning Engineers), including:
 - a. ANSI/ASHRAE 90.1 and 90.2 – Energy Standard for Buildings
 - b. ANSI/ASHRAE 62.1 and 62.2 – Ventilation for Acceptable Indoor Air Quality
 - c. ANSI/ASHRAE 15-Safety Code for Mechanical Refrigeration
 - d. ANSI/ASHRAE 55-Thermal Environmental Conditions for Human Occupancy

F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the accepted volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:

1. AMCA Air Moving and Conditioning Association
2. ANSI American National Standards Institute
3. ARI American Refrigeration Institute
4. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
5. ASME American Society of Mechanical Engineers
6. ASTM American Society of Testing and Materials
7. AWS American Welding Society
8. CS Commercial Standards, U.S. Department of Commerce
9. FM Factory Mutual
10. FS Federal Specification, U.S. Government
11. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
12. NEMA National Electrical Manufacturers Association
13. SMACNA Sheet Metal and Air Conditioning Contractor's National Association
14. UL Underwriters' Laboratories, Inc.

G. Each Contractor for the work under his charge, shall give all necessary notices, obtain and pay for all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. Each Contractor shall obtain all required Certificates of Inspection for his work and deliver same to the Architect before request for acceptance of his portion of work and before final payment is made.

H. All equipment shall be installed per manufacturer's recommendations and requirements. The Contractor shall notify the Engineer in writing when they intend to deviate from manufacturer's installation guidelines. The Engineer shall advise if the installation is acceptable prior to installation.

1.5 SUBMITTALS

A. Submit detailed shop drawings or brochures for approval of equipment and material proposed to be used on this project. Furnish the number of copies required by General Conditions.

- B. Documents submitted shall show the following:
1. Principal dimensions and details of construction.
 2. Operating and maintenance clearances.
 3. Weights of principal parts and total weights with information required for the design of supports and foundations.
 4. Sizes and location of piping and connections.
 5. Performance data, including pump and fan curves; sound data including sound power dB levels in 1/3 octave bands.
 6. Data on electric motors, including brake horsepower of driven equipment, nameplate ratings and classes, sound data, starting and running full load currents, required starter size and recommended overload heater ratings.
 7. Approval stamp of Underwriters' and other authorities having jurisdiction of Contract Drawings requiring such approval.
 8. Certified performance guarantees.
 9. Calculations and details for refrigeration for field assembled systems including description of specialties and pressure drops, layout of piping with lengths fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.
 10. Minimum scale for sheet metal plans and piping plans shall be ¼ inch equal 1 foot.
- C. Submit brochures that contain only that information which is relative to the equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless irrelevant information is marked out and relevant material is clearly marked.
- D. Specifications Compliance Statement
1. The manufacturer shall submit a point-by-point statement of compliance with the specifications.
 2. The statement of compliance shall consist of a list of all paragraphs (line by line).
 3. Where the proposed system complies fully, such shall be indicated by placing the word "comply" opposite the paragraph number.
 4. Where the proposed system does not comply or accomplishes the stated function in a manner different from that described, a full description of the deviation shall be provided.
 5. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question.

6. Submissions which do not include a point-by-point statement of compliance as specified shall be disqualified.

1.6 GUARANTEE

- A. Attention is directed to the provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.
- B. Manufacturers shall provide their standard guarantees for work under this Contract, unless specified otherwise. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and GC may have by Law or by other provisions of the Contract Documents. In any case, such guarantees and warranties shall commence when the Owner accepts the various systems, as applicable and as determined by the Architect. The guarantees and warranties will remain in effect for a minimum period of (1) year thereafter except where longer periods are specifically stated and specified.
- C. All materials, items of equipment and workmanship furnished under HVAC, shall carry the warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship, or design which may develop shall be made good, forthwith, by and at the expense of the Contractor responsible, including all other damage done to areas, materials and other systems resulting from this failure.
- D. Each Contractor shall guarantee that all elements of the systems provided under his Contract are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated on the drawings.
- E. Upon receipt of notice from the Owner of failure of any part of the systems or equipment during the guarantee period, the affected part or parts shall be replaced by the responsible Contractor.
- F. Each Contractor shall furnish, before the final payment is made, a written guarantee covering the above requirements.

1.7 THE CONTRACTOR

- A. The Mechanical Contractor (and his subcontractors) shall base his bid on site examinations performed by him/them. This requirement is mandatory. Each Contractor shall visit the proposed site where work is scheduled to be performed and ascertain for himself the amount of work required to fulfill the intent of his Contract and the complexity of the installation. Each Contractor shall not hold the Architect, his Consultants, agents, or employees responsible for or bound by, any schedule, estimate or for any plan thereof. Each Contractor shall study all Contract Documents (HVAC, Electrical, Architectural, Structural), etc., included under each Contract, to determine exactly the extent of work to be provided under each Section, and in installing new equipment and systems and coordinating the work with the other Trades and existing conditions.
- B. Each Contractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications and shall take all responsibility for and bear all losses resulting to him in the execution of his work.

- C. Each Contractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by each Contractor shall perform their work according to all the conditions as set forth in these specifications.
- D. Each Contractor shall furnish all materials and perform all work in accordance with the project specifications and any supplementary documents provided by the Architect. The work shall include every item shown on the drawings and/or required by the specifications as interpreted by the Architect. All work and materials furnished and installed shall be new and of the best quality and workmanship. Each Contractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.8 COORDINATION OF WORK

- A. Each Contractor shall compare his drawings and specifications with those of other Trades and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the mechanical or electrical work, to ensure that all work is installed in coordination and cooperation with other Trades installing interrelated work. Before installation, each Contractor shall make proper provisions to avoid interference in a manner approved by the Architect. All changes required in the work of each Contractor caused by his negligence shall be corrected by him at his own expense, to the Architect's satisfaction.
- B. Locations of piping, ductwork, conduits, and equipment shall be adjusted to accommodate the new work with interferences anticipated and encountered during installation. Each Contractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings will have to be completed to verify dimensions and characteristics of the various systems' installations.
- C. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
- D. Offsets, transitions, and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. Each Contractor shall provide manual air vents and drains as required for his work to affect these offsets, transitions, and changes in direction, as applicable.
- E. All work shall be installed in a way to permit removal (without damage to other parts) of coils, filters, control appurtenances, fan shafts and wheels, filters, belt guards, sheaves and drives and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors, ceiling tiles and cleaning access doors in ductwork.
 - 1. Access to any and all components requiring servicing, adjustment, calibration, maintenance, or periodic replacement shall be provided so that the Owner's operations personnel can freely gain access without removal of any materials other than the access panel or ceiling tile. Access shall be understood to mean free, clear and unobstructed from the floor up to the device and/or component being serviced. Access panels for RHC's shall be 24" x 24" minimum.
 - 2. Fire-rated access doors with closers shall be provided for all rated assemblies.

- F. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, ductwork, equipment, terminals and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.
- G. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, electric control components, etc., exist, such conflicts shall be reported to the Architect prior to signing of the Contract. If such action is not taken, each Contractor, as applicable, shall furnish such items as part of his work, for complete and operable systems and equipment, as determined by the Architect.
- H. Where drawing details, plans and/or specification requirements are in conflict and where pipe or duct sizes of same pipe or duct run are shown to be different between plans and/or between plans and sections or details, the most stringent requirement will be included in the Contract. HVAC systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.
- I. Final location of all air distribution devices, thermostats, heaters, control devices, sprinkler heads, etc., shall be coordinated with the Architectural reflected ceiling plans and/or other Architectural details, as applicable. (**Note:** Sprinkler head locations shall provide the specified coverage rating and water flow density and shall be in accordance with all applicable Codes and in full compliance with the requirements of the Owner's insurance carrier.) Offsets of ductwork added sheet metal, fittings, elbows, flexible connections, etc., shall be provided as required to comply with the Architectural reflected ceiling plans and/or installation details. Obtain approval of locations of all devices from Architect in the field, prior to installation.

1.9 COORDINATION DRAWINGS

- A. Before materials are purchased, fabricated or work is begun, each Contractor shall prepare coordination drawings for all floors/areas, including buried systems/services (all-Trade composite at ¼" scale), showing the size and location of his equipment and lines, in the manner described herein under General Requirements.
- B. Coordination drawings are for the GC and Architect's use during construction and shall not be construed as shop drawings or as replacing any shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the Architect, corrected, and be used to prepare the Record Drawings to be submitted to the Owner for his use.
- C. The cost of producing and reproducing the drawings will be included under the Contract of each Trade, including the cost or preparation of the Architectural building outlines. This process may include multiple revisions to these drawings which will be included in the cost. The intent is to provide a fully coordinated set of documents between trades no matter how many times they may have to be redone. The HVAC Contractor shall take the lead to produce the Architectural backgrounds, show all ductwork, piping, etc., and circulate the drawings to any of his Subcontractors and the other Trades (Electrical), so that they can indicate all their work as directed by the GC and Architect as required, to result in a fully coordinated installation.

- D. In addition to the regular coordination drawing review, the mechanical work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:
1. Valves and instrumentation should be grouped where possible and positioned in the best accessible locations.
 2. Location of control/diagnostic panels shall be shown and identified on the mechanical room coordination drawings.
- E. Prepare a complete set of computer based AutoCad (Latest Version) drawings at scale not less than 1/4" scale equals 1'-0", showing basic layout for the structure and other information as needed for preparation of Coordination Drawings. The drawings shall indicate the layout of all specialty tradework as indicated herein and shall be designated as Coordination Drawings. A signed liability release form will be required from the Contractor prior to the release of the disk from the Engineer.
- F. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.
- G. The main paths for the installation or removal of equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.
- H. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers and for spaces in the above ceilings where congestion of work may occur such as corridors and, where required, entire floors. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit 6" greater in diameter.
1. Specialty Trade shall include:
 - a. HVAC piping and associated control systems.
 - b. Electrical.
 - c. Sheet Metal Work.
 - d. Automatic Temperature Control
 - e. Fire Alarm
- I. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and return Coordination Drawings to the Contractor.
- J. Where conflicts occur with placement of materials of various trades, the General Contractor shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the affected specialty trade Subcontractor. The General Contractor shall then final date and sign each drawing.
- K. Fabrication shall not start until Coordinate Drawings have been distributed to all parties as indicated herein.
- L. Format: Coordination Drawings (plans only) shall be done using CAD in AutoCAD (Latest Version), in either IBM or Mac Format. Disks shall be given to the Architect for future transfer to Owner. Coordination Drawings will be used as base for as-built drawings.

- M. Distribution of Coordination Drawings:
1. The General Contractor shall provide one print of each Coordination Drawing to:
 - a. Each specialty trade Subcontractor.
 - b. Owner.
 - c. General Contractor.
 - d. Architect (for record purposes).
- N. After distribution:
1. Resolve all interferences not previously identified.
- O. Coordination Drawings include but are not necessarily limited to:
1. Structure.
 2. Partition/room layout, including indication of smoke and fire resistance rated partitions.
 3. Ceiling layout and heights.
 4. Light fixtures.
 5. Access panels.
 6. Sheet metal, heating coils, RTU's, ACU/ACCU's, grilles, diffusers, etc.
 7. All heating piping and valves.
 8. Smoke and fire dampers.
 9. Soil, waste and vent piping.
 10. Major water and gases.
 11. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit. Motor control centers, starters and disconnects.
 12. All equipment, including items in the Contract as well as O.F.C.I. and O.F.I. items.
 13. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicate areas in which the required access area may be greater than the suspected grid systems.
 14. Existing conditions, including, but not limited to, Mechanical and Electrical items.
 15. ATC panels.
- P. The Architect's response to all requests for information (RFI's) generated by the trade contractors shall be distributed to all other affected trades as if this information was contained in the original contract documents. In other words, the party that issues an RFI is responsible for distributing the information to all affected parties.

1.10 RECORD DRAWINGS

- A. Each Contractor shall maintain, current at the site, a set of Contract Drawings for his portion of the work on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions. Changes whether resulting from formal change orders, requests for information, or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, ducts, equipment, etc.
- B. Each Contractor shall indicate progress by coloring in various pipes, ducts and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.

- C. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner's representatives, and they shall be corrected if found either inaccurate or incomplete. This procedure is mandatory. Marked up drawings shall include all flow diagrams, schedules, details and control diagrams.
- D. Each Contractor shall meet at a minimum on a monthly basis, with the Owner's representative to transfer the information from his HVAC, Electrical etc., marked-up and colored-up prints to a set which will become the basis for preparation of as-built drawings.
- E. Upon completion of the project, each Contractor shall submit his marked-up drawings to the Architect for review and comment. After the Architect reviews and comments on this set of documents, each Contractor shall prepare as-built drawings on CAD using AutoCad (Latest Version). When the work is completed, each Contractor shall provide 2 hard copies to the Architect for submittal to the Owner and disks with all documentation and a set of reproducible drawing plots marked "As-Built" drawings. The Contractor shall bear all costs of producing the CAD "As-Built" drawings, providing all necessary drawing changes and printing the reproducible drawings for the work under his charge.

1.11 GIVING INFORMATION

- A. Each Contractor shall keep himself fully informed as to the shape, size and position of all openings required for his apparatus and shall give information to the Architect and other Contractors [or Subcontractors] sufficiently in advance of the work so that all openings may be built in advance.
- B. The manufacturers listed within this specification have been preselected for use on this project. No submittal will be accepted from a manufacturer other than those specified. Should any Contractor wish to propose a substitution during the bid period, such request shall be made in writing to the Architect, at least (15) working days, prior to bid date. If substitutions are deemed acceptable, such items shall be issued as an Addendum, prior to bid due date. The above requirement is mandatory.

1.12 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls, filters, etc., shall be stored in dry, heated spaces.
- B. Each Contractor shall have his equipment tightly covered and protected against dirt, water and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned, polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects developing before acceptance of the work shall be made good at each Contractor's [or Subcontractor's] expense as applicable.
- C. Each Contractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.

- D. Manufacturers' directions shall be followed completely in the delivery, storage, protection and installation of any equipment. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions and obtain the Architect's written instructions before proceeding with the work. Should any Contractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.
- E. Each Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.
- F. Where equipment of the acceptable manufacturers requires different arrangement or connections from those shown, it shall be the responsibility of each Contractor to install the equipment to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, each Contractor shall submit drawings showing the proposed installation. If the proposed installation is approved, each Contractor shall make all necessary changes in all effected related work provided under other Sections including location of roughing-in connections by other Trades, electrical requirements, piping, supports, insulation, etc. All changes shall be made at no increase in the Contract amount or additional cost to the other Trades and/or Owner.
- G. Testing Agency Labeling Requirements
 - 1. All equipment and materials required for installation under these specifications shall be new and without blemish or defect.
 - 2. Equipment and materials shall be products which will meet with the acceptance of the Authorities Having Jurisdiction over the work and as specified hereinbefore.
 - 3. Where such acceptance is contingent upon having the FM Global, it shall be provided with FM Global label. Factory manufactured and assembled packaged equipment, such as the examples of equipment listed below, shall have the entire assembled package inspected and Labeled by Factory Mutual.
 - 4. All equipment shall meet OSHA standards.
 - 5. All products shall be listed and labeled by UL or other national testing laboratories such as ETL and the products shall be so labeled.
 - a. Label of Underwriter's Laboratories, ETL or other nationally recognized testing agency acceptable to the Authorities Having Jurisdiction.
- H. All equipment of one type (such as valves, fans, RTU air handling units , air terminals, etc.), shall be the product of one manufacturer.

1.13 CUTTING AND PATCHING

- A. Each Contractor shall be responsible for all core drilling, as required for work under his Contract, but in no case shall he cut into any structural elements without the written approval of the Architect.
- B. All cutting, rough patching, finish patching, and painting shall be by the General Contractor. Coordinate all interior wall and floor interfaces with the Architect.

- C. All roof curbs, equipment rails, roof duct & pipe supports shall be provided under this Contract.
- D. All roof cutting and patching shall be by the roofing contractor. Coordinate all roofing interfaces with the Architect & Roofing contractor.

1.14 USE OF PREMISES

- A. Each Contractor shall confine all of his apparatus, storage of materials and construction to the limits indicated on the drawings and directed by the Architect and he shall not encumber the premises with his materials.
- B. In storing materials within areas (structure or ground), or when used as a shop, each Contractor shall consult with the General Contractor and shall restrict his storage to space designated for such purposes. Each Contractor will be held responsible for repairs, patching or cleaning arising from any unauthorized use of premises.
- C. Notwithstanding any approvals or instructions which must be obtained by each Contractor from the Architect in connection with use of premises, the responsibility for the safe working conditions at the site shall remain each Contractor's. The Architect or Owner shall not be deemed to have any responsibility or liability in connection therewith.
- D. Air handling unit sections shall not be used for storage of materials. The HVAC Contractor will be responsible for securing and maintaining the equipment clean. The above requirement is mandatory.

1.15 PROTECTION/CLEANLINESS

- A. All equipment and materials such as valves, fittings, piping, ductwork, plenums, grilles, registers, diffusers, etc., shall be properly protected from the accumulation of dirt, dust, debris or any other contaminants. All ductwork and piping openings shall be temporarily closed by each Subcontractor installing same, so to prevent obstruction and damage, as a minimum at the end of each working day or more often if required by job conditions. Each Contractor shall take precautions to protect his materials from damage and theft.
- B. Each Contractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.16 DAMAGE CORRECTION AND EXTRA WORK

- A. Each Contractor shall be held responsible and shall pay for all damages caused by his work to the new and existing building structures and new and existing equipment, piping, duct systems, etc., and all work and finishes installed under this Contract in the new or in existing building. Repair of such damage shall be done as herein before specified, at the expense of each Contractor and to the Architect's satisfaction.
- B. Each Contractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents whether observed before or after completion of work and whether or not fabricated, installed or completed. Each Contractor shall bear all costs of correcting such rejected work.
- C. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.17 TOUCH-UP PAINTING

- A. Each Contractor shall thoroughly clean all equipment and systems provided under this Contract from rust, splatters and other foreign matter or discoloration, leaving every part of each system in an acceptable prime condition. Each Contractor, for the work under his Contract, shall refinish and restore to the original condition all equipment and piping which has sustained damage to the manufacturer's prime and finish coats of paint and/or enamel.

1.18 DUCT AND PIPE SLEEVES, PLATES AND ESCUTCHEONS, FIRESTOPPING AND SMOKEPROOFING

- A. Where piping and/or ductwork pass through masonry or concrete walls or drywall partitions or floors, each Contractor shall provide and set individual sleeves for each pipe or duct and all other work under his charge, as necessary for passage of all pipes and/or ducts. Sleeves shall be of sufficient size to provide 1/2" air space around the pipe or duct passing through (including insulation where pipes or ducts are externally insulated). All openings shall be sealed, smoke-proofed and made tight. Each Contractor shall be responsible for the exact location of sleeves provided under his Contract and shall coordinate all requirements for piping and ductwork sleeves.
- B. Each Contractor, for work under his charge, shall determine the required inside diameter of each individual wall opening or sleeve before ordering, fabrication or installation.
- C. Sleeves and inserts shall not be used in any portions of the building, where their use would impair the strength or construction features of the building. Elimination of sleeves must be approved by the Architect.
- D. Provide chrome plated brass escutcheons with set screw for exposed piping, in all areas except in mechanical rooms. In this area use plain brass or cast-iron escutcheons suitable for painting. All escutcheons shall be sized to fit the bare pipe or insulation in a snug and neat manner. They shall be of sufficient size to cover sleeved openings for the pipes and of sufficient depth to cover sleeves projecting above floors. Escutcheons shall be manufactured by Beaton & Caldwell, Dearborn Brass, or Grinnell.
- E. Pipe or duct sleeves shall be made of Schedule 40 pipe, 20-gauge galvanized steel or 16-gauge steel as follows:
 - 1. Sleeves on pipes passing through masonry or concrete construction shall be Schedule 40 pipe.
 - 2. Sleeves on ducts passing through concrete construction shall be 20-gauge steel unless required otherwise by item 4. below.
 - 3. Sleeves on pipes or ducts passing through fire rated partitions shall be 16-gauge steel.
- F. Each Contractor shall fire stop, smoke stop, and/or acoustically seal the space between the sleeves provided under his Contract and piping or ductwork as applicable, as follows:
 - 1. See Specification Section 23 05 84 Through Penetration Fire-Stop Systems.

1.19 MISCELLANEOUS IRON AND STEEL

- A. Each trade shall provide all primary and secondary steel supports and hangers as shown on the drawings and/or as required to support HVAC equipment, ductwork, piping, exhaust fans, or any other materials provided under the work of this Section.

- B. The work of this Section of designing, furnishing, and installing all miscellaneous metal work associated with the system, and related items as indicated on the drawings and/or as specified herein, and includes, but is not limited to the items listed herein below.
- C. The scope of work shall include:
1. Miscellaneous steel and intermediate steel beams to hang ductwork and piping from the roof. All piping and ductwork must be hung from beam or supported from the floor. Provide supplemental miscellaneous steel for support of equipment.
 2. Support of ductwork and piping in shafts in addition to support provided by structure.
 3. Support of ductwork via floor stands as required.
 4. Pipe anchors in the building.
 5. Hangers, brackets, angel irons or rods required for the support and protection of HVAC equipment.
 6. Field prime painting of galvanized steel and field finish painting.
- D. Shop Drawings for General Miscellaneous Items
1. Submit Shop Drawings of all miscellaneous metal items to Architect for approval, showing sizes and thickness of all members, types of materials, methods of connection and assembly, complete dimensions, clearances, anchorage, relationship to surrounding work by other Trades, shop paint, and other pertinent details of fabrication and installation.
- E. The Subcontractor shall engage the services of a Professional Engineer registered within the state wherein the project is located to prepare complete Design Drawings and structural design computations based on, and closely following, the design and details on the Drawings. The Design Drawings and structural design computations, with the Engineer's seal affixed thereto, shall be submitted to the Architect for review. The structural design computations shall provide a complete structural analysis, including anchors and fastening devices, and shall certify as to conformation to governing laws and codes. These submittals, upon review, must be sufficient, when taken in conjunction with this Specification to provide the complete basis of the fabrication and erection.
- F. Samples
1. Submit duplicate samples of all materials to be furnished under this Section if, and in size and form, requested by Architect.
- G. Do not order materials or begin fabrication until Architect's approval of submittals has been obtained.
- H. In addition to the governing laws and codes, the following Specifications and Codes form a part of this Specification:
1. American Iron and Steel Institute applicable standards.
 2. American Institute of Steel Construction "Code of Standard Practice for Steel Buildings and Bridges" and "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".
 3. American Welding Society Code: Standard Code for Arc and Gas Welding in Building Construction.

- I. All materials shall be new stock, free from defects impairing strength, durability or appearance and of best commercial quality for each intended purpose.
 - 1. Unless otherwise specifically called for, work of this Section shall be fabricated of structural steel conforming to ASTM Specification A36.
 - 2. Steel pipe shall be seamless steel pipe conforming to ASTM Specification A53, Schedule 40.
 - 3. Steel tubing shall be seamless steel tubing conforming to ASTM Specifications A500 to A501.
 - 4. Construction specialties such as slotted inserts, wedge inserts, etc., shall be as manufactured by Hohmann and Barnard, Gateway Erectors, Inc., Richmond Screw Anchor Co. or as approved by Architect.
 - 5. Non-ferrous metals shall be as specified under descriptions of specific items, herein below.

- J. Provide all anchors, bolts, sockets, sleeves, and other parts required for securing each item of work of this Section to the construction, including furnishing to concrete workers all required insets and sleeves for use at concrete.
 - 1. All exposed fastenings shall be of the same material and finish as the metal to which applied, unless otherwise noted.
 - 2. Welding rods shall conform to AWS Standards and the recommendation of the welding rod manufacturer.
 - 3. Shop primer for other ferrous surfaces shall be a high-quality, lead-free, rust-inhibitive primer, Tnemec No. 10-99 Metal Primer or equivalent by Devoe and Reynolds Co., Carboline or Approved Equal

- K. Metal surfaces shall be clean and free from mill scale, flake, rust and rust pitting. Metal work shall be well formed and finished to required shape and size, true to details, with straight, sharp lines and angles and smooth surfaces. Curved work shall be true radii. Exposed sheared edges shall be eased.

- L. Weld all permanent connections. Welds shall be continuous on all exposed surfaces and where required for strength on concealed surfaces. Exposed welds shall be ground flush and smooth, with voids filled with metallic filling compound (metallic filling compound not permitted on surfaces to receive hot-dip galvanizing). Tack-welding will not be permitted unless specifically called for. Do not use screws or bolts where they can be avoided. Where used, heads shall be countersunk, screwed up tight, and threads nicked to prevent loosening.

- M. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water.

- N. Do all cutting, punching, drilling and tapping required for attachment of anchor bolts and other hardware and for attachment of work by other Trades. All such cutting, punching, drilling, etc., shall be done prior to hot-dip galvanizing of the various components.

- O. Live loads shall be not less than the minimum required by law. Where specific live load are not set forth in the laws and codes applicable to this work, and are not given on the Drawings or in this Specification, designs shall be such as to support the live loads which may normally be imposed without failure, without deflection of more than 1/360 of length of any member, and without permanent deformation, all with a factor of safety of not less than 2 1/2 to 1.

P. Shop Painting

1. All ungalvanized ferrous metals under this Section shall be given a shop coat of rust inhibitive primer of type specified above.
 - a. Immediately before shop painting, remove all rust, loose mill scale, dirt, weld flux, weld spatter, and other foreign material with wire brushes and/or steel scrapers. Power tool clean in accordance with SSPC SP-3 (Power Tool Cleaning). Remove all grease with oil by use of solvent recommended by paint manufacturer. Sandpaper exposed surfaces as required to produce smooth, even finishes.
 - b. Apply paint by spray process in strict accordance with manufacturer's printed instructions to uniform thickness(es) recommended by manufacturer. Apply thoroughly and evenly and work well into corners and joints taking care to avoid sags and runs.
 - c. Do not paint surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified primer over all unprimed in the field by brush roller.
 - d. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection, and coat all field welds and connections with primer equivalent to that used for the shop coat.

Q. Installation

1. All materials shall be carefully handled and stored under cover in manner to prevent deformation and damage to the materials and to shop finishes, and to prevent rusting and the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned prior to erection.
2. Work shall be erected square, plumb and true, accurately fitted, and with the tight joints and intersections. All anchors, inserts and other members to be set in concrete or masonry shall be furnished loose by this Trade to be built-into concrete and masonry and by those Trades as the work progresses. Later cutting or drilling shall be avoided wherever possible.
3. All metal work shall be rigidly braced and secured to surrounding construction, and shall be tight and free of rattle, vibration, or noticeable deflection after installed.
4. Where members, other than expansion bolts or inserts, are fastened into concrete, set such members in holes formed as specified below, and secure permanently in place by installation of proprietary-type expanding grout manufactured specifically for such purpose, used strictly in accordance with manufacturer's directions. Holes to receive members shall be formed with galvanized sheet metal sleeves, expanded polystyrene foam, or other approved method to provide at least 1/2 inch clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 inch from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.
5. Electrolytic Isolation
 - a. Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

R. Description of Major Items

1. The items described below constitute the major part of the work of this Section, but are not intended or implied to cover each and every item that may be required to properly complete the work. Carefully review the Drawings to determine the full extent of the miscellaneous metal work required.

S. Miscellaneous Items

1. Carefully review all Drawings for miscellaneous metal items required but not specifically listed above, such as miscellaneous steel clip angles, miscellaneous steel bracketing, and other miscellaneous metal items as indicated on the Drawings, reasonably implied therefrom, or reasonably necessary for the thorough completion of the work.
2. Provide rigid and secure anchorage of all components whether or not specifically described in complete detail on the Drawings.

- T. Piping supports shall be coordinated with the building structure and shall span between roof beams as required.

1.20 WATERPROOFING, FLASHING AND COUNTERFLASHING

- A. Unless specifically indicated otherwise on the drawings, each Contractor shall provide all counterflashing and waterproofing of all piping, ductwork and equipment provided by him, which pierce roofs, walls and other weather barrier surfaces. All work under this paragraph shall be coordinated with the GC.
- B. All work shall be performed in a workmanlike manner to ensure weatherproof installation. Any leaks developed due to each Contractor's work shall be repaired at his expense, to the Architect's satisfaction.
- C. Pipes passing through slabs shall have the sleeve extended above floors as hereinbefore specified to retain any water and the space between the pipe and sleeve caulked waterproof fire stopping. The top and the bottom shall be sealed with monolastic caulking compound.
- D. All flashing required for ductwork and piping penetrations shall be provided by the GC.

1.21 ELECTRICAL WORK, MOTORS, MOTOR CONTROLLERS

- A. See Section 23 05 13.
- B. See Division 26 for Electrical.

1.22 IDENTIFICATION OF MATERIALS

- A. See Section 23 05 53.

1.23 VALVE TAGS, NAMEPLATES AND CHARTS

- A. See Section 23 05 53.

1.24 PARTS LIST AND INSTRUCTIONS FOR OPERATION AND MAINTENANCE

- A. Each Contractor shall thoroughly instruct the representative(s) of the Owner, to the complete satisfaction of the Architect, in the proper operation of all systems and equipment provided by him. Each Contractor shall make arrangements, via the GC as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the periods of time in which they are to be given. The Architect shall be completely satisfied that the representative of the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by each Contractor to the Owner's representative, then each Contractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this paragraph of the specification has been complied with. All time required for Owner's instruction to satisfy the above requirements shall be included in this Contract. No extra compensation for such instructions will be allowed.
- B. Each Contractor, including but not limited to, the HVAC Contractor, shall submit to the Architect for approval, a total of (6) typed sets, bound neatly in loose-leaf binders, of all maintenance and operating instructions for the installation, operation, care and maintenance of all equipment and systems. All data and literature furnished shall be specific for the make and model of the equipment furnished. General non-specific catalog data will not be acceptable. Information shall indicate possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section such as fans, valves, RTU air handling units, etc., shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner through the General Contractor for approval prior to final submission of manuals.
- C. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited to, the following:
 1. Instructional classes on equipment and systems operation for Owner's representative and maintenance personnel, by engineering staff of each Contractor. Minimum of 48 hours of instruction for minimum of (6) people. Instruction shall include:
 - a. Explanation of manual and its use.
 - b. Summary description of the HVAC systems.
 - c. Purpose of systems.
 2. System
 - a. Detailed description of all systems.
 - b. Illustrations, schematics, block diagrams, catalog cuts and other exhibits.

3. Operations
 - a. Complete detailed, step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, adjusting and balancing. Include all posted instruction charts.
4. Maintenance
 - a. Parts list and part numbers.
 - b. Maintenance, lubrication and replacement charts and manufacturer's recommendations for preventive maintenance, as applicable to his work.
 - c. Troubleshooting charts for systems and components.
 - d. Instructions for testing each type of part.
 - e. Recommended list of on-hand spare parts.
 - f. Complete calibration instructions for all parts and entire systems.
 - g. Instruction for charging, filling, draining and purging, as applicable.
 - h. General or miscellaneous maintenance notes.
5. Manufacturer's Literature
 - a. Furnish complete listing for all parts required for models actually furnished.
 - b. Names, addresses and telephone numbers of manufacturers and suppliers.
 - c. Describe and operation of all models actually furnished.
 - d. Furnish all and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
 - e. Internal wiring diagrams and engineering data sheets for all items and/or equipment furnished under each Contract.
 - f. Guarantee and warranty data.
6. Each Contractor shall furnish instructions for lubricating each piece of equipment installed by him. Instructions shall state type of lubricant, where and how frequently lubrication is required. Frame instructions under glass and hang in a location as directed by Architect.

1.25 MANUFACTURER'S REPRESENTATIVE AND DE-BUGGING OF SYSTEMS

- A. Each Contractor shall provide, at appropriate time or as directed by the Architect, the on-site services of a competent factory trained Engineer or authorized representative of particular manufacturer of equipment provided under his Contract, such as for the air handling units, automatic temperature controls, building automation system (BAS), fire pump, domestic hot water heaters, boilers, etc., provided under this Contract, to instruct the Owner, inspect, adjust and place in proper operating condition any item provided by him, as applicable.
- B. The HVAC Contractor, as applicable, shall commission and set in operating condition all major equipment and systems, such as the condenser water, hot water and all air handling systems, etc., in the presence of the applicable equipment manufacturer's representatives, and the Owner and Architect's representatives. In no case will major systems and equipment be commissioned by any of the Contractor's forces alone, without the assistance or presence of the equipment manufacturers.
- C. A written report shall be issued by the particular equipment manufacturer and the Mechanical Contractor summarizing the results of the commissioning and performance of each system for the Architect's record. No additional compensation will be allowed for any Contractor for such services.
- D. The Contractor shall prepare and submit to the Architect for acceptance, a schedule of anticipated system commissioning. No system shall be commissioned without prior acceptance of the schedule by the Architect and Owner. No systems shall be commissioned prior to submittal and acceptance of Operation and Maintenance Manuals.

1.26 CONNECTIONS TO EQUIPMENT

- A. Each Contractor shall provide all duct and/or pipe connections, condensate traps, drains, overflows, relief valves and vents, power connections, etc., to make equipment operable, as provided under other Sections of the specifications, as shown on the Architectural and/or each Trade's drawings and herein specified, including final connections to equipment to result in a complete system, fully operational. Coordinate location of all equipment with Architect. Obtain installation diagrams and methods of installation of all equipment from manufacturers. Follow instructions strictly. If additional information is required, obtain same from Architect. If equipment is indicated on the Architectural drawings, it shall also be construed and understood by the Mechanical Contractor to be constructed as shown on the HVAC drawings and shall be fully serviced and connected at no extra cost to the Owner.

1.27 SMOKE DETECTION AND FIRE SAFETY SYSTEMS

- A. All duct or unit mounted smoke detectors shall be furnished and wired to the building fire alarm system by the Electrical Contractor. All smoke detectors required in units and ducts and for smoke barrier dampers shall be installed in the field by the HVAC Contractor.
- B. All smoke dampers, except in built-up air handling units, shall be furnished by the Sheetmetal Contractor with electric actuators field wired by the ATC Contractor. Dampers shall be field installed by the HVAC Contractor, except dampers in the air handling units.

- C. The Electrical Contractor, when providing smoke detectors, shall include additional contacts, as required and coordinated with the ATC Contractor, to allow for other control functions, as specified hereinafter. Close coordination must be exercised to allow for the provision of contacts.
- D. All smoke detectors shall be installed as recommended by the smoke detection system manufacturer in sheet metal ducts or plenums to ensure that the sensing elements are effective and shall coordinate installation of smoke detectors with the Electrical Contractor and detector manufacturer.
- E. The HVAC Contractor shall provide access doors to make all such detection heads accessible, and shall provide bracing for smoke detection sampling tubes, as recommended by the detector manufacturer, to properly and securely support such tubes.
- F. If duct smoke detectors are required to be installed in ducts that are exposed to outside ambient conditions, they shall be installed in ventilated accessible weatherproof enclosures. See details on HVAC Drawings.

1.28 ELECTRICAL ROOM REQUIREMENTS

- A. The HVAC Contractor [or Subcontractors] shall not install any piping, ductwork or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping, ductwork or equipment is intended to serve these rooms. If any Contractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.29 HOISTING EQUIPMENT AND MACHINERY

- A. All hoisting equipment and machinery required for the proper and expeditious prosecution and progress of the work under this Contract shall be furnished, installed, operated and maintained in safe condition by each Contractor for his material and/or equipment delivered to the designated hoisting area. All costs for hoisting operating services shall be borne by the Mechanical Contractor for all equipment and work under his charge.

1.30 STAGING

- A. All staging, exterior and interior, required to be over 8'-0" in height, shall be furnished and erected by each Contractor for work under his charge and maintained in safe condition by him for proper execution of his work.

1.31 PHASING DEMOLITION AND MAINTAINING EXISTING SERVICES

- A. During the execution of the work, required relocation of existing equipment and systems in the existing areas where new work and connections are scheduled to be made shall be performed by each Contractor as indicated on the drawings, as required by the job conditions and as determined by the GC in close cooperation with the Architect and Owner's designated representative to facilitate the installation of the new systems and completion of this Contract. The Owner will require the continuous operation of all existing systems, while demolition, relocation work of new tie-ins are being performed. Outages required for construction purposes shall be scheduled for the shortest practical periods of time, in coordination with the Owner's designated representative for specific, mutually agreeable periods of time after each of which the interruption shall cease and service shall be restored. This procedure shall be repeated to suit the Owner's working schedule as many times as required until all work is completed.
- B. Prior to any deactivation and relocation, capping, valving, tie-in, or demolition work, consult the drawings and arrange a conference with the Architect and the Owner's representative in the field to inspect each of the items to be deactivated, removed or relocated. Care shall be taken to protect all equipment designated to be relocated and reused. Give notice to all parties, with a minimum of (5) working days in advance.
- C. All draining of existing systems, filling and venting required to remove and relocate existing piping systems shall be included and provided under this Contract as required to perform the various equipment or piping relocations or new tie-ins.
- D. Except as otherwise noted, all deactivation, safe capping, valving, etc., of systems designated to be demolished shall be provided by each Trade, as applicable, and all demolition, removal and disposal of demolished materials shall be performed by the GC. All equipment scheduled to be removed shall be inspected by the Owner, and, if he decides that such equipment is to be salvaged, each Contractor shall deliver said equipment to an area within the site boundaries as determined by the Owner and Architect.
- E. The phasing of the work shall be performed in strict accordance with the GC construction schedule. The new systems will be installed and completely commissioned prior to occupancy. Coordinate requirements for temporary heat or rerouting of existing services as required to accomplish the construction schedule.

1.32 CONTROL WIRING

- A. The ATC Contractor shall provide all control and interlock wiring for all systems provided under the HVAC and ATC Contracts.
- B. All control wiring shall be installed in conduit and in accordance with the respective equipment manufacturer's requirements, and all connections shall be provided by the Mechanical and/or the ATC Contractor. All conduit and wiring provided by these Contractors shall be installed in accordance with the requirements of Section 26 of the specifications.

1.33 COMPONENT COORDINATION

- A. The HVAC, ATC and Electrical Contractors Scope of Work shall be implements in accordance with the following matrix:

Device	Furnished By	Installed By	Power Wiring	Control Wiring	Fire Alarm Wiring
Smoke Detectors	26	23	26	25	26
Fire Dampers	23	23	N/A	N/A	N/A
Sheet Metal Damper	23	23	N/A	N/A	N/A
Sheet Metal Damper Actuators	25	25	N/A	25	N/A
DDC Panels	25	25	26	25	N/A
Bipolar Ionization Generators	23	23	26	25	N/A
GHW Reheat Coil Control Valves	25	23	25	25	N/A
VFDs (VSDs)	23	26	26	25	N/A

PART 2 – PRODUCTS

NOT USED

PART 3 – EXECUTION

NOT USED

END OF SECTION

SECTION 23 05 10

SELECTIVE HVAC DEMOLITION

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section. Include all additional specifications and general notes located on the Architectural, Structural, Mechanical and Electrical drawings.

1.2 WORK INCLUDED

- A. This Section includes the following:
 - 1. Demolition of selected portions of Division 23 & Division 25 systems.
 - 2. Reclamation & storage of all existing refrigerants.
 - 3. All demolition items as shown on drawings H-000, HD-101, HD-102, HD102P, & HD-103.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 - ELECTRICAL AND FIRE ALARM
 - d. Division 01 - CONSTRUCTION WASTE MANAGEMENT

1.4 DEFINITIONS

- A. Remove: Detach items from existing construction.
- 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.

- E. Disposal and Removal: GC will legally dispose all demolition items off-site unless indicated to be removed and salvaged or removed and reinstalled.

1.5 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become GC property and will be removed from Project site, as per the Construction Waste Management Plan.
- B. Coordinate with Owner's adviser, who will establish special procedures for salvage.

1.6 SUBMITTALS

- A. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.
- B. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building managers and other tenants' on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services.
 - 4. Use of elevator and stairs.
 - 5. Locations of proposed dust and noise-control temporary partitions and means of egress, including for other tenants affected by selective demolition operations.
 - 6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.
- D. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.7 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. Professional Engineer Qualifications: Comply with Division 01 Section "Quality Requirements."
- C. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Standards: Comply with ANSI A10.6 and NFPA 241.
- E. Pre-demolition Conference: Conduct conference at Project site to comply with requirements herein. Review methods and procedures related to selective demolition including, but not limited to, the following:
 - 1. Inspect and discuss condition of construction to be selectively demolished.

2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Requirements of system downtime and scheduling with site personnel.

1.8 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. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.
- B. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.
- C. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.
- D. Owner assumes no responsibility for condition of areas to be selectively demolished.
 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- E. Hazardous Materials: ACM hazardous materials may 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.
- F. Storage or sale of removed items or materials on-site is not permitted.
- G. 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.

1.9 WARRANTY

- A. Existing Warranties: The GC will 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.
 1. If possible, the GC will retain original Installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition. If it is impossible to engage original Installer or fabricator, engage another recognized experienced and specialized firm.
 - a. Processed concrete finishes.
 - b. Preformed metal panels.
 - c. Roofing.
 - d. Firestopping.
 - e. Wall covering.

f. Walls

PART 2 – PRODUCTS

2.1 REPAIR MATERIALS

- A. Use repair materials identical to existing materials.
 - 1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
 - 2. Use materials whose installed performance equals or surpasses that of existing materials.
- B. Comply with material and installations requirements specified in individual Specification Sections.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been decommissioned, disconnected, and capped as per code.
- 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/Engineer.
- E. The GC will survey condition of existing building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 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.
 - 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and 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. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 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.

3.3 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Mechanical Contractor shall remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials. Demolished materials will be promptly and legally disposed of off-site by the GC.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. The GC will dispose of demolished items and materials promptly. Comply with requirements in Division 01 Section "Construction Waste Management."
 10. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations begun.
 11. Provide demolition on an on-going basis, schedule permitting. Demolition of existing systems or portions thereof shall be performed without interruption of the operation of the central heating plant.

12. The GC will remove demolition debris on a continuous and daily basis as work proceeds.
 13. Schedule and locate dumpster space as required by the project and coordinate location with facility personnel by the GC.
 14. The GC will remove from site any large pieces of equipment immediately upon demolition. Coordinate schedule of removal transport and cranes with facility personnel so that removal minimizes impact with on-site employee traffic movement.
- B. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- C. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- D. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- E. Concrete Slabs-on-Grade: Saw cut perimeter of area to be demolished, then break up and remove.
- F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 07 Section for new roofing requirements.
- G. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.
- 3.4 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 23 05 13

MOTORS AND CONTROLLERS

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all motors required for all mechanical equipment specified under this Division.
- B. Furnish and install all individual motor controllers, starters and disconnect switches not provided under Divisions 26 – Electrical Work.
- C. All motors shall be premium efficiency suitable for the duty and voltage service available and as indicated on the contract drawings.
- D. Provide all necessary control transformers so all motors, starters, disconnect switches, etc. are compatible with the control and operating sequences specified.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 – ELECTRICAL AND FIRE ALARM

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:

1. AFBMA: Anti-Friction Bearing Manufacturers Association.
 - a. 1-84 – Terminology for Anti Friction Ball and Roller Bearings and Parts.
 - b. 9-84 – Load Ratings and Fatigue Life for Ball Bearings.
 - c. 11-78 – Load Ratings and Fatigue Life for Roller Bearings.
 - d. 20-77 – Metric Ball and Roller Bearings Conforming to Basic Boundary Plans
2. ANSI: American National Standards Institute.
 - a. 50-84 – Mechanical Vibration of Rotating and Reciprocating Machinery.
3. ASTM: American Society for Testing and Materials.
 - a. A48-83 – Gray Iron Castings.
 - b. B117-85 – Method of Salt Spray (Fog) Testing.
4. IEEE: Institute of Electrical and Electronic Engineers.
 - a. 1-86 – General Principals for Temperature Limits in the Rating of Electrical Equipment.
 - b. 85-73 – Test Procedures for Airborne Sound Measurements on Rotating Electric Machinery.
 - c. 112-84 – Standard Test Procedures for Polyphase Induction Motors and Generators.
 - d. 114-82 – Test Procedures for Single-Phase Induction Motors.
 - e. 117-74 – Test Procedures for Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery. Single-Phase Induction Motors.
5. NEMA: National Electrical Manufacturer’s Association.
 - a. MG 1-78 – Motors and Generators.
6. NFPA: National Fire Protection Association.
7. National Electrical Code.
8. SAE: Society of Automotive Engineers.
9. SAE Grade 5.

1.5 SYSTEM DESCRIPTION

- A. Furnish and install all premium efficiency motors for all systems and equipment.
- B. Motor Controllers: Provide individual motor controllers not provided under Division 26. Coordinate with the Division 26 Contractor to determine the location, size and number of individual motor controllers to be provided under this Division.
- C. Mounting and installing of motors and drives.
- D. Installation of motor controllers supplied under this Division.
- E. Work shall be done in accordance with requirements of Division 26 "Electrical Work". Wiring shall be done under Divisions 26, 27 and 28.
- F. Disconnect switches; Provide combination motor controller and disconnect switch where required under Division 23 as specified in Division 26. If not specified under individual product sections, then disconnect switches shall be furnished and installed under Division 26.

1.6 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: Provide product description and list of materials including all motor efficiency ratings.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.7 QUALITY ASSURANCE

- A. Manufacturer regularly engaged in the design, testing and manufacturing of specified products and issuing complete catalog data on such products.
- B. Manufacturers must prove expertise in the design, testing and production of specified or similar to specified products for at least ten (10) years prior to date of bid.
- C. Manufacturer must provide written certification that the products provided meet or exceed the specification requirements. An executive officer of the company must sign the written certification.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions of the Contractor.
- B. The Contractor shall provide adequate storage space for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.
- C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received and shall send copies of these receipts to the Architect.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER CONTINGENT ON COMPLIANCE WITH SPECIFICATIONS

A. Motors:

1. General Electric Company
2. Reliance Electric Company
3. Baldor

B. Motor controllers:

1. General Electric
2. Square D.
3. Allen Bradley
4. Westinghouse/Cutler-Hammer

2.2 GENERAL

- A. All control wiring shall be installed in conduits and in accordance with the respective equipment manufacturer requirements. All connections shall be provided by the HVAC Contractor. All conduit and wiring provided by the Mechanical Contractor shall be installed in accordance with the requirements of Division 26 of these Specifications.
- B. Motors shall be built in accordance with latest Standards of NEMA and as specified. Motors shall be specifically and expressly wound for voltage required.
- C. Motors shall be tested in accordance with ANSI 50 and conform thereto for insulation resistance and dielectric strength.
- D. Motors shall be provided with adequate starting and protective equipment as specified or required and with conduit terminal box of size adequate to accommodate conduits and wires.
- E. Capacity shall be sufficient to operate motors under job conditions of operation and load, without overload and shall be at least the horsepower size indicated or specified.
- F. All motors shall be suitable for continuous duty at rated horsepower, with temperature not to exceed 40°C ambient (with a 1.15 SF). All motors shall be capable of 15% overload without overheating. All motors shall be rated and certified for use with VFD's per NEMA MG1 section 31.
- G. All motors shall be rated for inverter duty, and stamped as such. All motors shall have Class F insulation or higher temperatures.

1. Manufactured to maximize Corona Inception Voltage (CIV) rating.
 - a. The minimum acceptable shall be 2500 Volts at 155°C.
2. Windings shall be in-slot wound type
- H. Direct connected motors shall be furnished with adjustable base. Motors connected to driven equipment by belt or shaft shall be furnished with adjustable sliding bases, except for fractional motors which shall be furnished with slotted mounting holes.
- I. Motors shall have nameplates giving manufacturer's name, serial number, horsepower, speed and current characteristics.
- J. Motors smaller than 1/2 HP shall be capacitor, starter or split-phase type. Motors 1/2 HP and larger shall be squirrel cage, induction type. Motors 1 HP and larger shall have grease lubricated ball bearings and approved grease fittings. Motors provided shall have voltage, phase and hertz characteristics, as scheduled on the drawings.
- K. Except for electrical apparatus specifically called for to be provided under this Contract, all motor starters, disconnect switches, controllers and other electrical appurtenances required under the HVAC, etc. work, shall be provided under Division 26. Study the Electrical drawings and coordinate requirements and quantities with the Electrical Contractor.
- L. All electrical apparatus and controls furnished as a part of the HVAC, etc. work shall conform to applicable requirements under Electrical Section.
- M. Each Contractor shall provide the Electrical Contractor with all motor size and wiring requirements within (30) days from date of Contract to allow proper coordination of Trades by the General Contractor.
- N. Each Contractor shall verify with the Electrical Contractor available electrical characteristics before ordering any equipment or motors.
- O. Equipment which includes a number of correlated electrical control devices mounted in a single enclosure or on a common base with equipment, shall be supplied for installation completely wired internally with terminal strip ready for external wiring. Unless specifically directed otherwise in the Contract Documents, if these control devices are separately mounted they shall be furnished by the HVAC Contractor and wired by ATC Contractor or Electrical Contractor in accordance with the manufacturer's wiring diagram, as shown on the drawings and as specified hereinafter.
- P. All motors shall meet NEMA vibration requirements and shall be less than 0.15 in./sec.
- Q. All (direct drive) fan and pump shafts (which are connected to a variable speed controller) must be complete with a factory mounted shaft grounding brush/device.

2.3 MOTORS

- A. In accordance with NEMA, IEEE and ANSI 50 Standards.
- B. Capacity: Minimum of indicated horsepower and to operate driven devices under all conditions without overload.

- C. Provide all of the same manufacturer, except those provided integrally with equipment.
- D. Motor type and application (1/2 hp and above):
 - 1. Conditioned areas and heated ventilated areas protected from weather:
 - a. Squirrel-cage induction type, open drip-proof, NEMA B design, rated for 90 degree C rise over 40 degree C ambient, Class B insulation up to 1 hp and class f insulation above 1 hp, 1.15 service factor, continuous rating per NEMA MG1-1.40.
 - b. Unless otherwise noted on the mechanical contract drawings or specified.
 - 2. Motors installed outdoors, on roofs and out of building airstreams:
 - a. Squirrel-cage induction type, totally enclosed fan cooled, NEMA B design, class B insulation, up to 1 hp and Class F insulation above 1 hp 1.15 service factor, continuous duty unless otherwise noted on the contract drawings or specified.
- E. Motor shall be 1800 rpm single speed motors unless otherwise noted on the contract drawings.
- F. Motor type and application (less than ½ hp).
 - 1. Built in overload protection.
 - 2. Rewinding tap, permanent split capacitor type, unless otherwise noted on the contract drawings or specified.
 - 3. Suitable for service and location.
 - 4. Motor shall be 1800 rpm single speed motors, unless otherwise noted on the contract drawings.
- G. Motor voltages:
 - 1. Motors less than ½ hp: Single phase, 60 hertz, 120 volt, AC, unless otherwise indicated on the contract drawings.
 - 2. Motors ½ hp and up. Suitable for 3 phase, 60 hertz, 480 volt, AC power source, unless otherwise indicated on the contract drawings.
- H. Motor Efficiency Ratings And Construction
 - 1. Motors 1.0 hp up to 250 hp: Suitable for 3 phase, 60 hertz, 480 volt, AC power source, premium-efficient type, unless otherwise noted on the contract drawings as specified.

2. Guaranteed minimum power factor at full load and rated voltage and guaranteed minimum efficiency at full load and rated voltage when tested in accordance with IEEE Test Procedure 112A, Method B.
3. Premium-efficient type motors shall conform to the following efficiencies:

HP	Nominal Efficiencies For NEMA Premium Efficiency Motors Rated at 600 Volts or Less					
	Open Drip Proof			Totally Enclosed Fan-cooled		
	6 pole	4 pole	2 pole	6 pole	4 pole	2 pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7

4. Motors less than 1 hp shall be manufacturer's standard premium efficiency design.
 5. Motor nameplate shall be specially marked "energy efficient motor" or similar nomenclature.
 6. Motors built in accordance with current NEMA Standard MG-1 except as noted.
 - a. Motors NEMA Design B, NEMA T-frame sizes.
 - b. Insulation tested by manufacturer, Class F or better. Test per NEMA MG1-12.03.
 - c. Temperature rise limits in accordance with NEMA limits for insulation class, service factor and enclosure specified.
- I. Materials and Construction:
1. Motors up to 5 hp
 - a. Steel motor frames, cast aluminum end brackets, steel terminal box, copper windings.
 2. Motors 5 hp and larger:
 - a. Cast iron motor frames, cast iron end brackets, cast iron terminal box, copper windings.

3. TEFC Motors
 - a. Cast iron motor frames, cast iron end brackets, cast iron terminal box, copper windings, corrosion resistant fan internals, epoxy varnish coated for corrosion protection, cadmium plated hardware.
 - b. Severe duty motors:
 - 1) Cast iron construction (frame, end brackets and terminal box). External hardware, fan and fan cover coated or plated to prevent corrosion or corrosion-resistant material. Air gap surfaces coated with epoxy or zinc chromate. Shafts with rotating shaft mounted slingers or seals to prevent entry of contaminants at each end. Epoxy insulation system where used in high-moisture and corrosive atmospheres.
 4. Sound-power levels no greater than recommendations of NEMA (MG1-12-49).
- J. Motors 1/2 hp and above, conform to following:
1. Bearings: Antifriction type with bearing housings equipped with easily accessible plugged provisions for relubrication. Minimum L-10 life of 100,000 hours based on direct drive equipment. Bearing housings shall be equipped with grease openings for simultaneously adding new grease and purging the old grease. Provide corrosion resistant plugs or caps on grease openings.
 2. Belt-connected motors: NEMA foundation slide base and shaft as required for aligning pulleys. Minimum L-10 life based on belt drive shall be 40,000 hrs.
 3. Motor enclosure: Suitable for service and location.
- 2.4 MOTOR DISCONNECT (Provided by 26 00 00)
- A. Provide only devices of Specification Grade, UL listed and labeled, manufacturer's certification to meet applicable Federal Specifications, and to meet NEMA performance standards.
 - B. Disconnects shall be "Heavy Duty Type" (If integral to equipment).
 - C. Single phase disconnect switches: Two pole toggle operated AC manual motor starting switch without overload protection for single phase motors.
 - D. Three phase disconnect switches: 3 pole fusible or unfusible as required; 250 or 600 volt as required in NEMA 4 enclosures.
 - E. The operating handle for three phase disconnect switches shall be of the box-mounted type that directly drives the switch mechanism.
 - F. Three phase disconnect switches shall have a defeatable, front accessible, interlock to prevent the opening of the cover when the switch is in the "ON" position and prevent turning the switch "ON" when the door is open.

- G. Solid neutral: Provide as required.
- H. Provide ground lug for ground wire termination.
- I. All disconnects shall be lockable.
- J. Operating handle: Lockable in either open or closed position.
- K. All motor disconnects shall be horsepower rated.
- L. Feed through or double lugged: UL approved for the purpose.
- M. Installation:
 - 1. All switches shall have a nameplate indicating the circuit number feeding the switch. Nameplate shall be laminated black with white letters engraved.
 - 2. Install a motor disconnect switch with every motor unless noted otherwise on mechanical equipment schedules.

2.5 MOTOR CONTROLLERS (Provided by 26 00 00)

- A. Manual motor controller (If integral to equipment):
 - 1. For single phase motors, provide H-O-A switches with thermal overload.
 - 2. 2-speed: Fast-slow-off selector switch with overload protection for each speed, with pilot lights for slow and fast speed.
- B. Magnetic motor controller (If integral to equipment):
 - 1. Provide magnetic contactors with three overload relays, for motor running overload protection, per NEC.
 - 2. 120 Volt holding coil.
 - 3. Provide status pilot light in cover, red for energized. Pilot light shall be operated by an extra interlock (not placed across holding coil). Pilot light shall be long life (130 volt) type 6S6 incandescent lamps.
 - 4. Provide reset button, and Hand-Off-Automatic switch in cover, field convertible to Off-Auto or Start/Stop pushbutton.
 - 5. Provide one set of convertible auxiliary contacts in addition to standard auxiliary holding contacts supplied with each contactor.
 - 6. Provide control transformer 120 volt secondary of sufficient capacity to handle operating coil and associated controls plus 75 volt amps.
 - 7. Provide surface mounted starters in NEMA Type 1 enclosure for indoor applications and NEMA Type 4 enclosure for outdoor applications.

8. Contacts shall be solid-silver cadmium oxide alloy which will not require any filing, dressing or cleaning throughout the life of the control equipment. Bare copper or silver flashed contacts shall not be permitted.
 9. Operating coils shall be pressure molded. When a coil fails under over-voltage condition, the motor controller shall drop out.
 10. Overload relays shall be of the hand-reset, trip-free variety so that blocking the reset mechanism in the reset position will not prevent the starter from dropping out if the motor is overloaded. This specifically excludes those overload relays which change to automatic reset from hand-reset when the reset mechanism is blocked unless the automatic reset feature can be removed or voided. Accidentally depressing the reset button or mechanism shall not shut off the motor. Overload relays shall not be field convertible from hand to automatic reset type.
 11. Disconnect switch shall be provided under Division 26 unless otherwise noted.
 12. Where specified, motor hp rated disconnect switches shall be provided in NEMA 1 enclosure for indoor applications and NEMA 4 enclosures for outdoor applications.
 13. Provide full coordination between settings or ratings of protective devices in accordance with the NEC.
- C. Combination motor controller (only where indicated on the contract drawings or specified).
1. Provide molded case circuit breakers with rotary operating handle and lock-off facility.
 2. Restrict opening of switch enclosure by the use of a defeater screw unless switch is in the OFF position.
 3. Provide contactors with three overlay relays.
 - a. 120 Volt holding coil.
 - b. Provide status pilot light in cover, red for energized. Pilot light shall be operated by an extra interlock (not placed across holding coil) Pilot lights shall be long life (130 volt) type 6S6 incandescent lamps.
 4. Provide reset button, and Hand-Off-Automatic switch in cover, field convertible to Off/Auto or Start/Stop pushbutton.
 5. Provide one set of auxiliary contacts in addition to standard auxiliary hold contacts supplied with each contactor.
 6. Provide control transformer 120 volt secondary of sufficient capacity to handle operating coil and associated controls plus additional 75 volt amps.

7. Time-delay relays shall be adjustable, pneumatic type, 2 to 60 seconds and operate on 120 volts, 60 hertz. They shall have at least one normally open and one normally closed timed contact. The type of operation is as indicated or required.

PART 3 – INSTALLATION

3.1 MOTORS

- A. Coordinate with appropriate trades.
 1. Motor and base mounting requirements.
 2. Motor electrical requirements.
- B. Motors shall be installed in accordance with manufacturer's installation instructions.
- C. Motors shall be installed in accordance with all applicable codes.

3.2 CONTROLLER

- A. Provide all controllers not indicated on Electrical drawings.

END OF SECTION

SECTION 23 05 14

VARIABLE FREQUENCY DRIVES

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish variable frequency drives (VFDs) for mechanical equipment as scheduled on the drawings and specified herein. The term VFD shall refer to the entire assembly including but not limited to the by-pass.
- B. The VFDs shall be installed and wired by the electrical contractor. Coordinate work with the electrical contractor.
- C. The VFD's shall comply with the latest applicable standards of ANSI, IEEE, NEMA, NEC, UL and City Test Lab. The controllers shall be rated as indicated. As a minimum, the full load output current of the drive shall be equal to the equivalent motor horsepower as listed by NEC Table 430-150.
- D. Drive horsepowers shall be minimum size as indicated. Coordinate size with driven equipment manufacturer.
- E. Provide UL listed, accessory reactors to be UL listed. Bypass panels shall be constructed of UL recognized components assembled in a UL listed enclosure in strict accordance with the NEC for electrical safety. In addition, the assembly shall be UL listed.
- F. All exterior VFD applications shall be NEMA-3R rated.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 - ELECTRICAL AND FIRE ALARM

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. IEEE: Institute of Electrical and Electronic Engineers
2. NEMA: National Electrical Manufacture's Association
3. MG 1-78: Motors and Generators
4. NEC: National Electrical Code
5. ANSI: American National Standards Institute
6. UL: Underwriter's Laboratories

1.5 SUBMITTALS

A. See Section 23 05 00 and General Condition for additional requirements.

B. Product Data: Provide product description and list of materials, including the following:

1. Harmonic calculations
 - a. List of all drives.
 - b. Simplified one line diagram indicating linear as well as drives, transformers and PCC.
 - c. Technical description of the program used for the calculations.
 - d. Description of all inputs and outputs from the program.
2. Complete drawings furnished and approved before proceeding with manufacture. Drawings shall consist of a specific bill of materials, connection diagrams and suitable outline drawings showing details necessary to locate conduit stub-ups and field wiring.
 - a. Details including all labeling.
 - b. Assembled panel short circuit rating and how it will be labeled.
 - c. Heat release of the drive.
3. Description of field testing.
 - a. Proposed schedule of testing indications coordination with occupancy.
4. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

- A. Manufacturers must have more than ten (10) years of documents experience in the design, testing and manufacturing of specified or similar products.
- B. Manufacturer must provide written certification that the products provided meet or exceed the specification requirements. An executive officer of the company must sign the written certification.

1.7 WARRANTY

- A. Attention is directed to provisions of the General Conditions and Supplementary General Conditions regarding guarantees and warranties for work under this Contract.

- B. Manufacturers shall provide guarantees for work under this Contract. However, such guarantees shall be in addition to and not in lieu of all other liabilities which the manufacturer and the Contractor may have by Law or by other provisions of the Contract Documents.
- C. All materials, items of equipment and workmanship furnished under each Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Contractor including all other damage done to areas, materials and other systems resulting from this failure.
- D. The Contractor shall guarantee that all elements of the systems provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- E. Upon receipt of notice from the Owner's representative of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by the Contractor, within three (3) working days, at no cost to the Owner.
- F. The Contractor shall furnish a written guarantee covering the above requirements before the final payment is made.

PART 2 – PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

- A. General
 - 1. Provide a complete variable frequency drive (VFD) (in a single enclosure) of capacity, quantity and characteristics as described in this specification and as shown and scheduled on the drawings. Acceptable manufacturers contingent on compliance with specifications are:
 - a. Acceptable Manufacturers
 - 1) ABB
 - 2) Square D
 - 3) General Electric
 - 4) Eaton Cutler-Hammer
 - 5) Danfoss
 - 2. All VFDs shall be of the same manufacturer.
 - 3. Each drive and assembly shall be U.L. listed and labeled.
 - a. Label shall include the AIC rating for the assembly which shall not be less than 100,000 AIC. Any unit shipped without such label shall be removed from the job with NO EXCEPTIONS. This also includes six pulse drives with or without bypasses.
 - b. All exterior mounted VFD's shall be NEMA-3R rated.
 - 4. Each drive shall be mounted with its accessories in a single cabinet.
 - 5. Installation and start-up services for the equipment shall be covered by this specification.

6. Input control signal shall be compatible with automatic controls and/or building automation control system. Submit written, signed off coordination with submittal.
7. Complete drawings shall be furnished and approved before proceeding with manufacture. Drawings shall consist of a specific bill of materials, connection diagrams and suitable outline drawings showing details necessary to locate conduit stub-ups and field wiring.
8. The VFD shall comply with the latest applicable standards of ANSI, IEEE and NEMA. The controllers shall be rated as shown in the drawings. As a minimum, the full load output current of the drive shall be equal to the equivalent motor horsepower as listed by NEC Table 430-150.
9. Drive horsepowers shall be minimum size as indicated. Coordinate size with driven equipment manufacturer.
10. The VFD manufacturer shall supply with submittal information, harmonic calculations made in accordance with IEEE 519-1992 Standards showing the specified THVD, line notching and the specified THCD limits are met. Calculations shall assume worst case system conditions. System 1-line, 480V transformer data, standby generator data, and primary fault current data required to make these calculations are provided in the system short circuit study and can be obtained from the Electrical Contractor. The submittal shall include, as a minimum, the following information:
 - a. All input data and assumptions.
 - b. Explanation of method used to perform the analysis.
 - c. All calculations and computer printouts used in the analysis, including input documentation.
 - 1) List all drives and accessories.
 - 2) Explanation of all inputs
 - 3) Explanation of all outputs.
 - d. A system impedance diagram based on the Electrical one-line diagrams. It shall be the drive manufactures responsibility to obtain all information required.
 - e. All calculations shall be in accordance with IEEE 519 with all drives at 100% speed. The point of common coupling shall be the secondary connection of the transformer supplying that group of devices. These calculations shall be done with the transformer loaded to no more than 70% of its nominal capacity (without fans). These calculations shall also be done with all drives running.
 - f. Each point of common coupling shall be defined as the secondary side of the transformer that feeds that group of drives. At the point of common coupling, the following numbers shall meet with the maximum load on the transformer no greater than 70% of its nominal capacity.
 - 1) **Total harmonic voltage distortion is less than 3%**
 - 2) **Total harmonic current distortion is less than 5% and harmonic table requirements $I_{SC} / I_L < 20$**

- g. A detailed description of the tests, procedures and supporting calculations required to substantiate the installed systems compliance with the specified THD limits.
 - 1) The description shall include information on the proposed test equipment and test conditions.
 - 2) Include the name and qualifications of the firm which will conduct the field tests.
- 11. Drives shall be capable of the full rated motor horsepower at all carrier frequencies of that drive.

B. Construction

- 1. All Motor Sizes
 - a. All VFD's shall be 6-pulse (or greater) input. Provide data and calculations showing the drive harmonics.
 - b. 5% line reactors shall be provided on each drive as a minimum.
- 2. Harmonic Table

ISC / I _L	Harmonic Order (Odd Harmonics)					THD
	H<11	11<h17	17<h23	23<h35	35<h	
<20	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

- 3. Integral Passive Filter (Each VFD)
 - a. Acceptable Manufacturers of Passive Filters
 - 1) MTE Matrix – Model AP
 - 2) TCI – Model HG7
 - b. The harmonic filter combination with the adjustable frequency drive shall meet all requirements specified in the 1992 edition of IEEE standard 519 for individual and total harmonic voltage and current distortion. The Point of Common Coupling (PCC) for all voltage and current harmonic calculations and measurements shall be the input terminals of the harmonic filter. To assure that voltage source PWM inverters do not experience over voltage trips, the harmonic filter shall not cause the inverter bus voltage to increase by more than 5% when the filter is operating from the nominal distribution voltage. To assure that the filter will not reduce the life of a voltage source inverter's bus capacitor, the output current waveform of the harmonic filter and the input current waveform of the inverter shall be consistent with the

input waveform of an inverter fed from a drive equipped with a 3% minimum impedance line reactor.

- c. To ensure generator compatibility, the harmonic filter must never introduce a capacitive reactive power (KVAR), which is greater than 20% of its KVA rating. This shall be less than 5% at full load and less than 8% at 30% load.
- d. The filter shall not cause resonance with the power system or import harmonics from other sources. The no load voltage boost at the filter output shall be less than 5% above line voltage. The full-load voltage drop across the filter shall not exceed 5%. The filter shall be suitable for use on all six-pulse drives, either with or without line reactors or DC link chokes. The filter shall be supplied by the VFD manufacturer in a single enclosure with a common single power connection and be UL Listed and have an efficiency of 99% or greater. It shall not cause voltage elevation of the power line outside of normal tolerances at light loads or no load.

4. All Drives

- a. The VFD shall be of the pulse width modulated (PWM) design converting the fixed utility voltage and frequency to a variable voltage and frequency output via a 2-step operation. VFDs utilizing a 3rd power section are not acceptable. Efficiency shall exceed 96% at 100% speed and load. Line side displacement power factor shall exceed (0.95) regardless of speed and load. The VFD shall be rated for 110% current for (1) minute for variable torque loads and 150% current for (1) minute for constant torque loads.
- b. VFDs located indoors shall be housed in a signal NEMA 1 metal enclosure (including filters, line reactor, and other required accessories).
- c. Drives located outside shall be provided with a single NEMA 3R enclosure and an independent heating and cooling system to maintain manufacturer's ambient operating conditions.
- d. Drives located other than outside (submit list of all drives individually indicating):
 - 1) Space drive is located.
 - 2) Space ventilation is adequate, space air conditioning is adequate or the size of the cooling provided in the drive.
 - 3) Space heating is adequate or the size of the heater provided in the drive.
- e. Standard operating conditions shall be:
 - 1) Incoming 3-phase 480 VAC power, +5% or -10%, 60 Hz.
 - 2) Humidity 0 to 95% (non-condensing and non-corrosive).
 - 3) Altitude 0'-0" to 3,300'-0" above sea level.
 - 4) Ambient temperature 0° to 40°C.
- f. VFDs shall include the following system interfaces:
 - 1) Speed reference interface with a differential amplifier or isolated input 0-10 VDC or 4-20 mADC signal.

- 2) Run relay with an isolated set of Form C contacts.
 - 3) Minimum of 2 programmable contacts.
 - 4) Trip contacts (Form C).
 - 5) VFD will accept an external trip contact and indicate so on the display.
 - 6) Dedicated terminal blocks for interface with maintained remote start contacts.
 - 7) Output signal proportional to output frequency (0-10 VDC or 4-20 mADC).
 - 8) Output signal proportional to output current (0-10 VDC or 4-20 mADC).
 - 9) Provided with communications chip to provide complete interface with the ATC control and automation system.
- g. The VFD shall include the following protective features:
- 1) Lockable Fused disconnect (or breaker) rated for 100,000 AIC.
 - 2) Electronic instantaneous overcurrent protection.
 - 3) DC bus under-voltage protection.
 - 4) DC bus overvoltage protection.
 - 5) Ability to withstand output line-to-line short circuits without component failure.
 - 6) Status indication via an LED display of the following protective functions:
 - a) DC Bus under-voltage
 - b) Overcurrent
 - c) DC Bus Overvoltage
 - d) Controller over-temperature
 - e) Overload
 - f) Overload Warning
 - g) Over-frequency and Phase Loss
 - h) A single light to indicate a VFD trip is not acceptable.
 - 7) Overload capability shall be 110% of the inverter rating for (1) minute.
 - 8) Selectable auto restart.
 - 9) VFD will catch a motor spinning in the forward or reverse direction upon starting.
 - 10) Upon loss of the input signal (4-20 mA), the drive will stop or go to preset speed.
- h. Standard adjustments shall include:
- 1) Minimum frequency (4-60 Hz)

- 2) Maximum frequency (40-120 Hz)
 - 3) Minimum of three (3) preset speeds (4-120 Hz) initiated by contact closures
 - 4) Minimum of three (3) acceleration times (2-300 seconds)
 - 5) Minimum of three (3) deceleration times (2-300 seconds)
 - 6) Minimum speed dwell time (0-18 seconds)
 - 7) Voltage boost (0-40V) for starting torque control
 - 8) Adjustable Carrier frequency 700-8,000 Hz for motor noise reduction or flexible switching technology. This adjustment shall be without de-rating the drive or motor.
 - 9) Current limit (70-120%)
 - 10) Critical frequency avoidance ([2] bands with 10 Hz adjustable widths)
- i. Door mounted operator controls and status indication from the LED display shall include:
- 1) Run/stop selection and LED indication (keypad or remote)
 - 2) Speed control selection and LED indication
 - 3) Forward/Reverse selection
 - 4) Manual speed adjustment
 - 5) Frequency meter
 - 6) Motor RPM
 - 7) Ammeter
 - 8) Output voltage
 - 9) Elapsed time meter
- j. The keypad shall have an LED display. The reverse button and the programming functions may be locked out if desired.
5. The following list of options shall be included:
- a. Input lockable disconnect rated 100,000 AIC.
 - b. Thermal motor overcurrent relay.
 - c. Bypass which includes an output contactor electrically and mechanically interlocked with a bypass contactor, run relay including control logic, status lights and a thermal motor overcurrent relay. The complete bypass system and Inverter/Off/Bypass selector switch shall be packaged in a single VFD enclosure. The bypass shall include a starter.
 - d. Drives may be provided without bypass only when the drawing states that the specific drive shall not have bypass.
 - e. Electronics shall allow VFD to follow discrete increase speed and discrete decrease speed contact closures from a photohelic or similar device.
 - f. 120V control transformer and circuitry.

- g. Output line reactors or output filters when the drive location and the motor are more than 100 feet apart.
 - h. Interior heaters shall be provided to maintain the minimum drive temperature when the drive is off.
 - i. A Customer Interlock Terminal Strip – provide a separate terminal strip for connection of fire, smoke, freeze contacts and external start command. All external interlocks and start/stop contacts shall function with drive in hand, auto or bypass.
 - 1) Damper control circuit shall be operable in the hand, auto and bypass.
6. Service
- a. The VFD manufacturer shall provide a start-up service package for all VFDs provided. Service shall include inspector for final adjustment, operational checks, and a final report for record purposes. The service package shall include a (1) year parts and labor warranty and 2 year parts warranty each from date of written acceptance and be performed by local factory trained service engineers. The service center must be permanently located within (200) miles of the job site and able to provide 24-hour service.
7. Protection
- a. The VFD shall be protected against damage at all times. The drive shall be stored in a clean, dry environment with temperature and humidity within the range as specified by the drive manufacturer. Space heaters shall be energized controlled storage as recommended by the manufacturer. Storage space shall be environmentally controlled.
8. Factory Tests and Checks
- a. VFD power semiconductors and diodes shall be 100% inspected and tested, including load testing.
 - b. Small signal semiconductors, resistors, capacitors and diodes shall be lot sampled. Testing shall include parameter, as well as functional characteristics.
 - c. All printed circuit boards shall be tested under a temperature cycling (0°C to +65°C) 24-hour load test and then functionally tested via fault finder bench equipment prior to unit installation.
 - d. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The VFD shall trip electronically without device failure.
 - e. After all tests have been performed, each VFD shall undergo a 24-hour burn-in test. The drive shall be burned-in at 100% inductive or motor load for (24) hours without an unscheduled shutdown.
9. A (1) day training course for Owner's personnel shall be presented by representatives of the manufacturer at the jobsite.

PART 3 – EXECUTION

3.1 VFD INSTALLATION

- A. Install in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.
- B. Install to meet the Local and State Electrical Code and so as to ensure easy accessibility for service, removal, or replacement of all components.
- C. Provide supplemental steel, support, rods and hangers necessary to hang or mount VFDs.
- D. Receive and inspect VFDs to ensure they are without defect. Defective or damaged VFDs shall be returned to the manufacturer.
- E. Protect equipment to prevent damage from water, dirt, or accident. Protection shall include, but not be limited to, temporary plastic wrap to maintain equipment in original factory condition.
- F. Wiring installation and handling shall be in accordance with manufacturer's recommendations.

3.2 FIELD TESTS AND CHECKS

- A. Testing, checkout and start-up of the VFD equipment shall be performed under the technical direction of the manufacturer's service engineer. Under no circumstances are any portions of the drive system to be energized without authorization from the manufacturer's representative.
- B. The Contractor shall provide independent harmonic testing by an independent testing company. Provide readings with printouts of the harmonic current at each harmonic as well as the total voltage distortion. The following readings shall be provided:
 - 1. At each point of common coupling:
 - a. With all drives running with load
 - b. With all drives off
 - 2. At the power connection to each drive:
 - a. With the drive running loaded
 - b. With drive off
 - 3. All the above data shall be submitted to the Architect for review. If these tests shown that the drives are not in compliance with the Specifications, the drive manufacturer shall make all changes required to comply with the Specifications at no cost to the Owner. If required, this could mean replacing the drives that are not in compliance.
 - 4. A copy of all tests and checks performed in the field, complete with meter readings and recordings, where applicable, shall be submitted to the Owner for this record.

END OF SECTION

SECTION 23 05 16

PIPE EXPANSION

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all necessary offsets, joints, expansion loops, anchors, guides, hangers, flexible hoses and flexible pipe loops so that no stress is placed on the piping systems or equipment due to thermal expansion.
- B. Make proper provision for expansion and contraction in all parts of piping systems wherever possible by means of pipe bends, pipe offsets, swing connections or changes in direction of piping.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASME B31.9 – Building Services Piping.
 - 2. ASME B16.5 – Pipe Flanges and Flanged Fittings.
 - 3. ASTM A 269 – Standard specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

4. EJMA (STDS) – Standards; Expansion Joint Manufacturers Association; 1993.
5. MIL-E-17814 – Expansion Joints, Pipe, Slip-Type, Packed

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional information.
- B. Product Data:
 1. Flexible Pipe Hoses, Loops & Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot and per assembly, fundamental frequency of assembly, braid structure and total number of wires in braid.
- C. Design Data: Indicate selection calculations.
- D. Complete expansion, stress, and seismic calculations.
- E. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures and external controls.
- F. Project Record Documents: Record installed locations of flexible pipe hoses, loops & connectors, anchors and guides.
- G. Maintenance Data: Include adjustment instructions.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products of the type specified in Part 2 – Products.
- B. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- C. Welders: Certify in accordance with ASME.

1.7 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system and ASTM F708 for design and installation of pipe supports.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
 1. Provide certificate of compliance from authority having jurisdiction, Indicating approval of welders.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All anchors, guides, hangers, flexible hoses, loops & connectors shall be delivered in containers and shall be kept in a dry and protected area.

- B. All anchors and guides, where exposed, shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

1.9 ENVIRONMENTAL

- A. Do not paint or install, anchors or guides, hangers and flexible hoses, loops & connectors when:
 - 1. Environmental conditions are outside the specific limitations of the referenced codes and/or manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 ENGINEERING SERVICES

- A. The Contractor shall retain a registered Professional Engineer licensed to practice in the project state to review all loads imposed on the building structure and piping system to assure that no points are overstressed.
- B. The maximum allowable stress shall be 15,000 psi for hot water.
- C. The Contractor shall submit shop drawings with calculations (with P.E. stamp) detailing the proposed anchor locations for review.
- D. All anchor details and forces shall be submitted to the project structural engineer for review prior to any installation.

2.2 GENERAL

- A. Make proper provision for expansion and contraction in all parts of piping systems:
 - 1. Hot water
- B. Wherever possible, provide expansion and contraction by means of pipe bends, pipe offsets, swing connections or changes in direction of piping.
- C. Securely anchor all piping utilizing expansion loops to the building structure with steel angles, properly braced and welded to the pipe.
- D. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
 - 1. Anchor & Guides
 - a. Keflex, Inc.
 - b. Metraflex
 - c. Robertshaw-Fulton
 - d. Senior Flexonics Pathway
 - e. PHD Manufacturing, Co.
 - 2. Flexible Expansion Loop
 - a. Metraflex (Metraloop)

- b. Flexonics
- c. Adesco
- d. American BOA

E. Temperature and pressure suitable for the service.

2.3 ANCHORS AND GUIDES

A. Flexible Expansion Loop (Seismic Applications):

1. All equipment, rigidly mounted on vibration isolators, shall be attached to the piping system using flexible loops designed for seismic movement. Flexible loops shall be capable of movement in the X, Y, and Z planes and must completely isolate the equipment from the piping. System design engineer shall determine the amount of seismic movement required by the Uniform Building Code and/or other applicable codes.
2. All piping passing through building seismic joints shall contain a flexible expansion loop designed for seismic movement. Flexible loops shall be located at or near the building seismic joint. A vertical support hanger, located within 4 pipe diameters, shall be installed in each side of the flexible loop. Each hanger to be transversely and longitudinally braced per local codes. Seismic bracing shall not pass through building seismic joint and shall not connect or tie together different sides or parts of building structure. Flexible loops shall be capable of move in the X, Y and Z planes. System design engineer shall determine the required amount of seismic movement required by the Uniform Building Code and/or other applicable codes.
3. Flexible expansion/seismic loops shall consist of two flexible sections of hose and braid, two 90" elbows and a 180" return assembled in such a way that the piping does not change direction, but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180" return, and a drain/air release plug. Flexible loops shall impart not thrust loads to system support anchors or building structure. Flexible lops may be installed to accommodate both thermal and seismic motion. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings. Movement capabilities and location, relative to seismic separation, shall be determined by system design engineer and manufacturers recommendations.

B. Flexible Expansion Loop (Thermal Applications):

1. Provide flexible expansion loops of size and type noted on drawings. Flexible loops shall consist of two flexible sections of hose and braid, two 90" elbows, and a 180" return assembled in such a way that the piping does not change direction but maintains its course along a single axis. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180" return, and a drain/air release plug. Flexible loops shall impart no thrust loads to system support anchors or building structure. Loops shall be installed in a neutral, pre-compressed or pre-extended condition as required for the application. Install and guide per manufacturer's recommendations. Materials of construction and end fitting type shall be consistent with pipe material and equipment/pipe connection fittings.

C. Anchors & Guides

1. Pipe guides shall be of spider and sleeve type to insure multiplanar guiding and to allow complete insulation of the piping and shall be covered inside and outside with protective coating. Top half shall be removable.
2. Guides shall be installed in accordance with "Standards of the Expansion Compensators Mfrs. Assn.", latest edition.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All mains and risers having expansion offsets shall be securely anchored to the building construction in such a manner as to throw all expansion towards the offsets or joints.
- B. All anchors shall be constructed from heavy steel and connected to the building construction. Anchors shall be furnished with turnbuckles or other suitable means for adjustment.
- C. Contractor shall be responsible for any additional structural members that may be required for proper installation of hangers, anchors, guides and supports.
- D. The method of securing the anchors to the building construction must be approved by the Architect prior to installation.

END OF SECTION

SECTION 23 05 19

HYDRONIC PIPING SPECIALTIES

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Secure all permits and local/state approvals for the installation of all components included under this Section.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. ASME: American Society of Mechanical Engineers
- C. ANSI: American National Standards Institute
 - 1. B16.1: Cast Iron Pipe Flanges and Flanged Fittings
 - 2. B16.3: Malleable Iron Threaded Fittings
 - 3. B16.4: Cast Iron Threaded Fittings
 - 4. B16.5: Pipe Flanges and Flanged Fittings
 - 5. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 - 6. B31.1: Power Piping

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- 1.6 QUALITY ASSURANCE
- A. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- 1.7 REGULATORY REQUIREMENTS
- A. Conform to ASME B31.9 code for installation of steam and condensate piping systems including specialties.
 - B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- 1.8 DELIVERY, STORAGE AND HANDLING
- A. Provide temporary end caps and closures piping and fittings. Maintain in place until installation.
 - B. Protect piping systems and specialties from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- 1.9 ENVIRONMENTAL
- A. Do not install equipment when environmental conditions are outside the specific limitations of the referenced codes and manufacturer's recommendations.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide Thermometers and Pressure Gauges:
 - 1. At each heating coil
 - 2. As shown on the drawings
 - 3. As required
- B. Thermometers and pressure gauges shall be provided for the above described equipment regardless of pipe size. If pipe size is such that the installation of wells or taps is not feasible, then oversized pipe to accommodate the above installation requirements.
- C. No products containing mercury will be acceptable.

2.2 THERMOMETERS

- A. Acceptable manufacturers subject to compliance with the specifications.
 - 1. Trerice
 - 2. Weksler
 - 3. Moeller
 - 4. Taylor
- B. All thermometers in liquids shall have separable sockets.
- C. Thermometers shall be with glass fronts, aluminum or phenol cases, and adjustable as required for ready reading from the floor.
- D. All thermometers shall use non-toxic liquid filled magnifying lens front tubes.

- E. All thermometers shall have 9" scales and 12" cases.
- F. All thermometers shall be accurate to $\pm 1\%$ of scale range.
- G. Thermometer ranges shall be selected so that the normal operating range of each will occur in the middle half of the total range and so that under minimum and maximum conditions thermometers will not be harmed.

2.3 THERMOMETER WELL

- A. 304 or 316 stainless steel tapered shank.
- B. Where installed in insulated systems provide extended neck.
- C. 3/4 inch NPT process connection; 1/2 inch NPT instrument connection and nominal 1/4 inch bore.

2.4 PRESSURE GAUGES

- A. Acceptable manufacturers subject to compliance with the specifications.
 - 1. Terice
 - 2. Weksler
 - 3. Dresser
 - 4. Fisher & Porter
- B. Except for the automatic temperature control system, gauges shall be constructed with bourdon type bronze tubes, stainless steel movements, white dials, black micrometer adjustable points, aluminum or phenol surface mounted beaded cases, matching aluminum or phenol screwed rings and bottom connections. All gauges shall have 4 1/2" diameter cases. All gauges shall be accurate to 1% of scale range.
- C. Gauge ranges shall be selected such that the normal operating range of each will occur in the center of the total range and under minimum and maximum conditions no gauge will be harmed.
- D. All gauges shall be provided with needle valves
 - 1. Barstock needle Valves shall be equal to:
 - a. Crane
 - b. Edward
 - c. Dresser.
 - d. WAIK Instrument Corp.
- E. Pressure Gauges installed in pump discharge piping shall be provided with snubbers equal to Ray.

2.5 AIR VENTING AND DRAINAGE

- A. Manual air vent.
 - 1. Provide hose end ball valves, (minimum size 1/2" with chains and caps), or larger where shown or required by the service.
 - 2. See HVAC Valve specification
- B. Automatic air vent.

1. Acceptable manufactures subject to compliance with the specifications:
 - a. Armstrong
 - b. Bell and Gossett
 2. Float type with isolating valve, cast iron body, stainless steel float, stainless steel valve, and valve seat. Suitable for 300 psig operating pressure and 300 degrees F system temperature.
 3. Vents shall be designed to eliminate air from the system automatically without permitting the passage of water.
 4. Minimum size shall be ¾" or as indicated or required.
 5. Similar to Armstrong Model 1-AV.
- C. Drains
1. Provide ball valves with capped hose connections, (minimum size 3/4"), or larger where shown or required by the service.
 2. All drain valves shall have hose end connections with cap & chain.
 3. See HVAC Valve specifications

PART 3 – EXECUTION

3.1 THERMOMETER INSTALLATION

- A. Shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.
- B. Shall be turned as such to be readily visible from the operating floor.
- C. Thermometers subject to vibration or physical damage shall be adequately supported and protected.

3.2 THERMOMETER WELL

- A. Shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.

3.3 PRESSURE GAUGE INSTALLATION

- A. Shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.
- B. Shall be turned as such to be readily visible from the operating floor.
- C. If the gauge is more than 8'-0" above the floor or cannot otherwise be made readily readable, extended pipe connections gauge to a readable location.
- D. Gauges subject to vibration or physical damage shall be adequately supported and protected.

3.4 AIR VENTING INSTALLATION

- A. Manual air vent
 1. Provide all high points in closed water piping systems shall be relieved of air through accessible manual vents on the high points of the pipe lines and at the equipment. Vent valves on piping and equipment shall be 1/2" ball valves with chains and caps and with discharge pipes to convenient points for catching discharge.

2. Provide access doors to all vents.
- B. Automatic air vent
1. Provide as indicates and at expansion tank connection to main pipe.
 2. Pipe to spill over floor drain or sink.
- 3.5 DRAINAGE
- A. Pitch all piping for drainage through equipment or through accessible drain valves so that system can be conveniently freed of water by gravity flow.
 - B. Provide drains from boilers with neutralization kits. Discharge drains to nearest floor drain.

END OF SECTION

SECTION 23 05 25

HVAC VALVES AND STRAINERS

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Divisions Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all shut-off, check, balancing and other type valves and strainers as shown and as required to make a complete and operational system.
- B. Provide isolation valves at all drains, piping mains and branches at all piping systems, equipment, risers and before and after all control valves.
- C. Secure all permits and local/state approval for the installation of all components included under this Section.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. MSS SP-67 – Butterfly Valves Manufacturers Standardization Society of the Valve and Fittings Industry.
 - 2. MSS SP-69 – Pipe Hangers and Supports – Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry.
 - 3. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry.
 - 4. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry.

5. MSS SP-11- Ball Valves Threaded, Socket-Welding, Solder Joint, Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry.
6. UL 1479 – Standard for Fire Tests of Through-Penetration Firestops; Underwriters Laboratories Inc.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Include data on valve materials, pressure class, construction, dimensions, and ratings. Provide manufacturers catalogue information. All valves of one type shall be by one specific manufacturer.
- C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- D. Project Record Documents: Record actual locations of all valves and valve tag numbers.
- E. Maintenance Data: Include spare parts list and exploded valve assembly views.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing valve and strainer products specified in this section, with documented experience.
- B. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- C. All valves and strainers shall contain manufacturer's name and pressure class marked on the valve body.

1.7 REGULATORY REQUIREMENTS

- A. Perform Work in accordance with all State and Local codes.
- B. Conform to all State and Local code for installation of boiler safety valves and backflow prevention devices.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

PART 2 – PRODUCTS

2.1 GENERAL

- A. One valve manufacturer's figure numbers are listed; valves from other manufacturers listed in the list of acceptable manufacturers will be accepted.
- B. Provide all shutoff, check, balancing and other types of valves and strainers as shown on the drawings and required for proper operation, maintenance, isolation, and safety of all piping systems.
- C. Provide isolation valves at all drains and piping mains and branches for all water piping, at all equipment connections and before and after automatic control valves.
- D. Face-to-face and end-to-end dimensions of flanged iron body valve shall conform to ANSI B16.10. Design workmanship, materials and testing shall conform to MSS-SP-70 (gates), MSS-SP-71 (swing checks) and MSS-SP-85 (globe).

- E. All valves or strainers of the same type shall be of the same manufacturer. Before purchasing any valve, the Contractor shall submit for approval the name of the manufacturer, the figure number which he proposes to furnish and engineering data on each figure number. For acceptable manufacturers, see schedules herein.
- F. All valves used for balancing purposes, shall have memory stops.
- G. Valves and strainers shall be rated in accordance with the "Spec. Class No." Specified for that system.

2.2 ACCEPTABLE MANUFACTURERS CONTINGENT ON COMPLIANCE WITH THE SPECIFICATIONS

- A. Butterfly Valves
 - 1. High Performance
 - a. Jamesbury
 - b. Bray
 - c. Keystone
 - d. Flow Seal
 - e. WKM
- B. Flow Control Balancing Valves
 - 1. Tour & Andersson / TA Hydronics
 - 2. Armstrong
 - 3. Macon Balancing
- C. Check Valves
 - 1. Swing
 - a. Walworth
 - b. Kitz
 - c. Powell
 - d. NIBCO
 - 2. Silent
 - a. Mueller Steam Specialty
 - b. Mission Valve
 - c. Williams Hager
 - d. NIBCO
- D. Vacuum Breakers
 - 1. Sarco
 - 2. Armstrong
- E. Ball Valves
 - 1. Apollo
 - 2. Kitz
 - 3. NIBCO

- F. Strainers
 - 1. Y Type
 - a. Elliot
 - b. Armstrong
 - c. Mueller Steam Specialty
 - d. Sarco

2.3 VALVE CHART

Service	Minimum Class and Material		Joints	
	2" and Less	2½" to 12"	2" and Less	2½" & Up
Hot water supply and return	MSS Class 150 Bronze	MSS Class 125 Cast Iron	Threaded	Flanged
Makeup and fill	MSS Class 150 Bronze	MSS Class 125 Cast Iron	Threaded	Flanged
Miscellaneous drains 2½" and up		MSS Class 125 Cast Iron		Flanged

2.4 BALL VALVE

- A. Up to 2" (for water 200°F and below)
 - 1. Full port
 - 2. All stainless steel ball and stem
 - 3. Extended stem for insulation
 - 4. Two-piece bronze body
 - 5. 600 PSIG WOG
 - 6. 150 PSIG steam trim
 - 7. Threaded
 - a. Similar to Apollo Fig. 77-140-64
 - 8. Soldered
 - a. Similar to Apollo Fig. 77-240-64

2.5 SILENT CHECK VALVES

- A. Spring Loaded, Globe Type
 - 1. Screwed
 - a. Similar to Mueller 303 BP.
 - 2. Cast steel body, stainless steel trim for valves above 150 psi.
 - 3. Flanged
 - a. Similar to Mueller 105 MAP.

2.6 FLOW CONTROL BALANCING VALVES

- A. Balancing valves shall be installed, as shown on the drawings and as required, to ensure the accurate balancing of all flows in the hydronic heating and cooling systems. The balancing shall meet the specified water flows with a maximum tolerance of $\pm 5\%$.
- B. Valves shall be of the "Y" pattern globe style design and must offer a minimum of (4) full rotations of the hand wheel for accurate adjustment and for precise flow control.
- C. Valves shall exhibit an accuracy of $\pm 5\%$ within the normal operating range.
- D. Valves shall have integral self-sealing metering ports for measuring differential pressure, flow rates and temperature. Ports shall be protected with individual threaded caps.
- E. Valves must offer 100% positive, leak-proof shutoff against the same fluid pressure as the valve body rating to a nominal value of 300°F
- F. Valves sizes 1/2" to 2" similar to TA (STAD/S) shall have a digital hand wheel for positioning accuracy. Provide a transparent dust/paint cover to prevent destruction of the digits during construction. Sizes 2 1/2" to 12" similar to TA (STAF/G) shall have a numerical Vernier sleeve for position readout.
- G. All balancing valves must offer a hidden memory feature to prevent unauthorized adjustment and to ensure a return to the original setting after shutoff.
- H. All balancing valves shall comply with international quality standard ISO 9001.
- I. Valves larger than 12": use lubricated plug valve.
- J. All balancing valves size 1/2" to 2" shall be manufactured from pressure diecast dezincification resistant AMETAL copper alloy which does not require dielectric fittings. Valve bodies size 2 1/2" to 12" shall be manufactured from a cast iron equivalent to ASTM 35B with all wetted, moving parts of dezincification resistant AMETAL copper alloy.
- K. This valve may be 1/2" with a reducer and increaser to 3/4" pipe as required for balancing. This is the only type of valve that can be 1/2".

2.7 BUTTERFLY VALVES

- A. High Performance (For services above 150°F and or above 150 PSIG)
 - 1. Sizes 2 1/2" and larger shall be an **ANSI class valve** equal to or greater than the class specified for the service but in no case be less than ANSI Class 150.
 - 2. Body carbon steel with a fully lugged body suitable for bi-directional tight shut off to full rated pressure without a downstream flange.

3. Valve shall have no disk contact with the seat when in the open position or any intermediate position. Seal suitable for the operating service and operating temperature plus 50°F.
4. Bearings shall be constructed of SS/Graphite.
5. Seats shall be Xtreme (X).
6. Valve shall be of the double off-set design.
7. The disk shall be 316 stainless steel.
8. The shaft shall be 17-4 PH stainless steel.
9. The disk pin shall be 316 or 17-4 stainless steel.
10. Seat retainer ring fasteners shall not in contact with system fluid.
11. The disk shall be stainless steel.
 - a. Operator
 - 1) Lever Operator for Valve Sizes Less than 6".
 - a) Infinite Positioner: Ductile iron ASTM A536. Provide operator with position indicator which shall also indicate "open" and "closed" position. Provide memory stop.
 - 2) Gear Operator for Valve Sizes 6" and Greater.
 - a) Cast iron ASTM A126 Class B housing. Bronze shaft bearings. Steel ASTM A216 worm gear. Ductile iron ASTM A536 segment gear. Ductile iron ASTM A536 hand wheel. Minimum hand wheel diameter shall be 12" for valve sizes through 20".. Provide operator with position indicator and shall also indicate "open" and "closed" position. Provide memory stop. All gearing shall be enclosed in a housing.
 - b. Similar to Neles-Jamesbury series 815 High performance wafer sphere butterfly valve.

2.8 STRAINERS

A. General

1. Screwed ends to 2", flanged ends 2 1/2" and up.
2. Body
 - a. 150 lbs. WSP Class, cast iron up to 150 psi. Note cast brass may be used for copper piping systems.
3. Screen
 - a. 316 Stainless steel or Monel.
 - b. Free area not less than 2.5 times inlet area.

- c. Perforations (unless noted otherwise)
 - 1) Water
 - a) Up to 4": 1/16"
 - b) 6" & 8": 1/8"
 - d. Construction
 - 1) Screen wire gauge to suit size and service.
 - 2) Reinforced.
- B. Y Type
- 1. Screwed
 - a. Faced cap, straight thread, and gasket.
 - b. Similar to Mueller Steam Specialty Muessco #251-FC.
 - c. For 125 psig copper systems similar to Mueller Steam Specialty 358S.
 - d. For 150 psig copper systems similar to Mueller Steam Specialty 352M.
 - 2. Flanged
 - a. Bolted cover.
 - b. Similar to Mueller Steam Specialty Muessco #751 or #752.

PART 3 – INSTALLATION OF VALVES AND STRAINERS

3.1 VALVES

- A. Provide valves as noted and as indicated on drawings.
- B. Shutoff Valves
 - 1. Inlets and outlets of equipment.
 - 2. All branch connections to mains.
 - 3. As noted.
- C. Check Valves
 - 1. Pump Discharges: Silent check valves
 - 2. Other Locations: Types as noted
- D. Valves
 - 1. Accessible, but no valve handles pointing down below horizontal position. Removable without separating or lifting piping in which valves are installed. Provide cap screws on threaded bodies. Where abutting flanged strainers or similar devices, position valve with respect to device so as to permit removal of bolts.
- E. Drain valves at low points in water piping and where noted.
 - 1. In Equipment Rooms
 - a. Up to 3" Pipe: 3/4" ball valve

- b. 4" to 8" Pipe: 1 1/2" ball valve
- 2. 1/2" drain valve with capped hose connection except in equipment rooms.
- F. Where possible install butterfly valves with stems in horizontal position and with the low point of disc opening with the direction of flow.
- G. Provide stem extensions on all valves such that hand wheel or lever extends beyond insulation and is operable.
- H. All butterfly valves in water services above 150°F shall be of the high-performance type.
- I. Use flow control balancing valves for throttling service.
- J. Provide spring loaded silent type check valves on discharge of pumps.
- K. Install swing check valves in horizontal position only.
- L. Provide drain valves at low points between valves, low points of piping system and at equipment.
- M. Threaded valves shall be provided with a union adjacent to and downstream of valve.
- N. Butterfly valves shall not be used for balancing.
- O. Butterfly valves shall be installed between weld neck flanges of the same manufacturer only.
- P. Pressure Relief Valves
 - 1. Pipe to spill over floor drain or slop sink unless otherwise indicated.

3.2 STRAINERS

- A. Valved and provided with hose connection chain and cap.
- B. Line size, except as noted.
- C. Locate upstream of:
 - 1. Pumps
 - 2. Automatic control valves

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all hangers, supports and assemblies for all parts of the mechanical systems. This shall include all piping, ducts and equipment specified in this Division and as shown on the drawings
- B. All materials shall be new and manufactured for the specific purpose of supporting systems, equipment, pipes, ducts, conduits and accessories.
- C. All system components shall be installed in accordance with local codes including seismic isolation as required and specified under Section 23 05 98.
- D. Refer to Section 23 05 16 Pipe Expansion and closely coordinate with this work.
- E. Secure all permits and local/state approval for the components as specified and included under this Section.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- 1. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

1. Material standards shall be as specified or detailed hereinafter and as following:
2. ASME B31.9 – Building Services Piping, The American Society of Mechanical Engineers.
3. ASME B31.9 – Building Services piping.
4. ASHRAE Systems and Equipment Handbook.
5. ASTM F 708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.
6. MSS SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry.
7. MSS SP-69 – Pipe Hangers and Supports – Selection and Application; Manufacturers Standardization Society of the Valve Fittings Industry.
8. MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices; Manufacturers Standardization Society of the Valve and Fittings Industry.
9. NFPA-13 – Installation of Sprinkler Systems
10. MSS-SP-127-2001 – Bracing for Piping Systems.

1.5 SYSTEM DESCRIPTION

- A. In addition to special hangers and supports specified elsewhere in this Section and shown on the drawings for ducts, piping and equipment, furnish and install safe and substantial means of support for all parts of the mechanical systems. Shop drawings shall be submitted for review and approval for all supports. All piping, ductwork, exhaust pipe and breeching hangers and supports in all mechanical rooms, penthouses and energy plant shall be installed with vibration isolators and Seismic restraints. This requirement is mandatory and shall be strictly enforced.
- B. All piping shall be hung to true alignment, using appropriate and substantial hanger arrangements. Wire and strap hangers will not be permitted. Hangers shall be located so that piping and hangers will be clear of other piping, hangers, conduits, lighting and other obstructions.
- C. The hanging and supporting of piping and equipment shall conform to recommendations of the manufacturers of same and American National Standard, ANSI/MSS SP-58 and SP-69 latest edition, except where requirements of this specification exceed the above referenced Standards.

1.6 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. All brackets and hangers shall be submitted for review. Include the method of hanging and supporting all piping, ductwork and equipment.

- C. The Architect is to be notified when the first bracket is assembled so that the installation can be reviewed in the field.
- D. Provide location of all inserts to be used for hanging ductwork, piping and equipment and the weight of all components (including water weight).

1.7 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in manufacturing products of the type specified in Part 2 – Products.
- B. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- C. Welders: Certify in accordance with ASME.

1.8 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system and supports.
- B. All applicable seismic codes.
- C. ASTM F708 for design and installation of pipe hangers.
- D. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations
 - 1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.9 DELIVERY, STORAGE AND HANDLING

- A. All hangers and supports shall be delivered in containers and shall be kept in a dry and protected area.
- B. All exposed hangers, supports, etc. shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

1.10 ENVIRONMENTAL

- A. Do not paint or install inserts, hangers and/or supports when environmental conditions are outside the specific limitations of the referenced codes and manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Pipe supports shall be of type and figure number as specified.
- B. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

1. Pipe Hangers
 - a. Carpenter & Patterson
 - b. B-Line
 - c. Grinnell
 - d. National Pipe Hanger Corp.
 - e. Piping Technology & Products Inc.
 - f. PHD Manufacturing, Inc.

2. Channel Support Systems
 - a. B-Line Systems, Inc.
 - b. Grinnell Corp. Power-Strut Unit
 - c. GS Metals Corp.
 - d. Michigan Hanger Co., Inc. O-Strut Div.
 - e. National Pipe Hanger Corp.
 - f. Thomas & Betts Corp.
 - g. Unistrut Corp.
 - h. Wesanco, Inc.

2.2 PIPE HANGERS

- A. Bracket assemblies for supporting piping are to be fabricated by welding and all irregular surfaces are to be smoothed up by grinding. Shop drawings shall be submitted for review for each type bracket. The Architect is to be notified when the first bracket is assembled so that installation can be reviewed in the field. Exposed hangers, supports and brackets are to be given (2) coats of rust resistant paint of the color as selected by the Architect. Additionally, provide for Architect's review, the following:
 1. Location of all inserts to be used for hanging ductwork and piping where applicable and the weight of such pipe or equipment to be hung, including the weight of water, valves and insulation.
 2. Method of hanging and support of all piping, ducts and other equipment.

- B. All pipe supports shall be of type and arrangement as hereinafter specified. They shall be so arranged as to prevent excessive bending stresses between supports.

- C. All bracket clamp and rod sizes indicated in this specification are minimum sizes only. This Section shall be responsible for structural integrity of all supports. All structural hanging materials shall have a safety factor of (5) built in. Beam clamps shall be 2-sided steel clamps designed to firmly attach to the flange of the beam with the load directed downward on the centerline of the beam web. Beam clamps shall be similar to B-Line #B3055, or approved equal.

- D. Other forms of hangers and supports shall be used to accommodate special or unusual job conditions or conditions not covered herein, subject to the approval of the Architect. When special conditions require the use of concrete inserts which are not "built in", such inserts may be used in locations approved by the Architect and shall be Phillips "Red Head" or approved equal. Explosive powder studs or detonator assisted studs or anchors will not be permitted.

- E. All pipes shall be hung free of dependence on pipe sleeves for support.
- F. All auxiliary steel required for pipe, duct and equipment supports shall be furnished and installed by the Mechanical Contractor.
- G. Threaded pipe, chains, wire and perforated straps will not be accepted. No piping shall be supported from ductwork, conduit or other piping. All system components and equipment shall be independently supported. Distribute hangers on parallel piping to avoid overloading of structure.
- H. Roller type supports shall be used for pipes subject to axial movement (all hot water steam, condensate and any emergency generator exhaust). They shall be braced so that movement occurs in roller rather than support rods. This requirement shall apply to piping 2 1/2" and up.
- I. Hangers and supports used for systems exposed to weather shall be hot dipped galvanized in accordance with ASTM A153-73 or A123. Rods and nuts shall be electro-galvanized.
- J. All horizontal water, drain, waste, vent and rainwater piping shall be hung with clevis steel hangers similar to B-Line #B3100. Groups of pipes in the same horizontal plane and with the same pitch may be supported on B-Line #3160 gang hangers. Wall brackets similar to shall be B-Line #B3066 and #B3077.
- K. All pipes which are hung so that the centerline of the pipe is less than 10" below the point of suspension of the hanger rod and all hydronic hot water piping shall be supported on roller hangers similar to B-Line #B3110.
- L. Unless otherwise noted, maximum hydronic pipe hanger spacing shall not exceed the recommendations of the pipe manufacturer and the following:
 - 1. For 1/2" copper and steel pipe: 5'-0" o.c.
 - 2. For pipe 3/4" to 1 1/2": 8'-0" o.c.
 - 3. For pipe 2" to 8": 10'-0" o.c.
 - 4. For pipes 10" and up: 15'-0" o.c.
 - 5. In addition, hangers shall be installed within 2'-0" of each change in direction and on each side of valves 3" in size and up.
- M. Hanger rods shall be of steel and not less in diameter than:
 - 1. For pipe 2" and under: 3/8"
 - 2. For pipe 2 1/2" and 3": 1/2"
 - 3. For pipe 4" and 5": 5/8"
 - 4. For pipe 6": 3/4"
 - 5. For pipe 8", 10" and 12": 7/8"

- 6. For pipe 14" and 16": 1"
- 7. For pipe 18" and up: 1 1/4"
- N. Insulated steel piping 2 1/2" and up, shall be fitted with steel pipe covering protection saddles similar to B-Line #B3163 and of the same depth as the specified insulation. Saddles shall be tack welded to the pipe and filled with loose insulation. Standard length saddles may be cut in (2) equal sections for attachment to pipes 6" diameter and under.
- O. Insulated piping 2" and under, shall be fitted with 16 gauge steel covering protectors at each hanger location similar to B-Line #B3151.
- P. All vertical piping shall be supported with steel riser clamps similar to B-Line #B3773. Such clamps on copper tubing shall be applied over couplings only.
- Q. All pipes suspended at an elbow shall be hung using plate lugs similar to Grinnell #HS.53 with forged steel clevis similar to B-Line #B3201.
- R. Spring hanger locations shall be provided as specified herein, under vibration isolation, and shall be Grinnell, pre-engineered to meet loads and movements in accordance with ANSI B.31.1.10, where applicable.
- S. Drop rods for hangers may be used wherever possible and shall be installed prior to slabs being poured. Drop rod details shall be submitted to the Architect and Engineer for review.

2.3 DUCT HANGERS

- A. See Specification 23 31 00 Sheet Metal.

2.4 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Grout: ASTM C 1107, Grade B, factory-mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, non-corrosive and non-gaseous
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 – EXECUTION

3.1 PREPARATION

- A. All hangers, rod and supports shall receive two (2) coats of rust inhibitive paint.

- B. Provide inserts for placement in concrete formwork.
- C. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- D. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
- E. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.2 INSTALLATION

- A. Pipe Hangers and Supports.
 - 1. Install in accordance with ASME B31.9, ASTM F 708, or MSS SP-89 or NFPA-13.
 - 2. Support piping, ductwork and equipment as specified under Part 2.
 - 3. Install hangers to provide minimum ½ inch space between finished covering and adjacent work.
 - 4. Place hangers with 24 inches of each horizontal elbow and on each side of valves 3" in size and up.
 - 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 or between hanger support and piping.
 - 9. Prime coat (2 coats rust inhibitive paint) exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - 10. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- B. Where pipe support members are welded to structural building framing, scrape, brush clean and apply two coats of zinc rich primer to welds.

3.3 EXPANSION DEVICES

- A. Expansion anchors: Similar to Hilti "Drop-In Anchor HDI" flush type.
- B. Drill concrete to receive required expansion cases on concrete fasteners.

- C. Install in shear only, not in tension.

3.4 EQUIPMENT BASES AND SUPPORTS

- A. Provide rigid anchors for ducts and pipes immediately after vibration connections to equipment.
- B. Refer to Specification Section 23 00 01 for additional information.
- C. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor.
- D. Grouting: Place grout under supports for equipment and make smooth bearing surface.

3.5 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base-metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.7 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 a minimum dry film thickness of 2.0 mils.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 53

MECHANICAL IDENTIFICATION

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install nameplates, valve tags, valve charts, stencils and pipe markers on all Mechanical equipment, piping, and ductwork.
- B. Provide nameplates with the unit number and service designation on all mechanical equipment.
- C. Indicate all valve tag numbers on Record Drawings and submit framed under glass valve tag charts including valve service and location.
- D. Provide manufactured pipe and ductwork identification stencils with flow arrows and service indicated. All backgrounds of the stencils shall be color coded with specific service designation
- E. Prepare valve charts and frame under glass. All valves and the tag numbers shall be shown on the Record As-Built Drawings.
- F. Provide valve computer data base to match chart.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASME A 13.1 – Scheme for Identification of Piping Systems; The American Society of Mechanical Engineers.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: Submit product description including materials, attachment methods, color coding and lettering sizes.

1.6 QUALITY ASSURANCE

- A. All materials, lettering and individual system color coding schemes shall be uniform and of one single manufacturer.
- B. No identification shall be installed until all systems are complete and insulated.
- C. All surfaces shall be cleaned.
- D. No nametag or identification shall break or penetrate a surface used as a vapor barrier.

1.7 REGULATORY REQUIREMENTS

- A. Conform to all local/state and NFPA requirements for color-coding or painting of systems, piping or equipment related to Life Safety or Fire Protection.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All identification systems shall be stored in sealed containers in suitable locations to keep the containers and contents dry and clean.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. All surfaces shall be cleaned and dry before applying any form of identification or tagging.
- B. Consult with the manufacturer prior to installation for the proper tagging and identification procedure and materials to be used on exterior outdoor equipment.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Acceptable manufactures contingent on compliance with the specification.

1. Seton
2. W. H. Bradey Company
3. Marning Services Incorporated

2.2 PIPE IDENTIFICATION AND VALVE TAGS

- A. All piping, except that piping which is within inaccessible chases, shall be identified with semi-rigid plastic identification markers equal to Seton Setmark pipe markers.
1. Direction of flow arrows is to be included on each marker.
 2. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the "Scheme for the Identification of Piping Systems" (ASME A13.1-1981).
 3. Setmark snap-around markers shall be used for overall diameters up to 6" and strap-around markers shall be used above 6" overall diameters.
 4. Markers shall be located:
 - a. Adjacent to each valve
 - b. At each branch
 - c. At each cap for future
 - d. At each riser takeoff,
 - e. At each pipe passage through wall (each side)
 - f. At each pipe passage at 20' - 0" intervals maximum.
- B. Valve tags
1. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart.
 2. Valve tags shall be color coded 0.032" anodized aluminum tags, with engraved letters similar to Seton S Type 250-BL or approved equal.
 - a. HVAC tags shall be round 2" diameter, similar to Seton 15426.
 - b. Plumbing tags shall be square 2" x 2" similar to Seton 42769.
 - c. Fire Protection tags shall be square 2" x 2" similar to Seton 42769 RED.
 - d. Lettering shall be 1/4" high for type service and 1/2" for valve number. Tag shall indicate service and valve number.
 - e. Each service shall be a different color.
 3. Tag shall be attached to valves with chain similar to Seton No 16 stainless steel jack chain.
 4. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.

5. Provide a tag for every valve except:
 - a. Perimeter radiation shut-off valves that are located at the finned tube radiation element within the accessible (from the space) heating enclosure
- C. Furnish a minimum of two (2) typed valve lists
 1. Each framed under glass or Plexiglas. Each chart shall be enclosed in an approved 0.015" thick plastic closure for permanent protection.
 2. Valve numbers shall correspond to those indicated on the Record Drawings and on the printed valve lists.
 3. The printed list shall include the valve number, location and purpose of each valve.
 4. It shall state other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.
 5. Printed framed valve lists shall be displayed in each Mechanical Room or in a location designated by the Owner.
- D. Valve data base.
 1. Provide a valve data base for all valves to operate on the building computer.
 2. Every valve shall include:
 - a. Tag Number
 - b. Service (Hot water etc.)
 - c. Size
 - d. Operation
 - e. Location
 - f. Manufacture
 - g. Model number
 - h. Submittal reference

2.3 DUCTWORK IDENTIFICATION

- A. All ductwork (supply, return, exhaust, etc.) serving multiple spaces or floors shall be identified with directional flow arrows and unit identification numbers (RTU-1, EF-1, etc.) on the side of each duct (or bottom if abutting other systems or obstructions).
- B. All flow arrows and labels shall be similar to Seton Name Plate Company vinyl labels or stencil painted.

- C. All duct access doors.

2.4 EQUIPMENT NAMEPLATES

- A. Equipment nameplates shall be 3" x 6" long, 0.02" aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.
- B. The nameplate shall contain the unit or equipment designation ("RTU" for air handling unit, etc.), unit number and area or system served.
- C. Nameplates for exterior equipment shall be applied with waterproof adhesive.

2.5 CEILING TACKS OR TAPE

- A. Provide steel color coded $\frac{3}{4}$ inch diameter ceiling tacks in acoustical tile ceilings or color coded tape applied to ceiling grid to locate equipment, valves or dampers that require regular maintenance or are part of a Life Safety System.
- B. The tacks or tapes shall be color codes as follows (coordinate with Owner):
 - 1. Yellow – HVAC
 - 2. Red – Life Safety (fire dampers, sprinkler valves, etc.)
 - 3. Green - Plumbing Valves.
 - 4. Blue – Heating Valves.

PART 3 – EXECUTION

3.1 PREPARATION

- A. All surfaces shall be cleaned and insulated (if applicable) prior to installing any identification.
- B. Exterior surfaces of outdoor equipment shall be dry and prepared to accept the specified identification.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion. Seal with clear lacquer.
- B. Install valve tags with chain.
- C. Install duct markers in accordance with manufacturer's instructions.
- D. Install plastic pipe markers in accordance with manufacturer's Instructions.
- E. Install plastic tape markers complete around pipe in accordance with manufacturer's instructions.

- F. Identify air handling units etc. with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- G. Identify control panels and major control components outside panels with plastic nameplates.
- H. Identify thermostats relating to air handling equipment serving multiple spaces.
- I. Identify valves in main and branch piping with valve tags.
- J. Tag automatic controls, instruments and relays. Key to control schematic.
- K. Identify piping, concealed or exposed, with pipe markers. Use tags on piping $\frac{3}{4}$ inch diameter and smaller. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 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.
- L. Identify ductwork with plastic nameplates and flow arrows. Identify with air handling unit or fan identification number and area served. Locate identification at air handling unit or fan, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 230584

THROUGH-PENETRATION FIRE-STOP SYSTEMS

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 230500 and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
 - 1. Floors
 - 2. Roofs
 - 3. Walls and partitions
 - 4. Other rated assemblies.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 - ELECTRICAL AND FIRE ALARM

1.4 REFERENCES

- A. American Society for Testing and Materials Standards (ASTM):
 - 1. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials

2. ASTM E814: Standard Test Methods for Fire Tests of Through-Penetration Firestops
 3. ASTM E119: Standard Test Methods for Fire Tests of Building Construction Materials
 4. ASTM E1399: Standard Test Methods for Cyclic Movement and Measuring of Joint Systems
 5. ASTM E1725: Standard Test Methods for Fire Tests of Fire-Resistive Barrier Systems of Electrical Systems Components
 6. ASTM E1966: Standard Test Methods for Fire Tests of Joints
- B. Underwriters Laboratories, Inc. (UL):
1. UL 723 Surface Burning Characteristics of Building Materials
 2. UL 1479 Fire Tests of Through-Penetration Firestops, including optional air leak test
 3. UL 2079 Fire Test of Building Joint Firestop systems
 4. UL Fire Resistance Directory (Component Listing Test Criterion)
- C. National Fire Protection Agency (NFPA)
1. NFPA 80 Standard Fire Door and Window Assembly Tolerances
 2. NFPA 252 Standard Fire Test for Fire Rated Doors (not specified for positive or negative furnace test pressure)
 3. NFPA 257 Standard Fire Test for Fire Rated Windows (not specified for positive or negative furnace test pressure)
 4. NFPA 101 Life Safety Code
 5. NEC 70 National Electrical Code
- 1.5 PERFORMANCE REQUIREMENTS
- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
1. Fire-resistance-rated load-bearing walls, including partitions, with fire-protection-rated openings.
 2. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.

3. Fire-resistance-rated floor assemblies.
 4. Fire-resistance-rated roof assemblies.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas.
1. Penetrations located outside wall cavities.
 2. Penetrations located outside fire-resistive shaft enclosures.
 3. Penetrations located in construction containing fire-protection rated openings.
 4. Penetrating items larger than 4-inch diameter normal pipe or 16 sq. in. in overall cross-sectional area.
- D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide product that after curing do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for HVAC systems, provide moisture-resistant through-penetration firestop systems.
 2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- E. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-development ratings of less than 450, as determined per ASTM E 84.

1.6 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: For each type through-penetration firestop system product indicated.
- C. Shop Drawings: For each through-penetration firestop system show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating items. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.
- D. Submit complete plans indicating clearly where all seals are located and the type of seal to be used at that location
- E. Qualification Data: For firms and persons specified to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
- G. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
1. Through-Penetration Firestop Systems tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

- 1) UL in "Fire Resistance Directory."
- 2) ITS in "Directory of Listed Products."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable, qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.10 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers subject to compliance with the specifications shall be one of following:
 1. Hilti Construction Chemicals, Inc.
 2. 3M Fire Protection Products

3. Tremco
4. United States Gypsum Company

2.2 FIRESTOPPING GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and fired experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
 1. Permanent forming/damming/backing materials, including the following:
 - a. Slag-/rock-wool-fire insulation.
 - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
 - c. Fire-rated form board
 2. Temporary forming materials
 3. Substrate primers
 4. Collars
 5. Steel sleeves

2.3 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop systems manufacturer and the following requirements:
 - 1. Remove from surfaces of openings substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contactor by cleaning methods used to remove smears from firestop systems materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
 - 1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD-QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.
 - 1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.
- C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels.
 - 1. The words: "Warning-Through-Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Through-penetration firestop systems designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Through-penetration firestop systems manufacturer's name.
 - 6. Installer's name.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Provide all labor, instruments and materials necessary to completely test, adjust and balance all HVAC systems and equipment installed under this contract.
- B. All instruments shall be newly calibrated for this specific project.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. AABC MN-1 – National Standard for Testing and Balancing Heating, Ventilating and Air Conditioning Systems.
 - 2. ASHRAE 111 – Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

1.5 SYSTEM DESCRIPTION

- A. Provide under this contract the services of an independent test and balance firm that specializes in testing and balancing of HVAC systems. The following services shall be provided:

1. Balance Plan Check and Review: Review the design documents prior to commencing balancing. Submit any noted questions or discrepancies in writing to the Architect.
2. On-going job site inspections of equipment, controls and metering devices during construction to verify conformance with design specifications, manufacturer's installation instructions.
3. Air System Balance
4. Hydronic System Balance
5. Control Systems Verification
6. System Performance Verification
7. Opposite Season Test

1.6 SUBMITTALS

- A. See Section 23 05 00 for submittal procedures.
- B. Submit name of testing, adjusting and balancing contractor for approval within 30 days after award of Contract.
- C. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting and balancing of systems and equipment to achieve specified performance.
 1. Submit under provisions of Section 01 45 00 – Quality Control.
 2. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing and equipment data required.
 3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for inclusion in operating and maintenance manuals.
 4. Provide reports in letter size, 3 ring binder manual, 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.
 5. Include detailed procedures, agenda, sample reports forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
 6. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE 111, NEBB forms, or forms containing information indicated in Schedules.
 7. Include the following on the title page of each report.
 - a. Name of Testing, Adjusting and Balancing Agency.
 - b. Address of Testing, Adjusting and Balancing Agency.

- c. Telephone number of Testing, Adjusting and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Report date.
- D. Project Record Documents: Record actual locations of all water systems balancing valves and rough setting.

1.7 DEFINITIONS

- A. AABC: The Associated Air Balance Council is a non-profit association of independent, certified agencies specializing in testing and balancing HVAC systems.
- B. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers.
- C. HVAC: Heating, Ventilating and Air Conditioning.
- D. TAB: Testing, Adjusting and Balancing of HVAC Systems to meet design objectives and obtain optimum system performance.
- E. NEBB: National Environmental Balancing Bureau
- F. TBE: Test and Balance Engineer is an individual certified by AABC as having a degree in Engineering and (3) years of test and balance experience, or (5) years of background in the air conditioning field and (5) years continuous field experience in testing and balancing work. The TBE must also pass the AABC Test and Balance Engineer Certification Examination.

1.8 AGENCY QUALIFICATIONS

- A. Testing and balancing agency shall be a member of AABC or NEBB with a minimum of five (5) years of documented experience.
- B. An AABC certified NEBB certified testing and balancing person shall be responsible for certification of the total work of this section.
- C. All work shall be performed in accordance with AABC National Standards. If these specifications set forth more stringent requirements than the AABC National Standards, the more stringent specifications shall prevail.

1.9 QUALIFICATION SUBMITTALS

- A. Testing and Balancing Agency shall submit a company resume listing personnel and project experience in the field of air and hydronic system balancing.

- B. Testing and balancing agency shall submit an inventory and calibration data of all instruments and devices in possession of the balancing agency to enable the Owner or his representative to evaluate the balancing agency's performance capability.
- C. The testing and balancing agency shall submit to the Owner or the Owner's representative, upon acceptance of the contract, an AABC or NEBB "Quality Assurance Guaranty."
- D. Within (30) days after acceptance of the contract, the testing and balancing agency shall submit to the Design Engineer a working agenda which will include procedures for testing and balancing each type of air and water flow system. The Test and Balance Report format will also be submitted indicating data to be recorded.

1.10 CONTRACT DOCUMENTS

- A. Within (30) days after selection of the test and balance agency, the HVAC Contractor shall provide the agency with the following:
 - 1. Construction Drawings
 - 2. Equipment Specifications
 - 3. Equipment Submittals
- B. The testing and balancing agency shall be provided the following as issued or received:
 - 1. Change Orders/Current Updated Construction Mechanical Drawings incorporating all revisions
 - 2. Equipment Manufacturer's Submittal Data
 - 3. Mechanical/Air Conditioning Contractor's Shop Drawings
 - 4. Temperature Control Drawings
 - 5. Project Schedule

1.11 NOTIFICATION AND SCHEDULING

- A. A prebalance conference shall be held prior to job start as scheduled by the Owner or Owner's representative. Attendees at the meeting shall include representatives of the test and balance agency, General Contractor, Mechanical Contractor, Control Contractor, Owner and Mechanical Engineer.
- B. The schedule for testing and balancing the HVAC system shall be established by the Owner or Owner's representative, in coordination with the testing and balancing agency on a critical path network.
- C. The testing and balancing agency is responsible for initiating this continuing coordination to determine schedule for final testing and balancing services.

- D. It will be necessary for the testing and balancing agency to perform its services in close coordination with the Mechanical Contractor, with all scheduling and deficiencies reported through the Owner or Owner's representative.
- E. Before testing and balancing commences, the testing and balancing agency shall receive notification, in writing, from the Mechanical Contractor that the system is operational, complete, and ready for balancing.
- F. A completed system exceeds physical installation: the Mechanical Contractor shall certify that all prime movers, fans, pumps, cooling towers, boilers, etc., are installed in good working order, and that full load performance has been preliminary tested.
- G. The Mechanical Contractor shall certify in writing, that all equipment has been checked, started, adjusted by the manufacturer, and operated for the specified period of time.

1.12 COORDINATION WITH OTHER TRADES

- A. To bring the HVAC system into a state of readiness for testing, adjusting and balancing, the Mechanical Contractor shall perform the following:
 - 1. Air Distribution Systems
 - a. Ensure that all splitters, extractors, volume, smoke and fire dampers are properly located and functional. Dampers serving requirements of smoke, minimum and maximum outside, return, relief, and exhaust air shall provide tight closure and full opening, with a smooth and free operation.
 - b. Verify that all supply, return, exhaust, and transfer grilles, registers and diffusers are installed and operational.
 - c. Ensure that air handling systems, units, heat pumps, makeup air units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc. are blanked and/or sealed to eliminate excessive bypass or leakage of air.
 - d. Ensure that all fans (supply, return, relief, and exhaust) are operating and free of vibration. All fans and drives shall be checked for proper fan rotation and belt tension. Overload protection shall be of proper size and rating. A record of motor current and voltage shall be made to verify that the motors do not exceed nameplate rating.
 - e. Make any necessary changes to the sheaves, belts, and dampers, as required by the testing and balancing agency, at no additional cost to Owner.
 - f. Install clean filters prior to testing.
 - 2. Water Circulating Systems
 - a. Check all pumps to verify pump alignment and rotation.

- b. Ensure that systems are clean, with the proper strainer screens installed for normal operation.
 - c. Check all pump motors for current and voltage, to ensure that motors do not exceed nameplate rating.
 - d. Provide overload protection of proper size and rating.
 - e. Ensure that all water circulating systems shall be clean, full and free of air, that expansion tanks are set for proper water level, and that all air vents are installed at high points of systems and are operating.
 - f. Check and set operating temperature of heat exchangers to design requirements.
- B. The Temperature Control Contractor shall perform the following:
- 1. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, and fire and freeze stats.
 - 2. Verify that all controlling instruments are calibrated and set for design operating conditions.
 - 3. Calibrate room thermostats after installation and before the thermostat control verification tests are performed. The test and balance agency shall verify the accuracy of final settings by taking temperature readings. The readings shall be in a typical conditioned space for each separately controlled zone.
 - 4. The Control Contractor shall allow sufficient time in the project to provide assistance and instruction to the testing and balancing agency in the proper use and setting of control components such as, but not limited to, computers, static pressure controllers or any other device that may need setpoints changed so that the testing and balancing work can be performed.
- C. The Mechanical Contractor, Temperature Control Contractor, and the suppliers of the HVAC equipment shall all cooperate with the testing and balancing agency to provide all necessary data on the design and proper application of the system components. In addition, they shall furnish all labor and materials required to eliminate any system deficiencies.
- D. In coordination with the General Contractor, the testing and balancing agency shall arrange for an area of ample size and convenient location for storage of tools, equipment, and other items as required.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The HVAC Contractor shall procure the services of an independent Balancing and Testing Contractor who specializes in the balancing and testing of heating, ventilating and air conditioning systems to balance and adjust, all moving equipment and air distribution and exhaust systems and test all water systems and equipment, as herein specified. All work by the Balancing Contractor shall be done under direct supervision of a qualified heating and ventilating Engineer employed by the Balancing Contractor. Balancing Contractor shall submit credentials and be approved prior to any contract award.
- B. Balance and testing shall not begin until all HVAC systems have been completed and are in full working order, as determined by the Architect. Where construction is phased, the Testing and Balancing Contractor shall submit a plan of action which outlines how each phase will be balanced and how, when completed, the entire system will be verified to be tested and balanced. The Balancing Contractor shall coordinate his work with the HVAC and ATC Contractors, shall place all heating, ventilating and air conditioning systems and equipment into full operation, and continue the operation of same during each working day of adjusting and balancing.
- C. The Balancing Contractor shall perform all tests as hereinafter specified, compile the test data, and submit five (5) copies of the complete test data to the HVAC Contractor for forwarding to the Architect for evaluation and approval.
- D. The HVAC Contractor shall award the test and balance contract to the approved agency at the beginning of construction of the project to allow the Balancing Contractor to schedule this work in cooperation with the HVAC Contractor, ATC Contractor and other Trades involved and comply with completion data and requirements, as well as provide a list of areas where special requirements for balancing devices (dampers, valves) might occur.
- E. The Balancing Contractor shall provide all testing instruments used for balancing air and water systems. Testing instruments shall have been calibrated within a period of six (6) months prior to balancing. Types, serial numbers and dates of calibration of all instruments shall be listed in the final air and water balance reports herein specified.
- F. The Architect's, Engineer's and Owner's designated representatives shall be notified minimum five (5) days in advance of proceeding with balancing work to allow time for the witnessing of the testing, balancing and adjusting.
- G. The Balancing Contractor shall provide all manpower, instruments, temporary connections and all other materials required to accomplish the balancing and testing as hereinafter specified. In the case of phased construction, the action plan shall include an explanation of all temporary facilities and their effect on the overall system.
- H. The Balancing Contractor shall balance cooling systems in the air conditioning season and heating systems in the heating season. **This requirement is mandatory.**
- I. In the event it becomes necessary for the Owner to balance the HVAC systems correctly, after the balancing is complete, the cost of this work will be back charged to the Balancing Contractor.

2.2 SCHEMATIC SYSTEM DRAWINGS

A. Piping Systems

1. The Balancing Contractor shall prepare schematic diagrammatic drawings for the following systems:
 - a. Hot Water
2. The drawings will be 1-line schematic representation of the systems as they are installed, indicating all major automatic control valves, strainers, pressure reducing valves, etc., as well as all water flow and energy meters.
3. The diagrams shall indicate, in addition to the graphic representation requirements outlined above, all pressure drops (design conditions and actual conditions) of each valve, strainer, meter, etc., as well as all flows at each meter.
4. The use of the Engineer's construction drawing diagrams can be utilized by the Balancing Contractor as the base of the diagrams required. However, the drawings will have to be updated by the Balancing Contractor for field modifications which may have occurred during construction.

B. Ductwork Systems

1. The Balancing Contractor shall prepare schematic diagrammatic drawings for the following:
 - a. Supply air systems (all units)
 - b. Return air systems (all units)
 - c. All exhaust air systems including specialized exhaust systems
2. The drawings will be 1-line airflow schematics emanating from the air handling equipment, through shafts, to the first major split of duct branches on each floor. The drawings will indicate the air quantities measured at these major branches, pressure drop and any other pertinent information deemed necessary by the Architect.
3. In addition to the duct schematic drawings, the Balancing Contractor shall prepare individual schematic drawings for each air handling unit indicating the pressure drop of each component of the unit, including the discharge plenum and unit duct discharge and shall prepare composite schematic drawing of all "special pressure" rooms or spaces which shall show on one drawing, the supply, return and/or exhaust systems, flow rates (design and actual) and final offset pressure/CFM.

- C. The intent of the required documentation would be to clearly indicate the balancing and performance of the systems as they are installed. Furthermore, the above-required information will be utilized by the Owner for future renovation and/or alterations of the various systems. Therefore, the drawing content and presentation will be submitted to the Architect for review prior to actual commencement of the work. In the case of phased construction, the schematics shall indicate the limit of each phase and any temporary measures taken to obtain system performance.
- D. The drawings shall be produced on AutoCAD latest, and a disc and one (1) set of reproducible vellums shall be submitted to the Owner through the Architect, for his use. All costs associated with the production of the documents shall be included under the Balancing Contractor's contract.
- E. Test Code Drawings
 - 1. Each report shall contain a single line drawing or drawings of the air distribution system with the fan system, applicable zoning, etc., indicated. Each and every outlet supply and return shall be indicated on this drawing by a number corresponding to the number of the outlet test sheet.

2.3 TEST FORMS USED BY BALANCING ENGINEERS AND TECHNICIANS SHALL BE SET UP TO INCLUDE THE FOLLOWING INFORMATION:

- A. Each sheet shall have the job name and address, the name of the Balancing Contractor, Owner, Architect and Engineer, the instruments used to perform the test, and the name of the test Technician, date and time of test, outside db/wb temperatures.
- B. All forms shall be submitted on a standard 8 1/2" by 11" good quality paper, bound together to form a complete report. All forms shall be submitted in typewritten form; handwritten forms are not acceptable. Cover of first sheet shall list the name of the job and the location of same. Copies of all forms shall be submitted to the Architect for review and acceptance prior to the work beginning.
- C. Diffuser, Grille, Register, and All Types of Air Terminal Test Sheets
 - 1. Each sheet shall be arranged in columns and all final sheets shall show the following data:
 - a. Fan system.
 - b. Room number or area designation.
 - c. Outlet code number which shall correspond to code number.
 - d. Size of outlet - manufacturer's listed data.
 - e. Type of outlet per manufacturer's model designation.
 - f. Manufacturer of outlet.
 - g. Manufacturer's effective area for each size.

- h. Schedule FPM and required CFM of each outlet, individually for heating and cooling.
 - i. Test resultant FPM and CFM of each outlet, individually for heating and cooling.
 - j. Testing, setting and report of CFM settings for each terminal box, including pressure drop at each setting (heating and cooling).
 - k. All rooms/spaces with ducted supply and return/exhaust are to have supply, return/exhaust quantities shown on the same sheet. All rooms are to have air quantities for supply, return/exhaust listed per individual room. Supply, return/exhaust readings shall be listed sequentially, with final CFM offset, or room pressure clearly identified.
- D. Air Handling Equipment Test Sheets
- 1. Each sheet shall contain two (2) columns, one (1) for specified conditions and one (1) for test conditions obtained. When units tested are variable air volume (VAV) data shall be submitted for maximum and minimum air flows.
 - 2. All final sheets shall list the following data:
 - a. System fan number.
 - b. Fan manufacturer and model number.
 - c. Fan curve.
 - d. Total CFM.
 - e. Return air, CFM.
 - f. Outside air, CFM.
 - g. Total static pressure.
 - h. Suction static pressure.
 - i. Discharge static pressure.
 - j. Motor manufacturer.
 - k. Motor size, voltage, phase and RPM.
 - l. Amperage nameplate rating.
 - m. Final operating amperage.
 - n. Fan RPM (supply).
 - o. Fan RPM (return).

- p. Component pressure drop.
- E. Exhaust and Ventilating Fan Test Sheets
- 1. Each sheet shall contain in two (2) columns, one (1) for specified conditions and one (1) for test conditions obtained. Variable volume systems data is to be submitted for both maximum and minimum air flows.
 - 2. All final sheets shall list the following data:
 - a. Exhaust fan system and exhaust fan number.
 - b. Fan manufacturer.
 - c. Fan curve.
 - d. Size and model.
 - e. Motor HP, voltage and phase.
 - f. Changes made or recommended.
 - g. Amperage nameplate rating.
 - h. Final operating amperage.
 - i. Fan RPM.
 - j. Total CFM.
 - k. Suction static, discharge static, total static.
- F. Temperature Test Sheets (As Applicable For Each Air Handling Unit)
- 1. The temperature test sheets shall list both the specified conditions and the actual operating conditions in opposite columns. Items listed on this sheet shall be as follows:
 - a. Heating Cycle: Hot Water
 - 1) Entering air db temperature.
 - 2) Leaving air db temperature.
 - 3) Entering and leaving coil water temperatures/entering steam pressure.
 - 4) Outside air db and wb temperatures.
 - 5) Unit discharge temperature.

G. Pump Test Sheets

1. For each pump the following data shall be listed:
 - a. Pump number and system name.
 - b. Pump manufacturer and model number.
 - c. Pump curve.
 - d. Motor HP and RPM.
 - e. Voltage - Nameplate, test.
 - f. Amperage - Nameplate, test.
 - g. GPM, rated, tested.
 - h. Pressure rise rated, test.
 - i. Inlet pressure, outlet pressure.
 - j. Inlet temperature.
 - k. Shut-off pressure.

H. Coil and All Other Heating Element Test Sheets (Unit Heaters, Reheat Coils, Reheat Boxes, Cabinet Unit Heaters, Fan Coil Unit)

1. For each element both the specified and test conditions shall be listed:
2. Inlet water temperature (hot water).
3. Inlet air temperature.
4. Outlet water temperature (hot water).
5. Outlet air temperature.
6. Pressure drop through unit.

I. Velocity and Pressure Test Sheets for Main and Branch Ducts

1. Duct location or designation.
2. Duct size.
3. Number of velocity readings.
4. Duct average velocity.
5. Total CFM.

6. Duct average static pressure.
- J. Calibration of air flow measurement stations in cooperation and in conjunction with ATC contractor, provide all necessary pitot tube traverses and/or other air measurements necessary to field verify the accuracy of all installed air flow measurement stations at all air handling units, exhaust air handling units, return fans and cuts. Calibration readings shall be taken at 100%, 75%, 50% of rated flow and a curve shall be prepared that indicates any deviation between air flow station readings and field readings at these floors.

PART 3 - EXECUTION

3.1 AIR SYSTEM BALANCING AND TESTING PROCEDURES

- A. The Balancing Contractor shall perform the following tests, and balance all systems in accordance with the following requirements after clean filters are installed in all filter banks before tests are performed:
 1. Test and adjust blower RPM or blade pitch angle on vane axial fans to achieve design requirements.
 - a. Test and record motor full load ampere.
 - b. Make pitot tube transverse of main supply, return and exhaust air ducts to obtain design CFM at fans.
 - c. Test and report system static pressure, suction and discharge.
 - d. Test and adjust system for design CFM recirculated air.
 - e. Test and adjust system for design CFM outside air.
 - f. Test and record entering and leaving air temperatures (db-wb cooling and db heating).
 - g. Adjust all main supply, return and exhaust air ducts to proper design CFM.
 - h. Adjust all zones and branches to proper design CFM, supply, return and exhaust systems.
 - i. Test and adjust each diffuser, grille, register, and constant volume box to within $\pm 5\%$ of design requirements.
 - j. Test and adjust all special pressure rooms to maintain pressure relationship indicated on the drawings and to the pressures specified herein. Note that air quantities on the drawing may have to be changed to satisfy the pressure relationship.
 - k. Identify and list size, type and manufacturer of diffusers, grilles, registers, and terminal volume boxes. Include information regarding coils where applicable.

- I. Measure air quantities in main and branch ducts by traversing entire cross sectional area of duct with pitot tube. Ducts having velocities of 1000 feet per minute or more shall be measured with inclined manometers (draft gauge) or magnehelic gauges; ducts having velocities of less than 1000 per feet per minute shall be measured with micromanometers, hook gauges, or similar low pressure instruments. Openings in ducts for pitot tube insertion shall be sealed with snap-in plugs and covered with duct tape after air balance is complete. Diffuser, grille and register air quantities shall be determined by direct reading velocity meters in accordance with the manufacturer's recommendations.
- m. Identify, adjust, balance and measure air quantities in all types of hoods or exhaust "trunks", where applicable. Identify systems by fan designation and room name.
- n. Obtain design air quantities in main ducts by adjusting fans. Branch duct air quantities shall be adjusted by volume dampers. Dampers shall be permanently marked after air balance is complete to enable them to be restored to their correct position if disturbed at any time.
- o. As part of this Contract, the Balancing Contractor shall change the pulleys, belts, and fixed sheaves to provide for permanent sheaves, pulleys and belts, based on the final balancing, in order to ensure proper air delivery of the various systems.
- p. The Balancing Contractor shall also make all necessary adjustments to vane axial fan blade pitch angle to achieve required airflow.
- q. In cooperation with the ATC Contractor, determine the proper setpoint for all automatically operated dampers, air valves, static pressure sensors, inlet vane actuators, or other variable or controllable devices requiring coordination between Balancing Contractor and ATC Contractor. The Balancing Contractor shall determine the lowest system static setpoint possible that will deliver the proper air quantities to all outlets at the maximum cooling condition, and will adjust the fan system to operate at its most economical setting to achieve this static setpoint. Fans will be adjusted to the most economical setting by adjusting the fan speed (or blade pitch angle) with any variable volume devices in their maximum or wide-open position. Final static pressure setpoints are to be recorded in the test and balance report and listed for each unit.
- r. Any dampers, safing of baffles required for final balancing, as determined by the Balancing Contractor the Architect, will be provided by the HVAC Contractor to ensure proper performance, at no extra cost to the Owner.

3.2 WATER SYSTEM BALANCING AND TESTING PROCEDURES

A. Preparation of the System for Water Testing and Balancing

1. The Balancing Engineer or Technician must prepare the water system for balancing in the following manner:

- a. Open all valves to full position, including coil stop valves, return line balancing cocks and close all bypass valves, including system differential pressure bypass valve if applicable.
- b. Remove, clean and/or replace all strainers.
- c. Examine water in system to determine if it has been treated and is clean.
- d. Check pump rotation, correct if necessary.
- e. Check expansion tank to make sure it is not air bound and that the system is full of water.
- f. Check all air vents at high points of water systems to make sure they are installed properly and are operating freely.
- g. Make certain all air is removed from circulating system.
- h. Check operation of differential automatic bypass valves, set valve in closed position.
- i. Check and set operating temperature of systems to design requirements.
- j. Complete air balancing must have been accomplished before water balance is begun.
- k. Set all temperature controls so that all cooling coils are calling for full cooling and heating coils are calling for full heating.
- l. Set hot and chilled water systems to proper GPM delivery.
- m. Check leaving water temperature, return water temperature and pressure drop through all coils. Reset to correct design temperatures.
- n. Balance each hot water coil, chilled water coil and all other heating elements.
- o. After making adjustments to coils and other waterflow elements, reset settings at pumps, as required to obtain proper flows.
- p. Determine system operating differential pressure and, in conjunction with the ATC Contractor, set any differential pressure valves for proper operation.
- q. Upon completion of flow readings and coil adjustments, and after water balance is complete, permanently mark all balancing valves, cocks and flow meters so that they can be restored to their correct position if disturbed. Properly set memory stops on all balancing valves so equipped.

- r. After the Balancing Contractor sets all waterflow balancing devices to proper design GPM, he shall mark the GPM flows on the piping schematic drawings.
- s. The Balancing Contractor shall determine the lowest possible differential pressure control point possible for all variable speed pumping systems and for all differential pressure bypass control valves. In systems that have both variable speed pumping controlled by differential pressure and a differential pressure bypass valve, the Balancing Contractor shall assure, in conjunction with the ATC Contractor, that a minimum of 3 psig difference in setpoints is maintained between the two control settings with the differential pressure setpoint for the variable speed pumping system being the lower of the two settings.

3.3 INSTALLED ELEMENT TEST PROCEDURES

- A. Element identification (location or number designation).
- B. Required temperature drop corrected for actual entering air and water conditions.
- C. Element adjusted until the required drop is obtained.

3.4 CONTROL SYSTEMS VERIFICATION

- A. Verify all control devices are properly connected.
- B. Verify all dampers, valves and other controlled devices are operated by the intended controller.
- C. Verify all dampers and valves are in the position indicated by the controller (open, closed, modulating).
- D. Verify the integrity of valves and dampers in terms of tightness of close off and full open positions.
- E. Check all valves are properly installed in the piping system in relation to direction of flow and location.
- F. Check calibration of all controllers.
- G. Verify the proper application of all normally open and normally closed valves.
- H. Check the location of all thermostats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
- I. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. Control Contractor will relocate as deemed necessary by the testing and balancing agency.
- J. Check the sequence of operation that any control mode is in accordance with approved shop drawings. Verify that only minimum simultaneous heating and cooling occurs. Observe that the control valves at the boiler/heat pump loop are properly sequenced.

- K. Verify all controller setpoints meet the design intent.
- L. Check all dampers for free travel.
- M. Verify the operation of all interlock systems.
- N. Perform all systems verification to ensure the safety of the system and its components.

3.5 SYSTEM PERFORMANCE VERIFICATION

- A. At the time of final inspection, the test and balance agency shall recheck, in the presence of the Owner's representative, specific and random selections of data, air quantities, and air motion recorded in the Certified Report.
- B. Points and areas for recheck shall be selected by the Owner's representative.
- C. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.
- D. Selections for recheck, specific plus random, will not normally exceed 25% of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.
- E. If random tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report listings, by 10% or more of the selected recheck stations, the report is rejected, all systems shall be readjusted and tested, new data recorded, new Certified Report submitted, and new inspection tests made, all at no additional cost to Owner.
- F. Following system verification of the Certified Report by the Owner's representative, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the testing and balancing agency so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after system verification.

3.6 OPPOSITE SEASON TEST

- A. The testing and balancing agency shall perform an inspection of the HVAC system during the opposite season from that in which the initial adjustments were made. The testing and balancing agency shall make any necessary modifications to the initial adjustments to produce optimum system operation.

3.7 RECORD AND REPORT DATA

- A. The test and balance report shall be complete with logs, data and records as required herein. All logs, data and records shall be typed on white bond paper and bound. The report shall be certified accurate and complete by the testing and balancing agency's certified balancing engineer.
- B. Six (6) copies of the test and balance report are required and shall be submitted to the Owner or the Owner's representative.

- C. The report shall contain the following general data in a format selected by the testing and balancing agency.
1. Project number.
 2. Contract number.
 3. Project title.
 4. Project location.
 5. Project Architect.
 6. Project Mechanical Engineer.
 7. Test and Balance Agency.
 8. Balancing Engineer.
 9. General Contractor.
 10. Mechanical Contractor.
 11. Date tests were performed.
 12. Certification.
- D. The test and balance report shall be recorded on report forms conforming to the recommended forms in AABC National Standards. At a minimum, the report shall include:
1. Preface: A general discussion of the system, any abnormalities and problems encountered.
 2. Instrumentation List: The list of instruments including type, model, manufacturer, serial number, and calibration dates.
 3. System Identification: In each report the supply, return and exhaust openings and traverse points shall be numbered and/or lettered to correspond to the numbers and letters used on the report data sheets.
 4. Air Handling Equipment (Roof Top Units, etc.)
 - a. Manufacturer, model number, and serial number.
 - b. All design and manufacturer related data.
 - c. Total actual CFM by traverse if practical; if not practical, the sum of the outlets may be used, or a combination of each of these procedures. For specific systems, such as ones with diversity, see the AABC National Standards.

- d. Suction and discharge static pressure of each fan, as applicable.
- e. Outside air and return air total CFM.
- f. Actual operating current, voltage, and brake horsepower of each fan motor.
- g. Final RPM of each fan.
- h. Fan and motor sheave manufacturer, model, size, number of grooves, and center distance.
- i. Belt size and quantity.
- j. Static pressure controls final operating setpoints.

END OF SECTION

SECTION 23 05 99

MECHANICAL VIBRATION CONTROLS

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Section, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all necessary vibration isolation materials to eliminate excessive noise and vibration from all building mechanical systems.
- B. All systems shall be installed in accordance with local codes including requirements for hold downs.
- C. Secure all permits and local/state approval for the installation of all components included under this Section.
- D. The work in this Section shall include the following:
 - 1. Vibration isolation elements for equipment.
 - 2. Equipment isolation bases.
 - 3. Piping flexible connectors.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. NEBB– Procedural Standards for Measuring Sound and Vibration; National Environmental Balancing Bureau.
 - 2. NEBB– Sound and Vibration in Environmental Systems; National Environmental Balancing Bureau.
 - 3. ASHRAE Guidelines – HVAC Applications; Chapter– Sound and Vibration Control.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. The Vibration Isolation Submittal shall include descriptive data for all products and materials including the following:
 - 1. Product Descriptions
 - a. A complete description of products to be supplied, including product data, dimensions, specifications and installation instructions.
 - b. An itemized list of isolated and non-isolated equipment. Detailed schedule and selection data for each vibration isolator and supporting equipment, including:
 - 1) Equipment identification mark
 - 2) Isolator type
 - 3) Actual load
 - 4) Static deflection expected under actual load
 - 5) Specified minimum static deflection
 - 6) Additional deflection-to-solid under load
 - 7) Ratio of spring height under load to spring diameter
 - 8) Base type

- c. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.
 2. Show equipment base construction for all equipment, including dimensions, structural member sizes and support point locations.
 3. Indicate isolation devices selected with complete dimensional and deflection data.
 4. Show all methods of suspension and support for ceiling hung equipment.
 5. Detail methods of isolation for ducts and pipes piercing walls and slabs.
 6. Provide specific details of anchors, including number, size and locations for each piece of equipment.
 7. Provide special details necessary to convey complete understanding of the work to be performed.
- C. Submission of samples may be requested for each type of vibration isolation and seismic device. After approval, samples will be returned for installation at the job if requested. All costs associated with submission of samples shall be borne by the Contractor.

1.6 QUALITY ASSURANCE

- A. All vibration isolators shall have calibration markings or some method to determine the actual deflection under the imposed load after installation and adjustment.
- B. All isolators shall operate within the linear portion of their load versus deflection curves. Load versus deflection curves shall be furnished by the manufacturer and must be linear over a deflection range of at least 50% above the design deflection.
- C. 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 $\pm 10\%$, and shall be non-resonant with equipment forcing frequencies or support structure natural frequencies.
- D. All neoprene components shall have a shore hardness of 30 to 50 $\pm 5\%$, after minimum aging of (20) days or equal oven aging.
- E. Substitution of internally isolated and restrained equipment in lieu of the isolation and restraints specified in this Section is acceptable provided all conditions of this Section are met. The equipment manufacturer shall provide a letter of guarantee stating that the specified noise and vibration levels will be obtained and that the seismic restraints shall be in compliance with these specifications. All costs for converting to the specified external vibration isolation and/or restraints shall be borne by the equipment manufacturer/installing contractor should submissions or installations be found to be unacceptable pursuant to the intent of this specifications.

- F. Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.
- G. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the Installing Contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.
- H. Manufacturer Responsibility
 - 1. Manufacturer of vibration control equipment shall have the following responsibilities:
 - a. Determine vibration isolation sizes and locations.
 - b. Provide equipment vibration isolation as scheduled or specified.
 - c. Guarantee specified isolation system deflections.
 - d. Provide installation instructions, drawings and field supervision to ensure proper installation and performance of systems.

1.7 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping system and ASTM F708 for design and installation of pipe hangers.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All vibration control shall be delivered in containers and shall be kept in a dry and protected area.
- B. All exposed hangers, supports, etc. shall be given 2 coats of rust resistant paint of a color selected by the Architect prior to installation.

PART 2 - PRODUCTS

2.1 ISOLATORS AND RESTRAINTS – GENERAL

- A. Acceptable Manufacturers subject to compliance to specifications.

1. Mason Industries (MI)
 2. Amber/Booth (AB)
 3. Kinetics Noise Control (KNC)
 4. Vibration Eliminator Co. (VEC)
 5. Vibration Mountings & Controls (VMC)
- B. The Mechanical Contractor shall provide necessary vibration isolation materials to eliminate excessive noise and vibration from being transmitted from HVAC equipment to the occupied areas of the structure. This includes all non-structural components such as, but not limited to, air handlers, fans, pumps, tanks, ductwork, piping, etc. (hereinafter called equipment).
- C. Vibration isolation types shall be capable of accepting, without failure, seismic forces determined in accordance with the (IBC) International Building Code and/or the State/Country and Local codes enforced at the specified project location. They shall maintain the equipment in a captive position and not short circuit isolation during normal operating conditions. Isolators shall have provisions for bolting and/or welding to the structure.
- D. All metal parts of vibration isolation units installed out-of-doors shall be hot dip galvanized, cadmium plated, or neoprene or PVC coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard #14.
- E. All base supported isolators shall have base plates with bolt holes for fastening the isolators to the support members.
- F. Isolator types are scheduled to establish minimum standards. At the Contractor's option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories must not degrade the vibration isolation system.
- G. Static deflection of isolators shall be as scheduled in this Section and as shown on the drawings. All static deflections stated are the minimum acceptable deflection under actual load. Isolators shall be selected for no less than 50% reserve deflection beyond actual operating conditions.
- H. Attachment plates to be cast into housekeeping pads, concrete inserts, beam clamps, etc.,
- I. Coordinate the size, location and special requirements of vibration isolation equipment and systems with other Trades. Coordinate plan dimensions with size of housekeeping pads.

2.2 VIBRATION ISOLATOR TYPES

A. Type A (Floor Spring and Neoprene)

1. The Type A spring isolator shall:
 - a. Have a minimum outside diameter to overall height of 0.8:1.
 - b. Have corrosion resistance where exposed to corrosive environment with:
 - 1) Springs cadmium plated or electro-galvanized.
 - 2) Hardware cadmium plated.
 - 3) All other metal parts hot dip galvanized.
 - c. Have reserve deflection (from loaded to solid height) of 50% of rated deflection.
 - d. Have minimum 1/4" thick neoprene acoustical base pad on underside, unless designed otherwise.
 - e. Be designed and installed so that ends of springs remain parallel.
2. Type A isolator shall be similar to Mason Industries Type SLF.

B. Type B (Floor Spring and Neoprene Travel Limited)

1. The Type B spring isolator shall be the same as Type A with the following additional features.
 - a. Built-in vertical limit stops with minimum 1/4" clearance under normal operation.
 - b. Tapped holes in top plate for bolting to equipment.
 - c. Capable of supporting equipment at fixed elevation during equipment installation. Installed and operating heights shall be identical.
 - d. Adjustable and removable spring pack with separate neoprene isolation pad.
2. Type B isolator shall be similar to Mason Industries Type SLR.

Note: This isolator must be bolted or welded to the structure.

- C. Type C (Spring Hanger Rod Isolator)
 - 1. Spring isolator (Type A) seated on a steel washer within a neoprene cup incorporating a rod isolation bushing.
 - 2. Spring diameters and hanger box shall allow 30° of hanger rod movement.
 - 3. When used on ductwork, provide eyebolts for attachment to duct straps.
 - 4. Type C isolator shall be similar to Mason Industries Type 30 or W30.

- D. Type D
 - 1. Double deflection neoprene isolator (minimum 0.3") encased in ductile iron or steel casing.
 - 2. Similar to Mason Industries Type BR, RBA or RCA.

- E. Type E (Elastomer Hanger Rod Isolator)
 - 1. Molded (minimum 1 3/4" thick) neoprene element with projecting bushing lining the rod clearance hole. Static deflection at rated load shall be minimum 0.035".
 - 2. Steel retainer box encasing neoprene mounting capable of supporting equipment up to (4) times the rated capacity of the element.
 - 3. Type E isolator shall be similar to Mason Industries Type HD.

- F. Type F (Combination Spring/Elastomer Hanger Rod Isolator)
 - 1. Spring and neoprene elements in a steel retainer box with the features as described for Type C and Type E isolators.
 - 2. Type F isolator shall be similar to Mason Industries Type 30N.

- G. Type G (Pad Type Elastomer Isolator)
 - 1. 0.75" minimum thickness, 50 psi maximum loading, ribbed or waffled design.
 - 2. Minimum 0.1" deflection.
 - 3. 1/16" galvanized steel plate between multiple pad layers.
 - 4. Provide load distribution plate where attachment to equipment bearing surface is less than 75% of the pad area.

5. Type G isolators shall be similar to Mason Industries Type Super W.

Note: Neoprene and duck washers and bushings shall be provided to prevent short circuiting.

H. Type H (Pad Type Elastomer Isolator)

1. Laminated canvas duck and neoprene, maximum loading 1000 psi, minimum 1/2" thick.
2. Provide load distribution plate where attachment to equipment bearing surface is less than 75% of the pad area.
3. Type H isolator shall be similar to Mason Industries Type HL.
4. Note: Bolting required for seismic compliance. Neoprene and duck washers and bushings shall be provided to prevent short circuiting.

I. Type J (Steel Rails)

1. Steel members of sufficient strength to prevent equipment flexure during operation.
2. Height saving brackets as required to reduce operating height.
3. Type J isolator shall be similar to Mason Industries Type ICS.

J. Type K (Pipe Anchors and Guides)

1. Acoustical pipe anchor or guide, consisting of a telescopic arrangement of (2) sizes of steel tubing separated by a minimum 1/2" thickness of Type H pad.
2. Vertical restraints shall be provided by a similar material arranged to prevent vertical travel in either direction (anchors only).
3. Allowable loads on isolation materials shall not exceed 500 psi, and the design shall be balanced for equal resistance in any direction.
4. Anchors and guides must be bolted or welded to meet seismic criteria.
5. Type K anchor shall be similar to Mason Industries Type ADA or VDA.

2.3 EQUIPMENT BASES

- A. All curbs and roof rails are to be bolted or welded to the building steel or concrete deck to attain acceleration criteria and shall be wind restrained for 110 mph wind loads.

B. Type B-1 (Integral Structural Steel Base)

1. The integral structural steel base shall be reinforced as required to prevent base flexure at equipment start-up and misalignment of driver and driven units. Centrifugal fan bases shall be complete with motor slide rails and shall be drilled for driver and driven units.
2. Height saving brackets shall be provided, as required, to reduce operating height and maintain 1" operating clearance under base.
3. Member depth shall be a minimum of 1/10 of the longest unsupported span.
4. Type B-1 equipment base shall be similar to Mason Industries Type M or WF.

C. Type B-3 (Spring Roof Curb)

1. Curb mounted rooftop equipment shall be mounted on structural spring isolation curbs that bear directly on the roof support structure, and are flashed and waterproofed into the roof's membrane waterproofing system. Equipment manufacturer's curb shall not be used.
2. All spring locations shall have removable waterproof covers to allow for spring adjustment and/or removal. Springs shall be Type A.
3. Curbs shall be thermal and sound attenuating type utilizing standard 2" roof insulation supplied and installed by the Roofing Contractor.
4. Unit shall be provided with wood nailer and flashing.
5. Curbs shall meet all NRCA Standards.
6. Curbs shall include a means of incorporating a sound barrier package, Type SBC-3 consisting of (2) layers of waterproof sheetrock furnished and installed by others.
7. Curbs installed on pitched roofs shall be factory built to compensate for elevation changes.
8. Curbs shall be similar to Mason Industries Type RSC.

D. Type B-4 (Flashable Roof Rail System)

1. Rooftop fans, condensing units, air handlers, etc. shall be mounted on continuous support piers that combines equipment support and isolation into (1) assembly.
2. Rails shall incorporate Type B isolators which are adjustable, removable and interchangeable after equipment has been installed.

3. The system shall maintain the same installed and operating height with or without the equipment load.
 4. The system shall have full pressure treated nailers on all (4) sides, designed to accept membrane waterproofing and shall be dry galvanized or plastic coated.
 5. Unit to be supplied with flashing.
 6. Roof rail shall be similar to Mason Industries Type RSR having a minimum 2" rated static deflection.
- E. Type B-5 (Roof Rail Base)
1. Rails shall be constructed from structural steel angles sized 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 Type B isolators. Bolt-on angle cross ties at the ends and center shall form (1) rigid platform.
 3. Roof rail shall be similar to Mason Industries Type TRSLR.
- F. Type B-6 (Non-Isolated Roof Curb)
1. Non-isolated, curb mounted rooftop equipment shall be mounted on structural curbs that meet the acceleration criteria hereinbefore defined.
 2. Curbs shall accept standard 2" roof insulation furnished and installed by the Roofing Contractor.
 3. Non-isolated curbs shall be similar to Mason Industries Type B-6000.

2.4 FLEXIBLE PIPE CONNECTOR

- A. All flexible connectors shall be installed on the equipment side of the shutoff valves, horizontal and parallel to equipment shafts whenever possible. All piping between the flexible connector and the equipment shall be independently supported off the equipment base.
- B. Type FC-1 (Elastomer Connector)
1. Rubber expansion joints shall be peroxide cured EPDM throughout with Kevlar tire cord.
 2. Straight connectors to have (2) spheres reinforced with a molded in external ductile iron ring between the spheres.
 3. Rated at 250 psig/170°F, dropping in a straight line to 170 psig/250°F for sizes 1 1/2" to 12".

4. All sizes shall employ control rods with neoprene end fittings isolated from anchor plates by means of 1/2" bridge bearing neoprene bushings.
5. Connectors shall be installed pre-extended per manufacturer's recommendations to prevent elongation under pressure.
6. Minimum safety factory of 3.6:1 at maximum pressure ratings shall be certified by test reports. Submittals shall also include (2) test reports by independent consultants showing minimum reduction of 20 dB in vibration accelerations and 10 dB in sound pressure levels at typical blade passage frequencies.
7. Connectors bolted to Victaulic type coupling or gage, butterfly or check valves to have a minimum 5/8" flange spacer installed between the connector and the coupling flange.
8. Connectors for pipe size 2" and smaller shall have threaded female union couplings on each end. Larger pipe sizes shall be fitted with flange couplings.
9. Type FC-1 flexible connector shall be similar to Mason Industries Super-Flex Type SFDEJ or SFEJ.

C. Type FC-2 (Flexible Stainless Steel Hose)

1. Stainless steel hose and braid rated with 3:1 safety factor.
2. 2" and smaller with male nipples, 2 1/2" and larger with fixed steel flanges.
3. Lengths as follows:

Size	Length	Size	Length	Size	Length
1/2	x 9	2	x 14	8	x 22
3/4	x 10	2 1/2	x 13	10	x 26
1	x 11	3	x 14	12	x 28
1 1/4	x 12	4	x 15	14	x 30
1 1/2	x 13	5	x 19	16	x 32
		6	x 20		

4. Type FC-2 flexible connector shall be similar to Mason Industries Type BSS.

D. Type FC-3 (Unbraided Exhaust Hose)

1. Low pressure stainless steel annularly corrugated with flanged ends.
2. Maximum temperature of 1500°F.
3. Lengths (in inches) as follows:

Size	Length	Size	Length
2 ½ x	15	8 x	22
3 x	16	10 x	26
4 x	17	12 x	28
5 x	18	14 x	30
6 x	19	16 x	32

4. Type FC-3 flexible connector shall be Mason Industries Type SDL-RF or equal by approved manufacturer.

E. Type FC-4 (Bronze Braided Flexible Hose)

1. Bronze hose and braid rated with a minimum 3:1 safety factor (minimum 150 psi).
2. Copper tube ends.
3. Minimum lengths (in inches) as follows:

Size	Length	Size	Length	Size	Length
1/8 x	7 ½	¾ x	11 ½	3 x	27
1/4 x	8 ¼	1 x	13	3½ x	32
3/8 x	9	1 ¼ x	14 ¾	4 x	33
½ x	9 ¾	1 ½ x	17	5 x	41
5/8 x	10	2 x	20	6 x	48
		2 ½ x	24		

4. Type FC-4 flexible connector shall be similar to Mason Industries Type BFF.

2.5 VIBRATION ISOLATION SCHEDULE

Equipment	HP	Mtng	On Grade ****				Above Grade			
			Isol	Defl	Base	Restr	Isol	Defl	Base	Restr
Air Conditioning Condensers		Roof	---	---	---	---	A	2.50	B-4	II
Air Conditioning Units (DX)		Flr	D	.30	---	IV	A	.75	J *	I,II
		Clg	---	---	---	---	F	.75	---	III
Cabinet Type Fans & Packaged AHUs	To 1	Flr	D	.30	---	IV	D	.35	---	IV
		Clg	---	---	---	---	E	.35	---	III
Cabinet Type Fans & Packaged AHUs	>1	Flr	A	.75	---	I,II	A **	See	---	I,II
		Clg	---	---	---	---	F	Guide	---	III
Curb Mounted Equipment		Roof	---	---	---	---	---	---	B-6	V
Other than AHU		Flr				V				V
Rooftop AHU >10 Ton		Roof	---	---	---	---	A	2.50	B-3	V

* Used on vertically arranged units. Rails shall be 1.5 times the unit height.

** Substitute Type B isolator for roof installations.

*** Substitute Type B-2 base for floor mounted Class 2 and 3 fans.

**** "On Grade" shall mean slab on grade only.

Notes:

1. "Isol", "Base" and "Restr" columns indicate letter type as appears in the specs.
2. "Mtng" refers to method of support of equipment from the structure.

3. "See Guide" indicates isolator deflection selection to be taken from Deflection Guide below.

Deflection Guide	
RPM	MW Deflection
<400	3.5"
<600	2.5"
>600	1.5"

PART 3 – EXECUTION

3.1 GENERAL

- A. Isolation systems must be installed in strict accordance with the manufacturer's written instructions and submittal data. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.
- B. Design Criteria
1. All mechanical equipment such as RTU's, ACCU's, HP's EF's, fans, air handling units, etc. shall be isolated from the building structure by means of noise and vibration isolators.
 2. All piping over 1" and ductwork in mechanical equipment rooms and penthouses diameter shall be isolated from the building structure by means of noise and vibration isolation hangers.
 3. Piping and/or ductwork penetrations through floors and walls shall not be rigidly connected to the building structure. Provide sleeves with clearances around the outside, as recommended by the vibration materials manufacturer. All such penetrations shall be smokeproofed and firestopped in an approved manner as hereinbefore specified.
 4. Generally, isolation facilities shall be designed to limit equipment room floor or roof loading to a maximum of 50 lbs./sq.ft. and vibration isolators shall be carefully and specifically selected for each piece of equipment.
 5. Flexible duct connections at fans and air handling units shall have a minimum clear gap of 3" between metal collars. Flexible connectors exposed to the weather shall be weatherproofed by the Mechanical Contractor. Refer to the Sheet Metal Section of this specification for requirements of flexible duct connections.

6. Piping found to have water hammer or other objectionable vibration or noise which cannot be eliminated by proper grading or other natural means shall be braced, trapped, hung with vibration isolation hangers, equipped with air chambers or mechanical shock absorbers, flexible pipe connectors, or otherwise silenced using means as approved by the Architect.
7. Motor driven equipment which is to be isolated shall have motor mounted on the isolated equipment or shall have motor, equipment and drive mounted on a common base.

3.2 EQUIPMENT ISOLATION INSTALLATION

- A. Equipment shall be isolated and restrained as per the vibration isolation schedule at the end of this Section.
- B. Place floor mounted equipment on 4" high concrete housekeeping pads (unless detailed otherwise) properly doweled or expansion shielded to the deck to meet acceleration criteria. Anchor isolators and/or bases to housekeeping pads. Housekeeping pad concrete work shall be by Division 3.
- C. Additional Requirements
 1. The minimum operating clearance under inertia bases shall be 2".
 2. The minimum operating clearance under other bases shall be 1".
 3. All bases shall be placed in position and supported temporarily by blocks or shims, as appropriate, prior to the installation of the equipment, isolators and restraints.
 4. The isolators shall be installed without raising the equipment.
 5. After the entire installation is complete, and under full operational load, the isolators shall be adjusted so that the load is transferred from the blocks to the isolators. The blocks shall be barely free and shall be removed. Remove all debris from beneath the equipment and verify that there are not short circuits of the isolation. The equipment shall be free in all directions.
 6. Install equipment with flexibility in wiring.

3.3 PIPING AND DUCTWORK ISOLATION INSTALLATION

- A. Isolate piping and ductwork outside shafts connected to rotating or reciprocating equipment and pressure reducing stations as follows:
 1. All water, piping in mechanical rooms.
 2. Water piping within 50'-0" or 100 pipe diameters (whichever is greater) from connected isolated equipment.

- B. The isolators shall be installed with the hanger box hung as closely as possible (without direct contact) to the structure.
- C. The isolators shall be suspended from substantial structural members sized for a maximum deflection of $L/360$ at mid span, not from slab diaphragm, unless specifically permitted by the structural engineer.
- D. Hanger rods shall not short circuit the hanger box.
- E. Horizontal suspended water piping 1 1/4" to 2" shall be suspended by Type E isolators with a minimum 3/8" deflection. Water pipe larger than 2" shall be supported by Type F isolators with a minimum 0.75" deflection or same deflection as equipment for the first (3) locations nearest equipment, whichever is greater.
 - 1. Type L isolators may be substituted for the above.
 - 2. Horizontal floor and roof supported pipe shall be the same as above except use isolators Type D and Type A, respectively.
- F. Ductwork shall be supported by Type C isolators with a minimum 0.75" deflection.
- G. Vertical riser pipe supports, where required, under 2" diameter shall utilize Type H isolation.
- H. Vertical riser guides, where required, shall avoid direct contact of piping with the building.
- I. Pipe anchors or guides, where required, shall utilize Type K isolators.
- J. Riser sway supports, where required, shall utilize (2) neoprene elements (Type G or H) to accommodate tension and compression forces.
- K. Install Type FC-1 (FC-4 for refrigerant piping) flexible connectors at all connections of pipe to isolated equipment such as pumps, cooling towers and as shown on the drawings.
 - 1. Flex connectors for emergency generators are to be supplied by the Electrical Contractor and installed by the Mechanical Contractor.
- L. Install FC-2, FC-3 or FC-4 type connectors only at locations which exceed temperature or service (such as gas, fuel oil, or refrigerant) limitations of FC-1.

3.4 INSTALLATION INSTRUCTIONS

- A. Adjust all base and piping isolators as required to prevent stress transfer to equipment.
- B. Set steel bases for 1" clearance between housekeeping pad and base. Set concrete inertia bases for 2" clearance. Adjust equipment level.

- C. Position equipment, structural base and concrete base on blocks or wedges at proper operating height.
- D. Provide all equipment and provide operating load conditions before transferring base isolation loads to springs and removing wedges.
- E. Provide isolators as specified and install in accordance with the manufacturers recommendations.
- F. Provide forms for 4" high housekeeping pads under all floor mounted equipment, including those with inertia blocks.
- G. Install equipment with flexibility in wiring connection.
- H. Verify all installed isolators and mounting system permit equipment motion in all directions.
- I. Adjust or provide additional resilient restraints to flexibly limit lateral motion to 1/4" during start-up of equipment.
- J. Before start-up, clean out all foreign matter between bases and equipment to prevent short circuit.
- K. Install flexible pipe connectors on pipe connected to equipment supported by vibration isolation. Hook up piping to equipment and mains with spool pieces. After completion of pressure testing but prior to start-up, remove spool pieces and install flexible pipe connectors. Identify spool pieces as to equipment served and either entering or leaving.

3.5 CERTIFICATION

- A. Upon completion of installation of all vibration isolation devices, the local representative shall inspect the completed project and certify in writing to the Mechanical Contractor that all systems are installed properly or require correction. The Mechanical Contractor shall submit a report to the Architect, including the representative's report, certifying correctness of the installation or detailing corrective work to be done.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Section, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all duct insulation, vapor barriers, jackets, finishes, adhesives, cements and accessories to make a complete and insulated system of all ductworks, fittings, joints, offsets and accessories specified herein.
- B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.
- C. Provide insulation systems for interior & exterior ductwork systems as well as for new and for existing tie-in ductwork systems.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.

2. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).
3. ASTM C 518 – Standard Test method for Steady-State Heat Flux Measurements and Thermal Insulating and Finishing Cement.
4. ASTM C 553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
5. ASTM C 612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
6. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
7. ASTM C 1071 – Standard Specification for Thermal and Acoustical Insulation (Glass, Fiber, Duct Lining Material).
8. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
9. ASTM E 96 – Standard Test Methods for Water Vapor Transmission of Materials.
10. ASTM E 162 – Standard Test Method for Surface flammability of Materials Using a Radiant Heat Energy Source.
11. ASTM G 21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
12. NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.
13. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
14. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.
15. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
16. ANSI/ASHRAE 90.1 - Energy Conservation in New Building Design.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.6 QUALITY ASSURANCE

- A. All insulation materials, finishes, coatings, cements, tapes, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.
- B. Insulation for the various duct systems and associated equipment shall be composed of materials which are non-combustible and/or provide a fire resistive system of insulation which complies with the applicable Code having jurisdiction. Generally, it is required that fire hazard ratings shall not exceed the following, except as noted:
 - 1. Flame Spread Rating: 25 (No Exceptions)
 - 2. Smoke Developed Rating: 50
- C. All fire hazard ratings shall be as determined by NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials", ASTM E84 or UL 723.
- D. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.
- E. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities as to fire hazard rating.
- F. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.
- G. Where insulation is specified for ductwork, insulate similarly all collars, dampers, edges, joints, etc. connected to system subject to heat loss or gain. Do not cover damper actuators or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.

1.7 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Accept materials on site, labeled with manufacturer's identification, product density and thickness.
- B. All materials shall be stored in a dry area free from moisture and debris.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during and after installation for minimum of 24 hours.

PART 2 – PRODUCTS

2.1 MANUFACTURERS ACCEPTABLE FOR PRODUCT TYPES INDICATED CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS

A. Insulation:

1. Manville Corporation.
2. Owens-Corning Fiberglass Corporation.
3. Armstrong World Industries, Incorporated.
4. Certainteed Corporation.
5. Knauf
6. Morgan Thermal Ceramics

B. Mastics and adhesives:

1. Childers Products Company.
2. H. B. Fuller Company, Foster Products Division.
3. 3M Company Adhesives, Coatings and Sealers.
4. Armstrong World Industries, Incorporated.
5. Ruston Plant.
6. Chicago-Mastic
7. Insul-Coustic
8. St. Clair Rubber
9. Vimasco
10. Baldwin-Ehret-Hill

2.2 FACED FLEXIBLE FIBER GLASS INSULATION

- A. Faced flexible fiber glass duct insulation shall be equal and equivalent to Owens-Corning Fiberglas Faced Duct Wrap, Series ED 100, FRK-25 having an approximate density of 1.0 lb./cu.ft. and an approximate thermal conductivity of 0.30 at 75° F.

- B. Insulation shall be tightly wrapped on the duct work with all circumferential joints butted and longitudinal joints lapped 2 inches and stapled. All joints shall be sealed with approved adhesive. Adhere insulation to ducts with 4-inch-wide strips of an approved bonding adhesive, at 18 inches on center. Additionally, secure insulation to bottom of rectangular ducts over 24 inches wide with weld pins or stick clips at no more than 18 inches on center. Alternative means of securing insulation to ducts will be permitted, subject to the manufacturer's recommendations and the Architect's written approval.
- C. Insulation shall be butted with facing overlapping all joints at least 2 inches and sealed with approved fire-retardant vapor barrier adhesive. All breaks, punctures, and pin penetration in facing, shall be sealed with vapor barrier tape per the manufacturer's published installation instructions.

2.3 RIGID FIBERGLASS BOARD INSULATION

- A. Rigid fiberglass board insulation shall be equal to Owens-Corning Fiberglas 25 with ASJ having an approximate density of 4.2 lbs./cu.ft. and an approximate thermal conductivity of 0.25 at 75°F.
- B. The insulation shall be applied by use of weld pins or stick clips. Such fasteners shall be spaced 3 inches from each corner of the board with intermediate pins spaced no more than 12 inches on center. Pin caps shall be covered with a round vapor seal patch that matches the jacket on the ASJ board.
- C. Ducts, plenums, and equipment having sharp bend shall have the insulation scored as required to conform to the curved surfaces to provide a neat and workmanlike appearance when finished.
- D. All insulation edges and joints shall be sealed with a fire-retardant vapor barrier adhesive, reinforced with a vapor barrier tape like that of the board facing. Tape shall be 3 to 5 inches wide as recommended by the manufacturer.
- E. The above specified insulation will be used in all areas, and it is intended that the finish present a neat and uniform appearance as to color and workmanship.

2.4 INSULATION FACING

- A. Code ASJ: All service jacket composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire-retardant adhesive. Longitudinal laps and butt strips shall be a minimum of 3 inches.
- B. Code FSKL: 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Water vapor permeability 0.04 perms. Longitudinal laps and butt strips shall be a minimum of 3 inches.

2.5 ADHESIVES

- A. Code ADH-1: Fibrous adhesive, non-flammable, quick setting adhesive for calcium silicate. Similar to Childers CP-97, 98.

- B. Code ADH-2: Fast-drying vinyl base coating and lagging adhesive. Similar to Childers CP-50A HV2.
- C. Code ADH-3: Fast-drying neoprene base adhesive for lap joints of foil-faced facing applied over pipe insulation. Similar to Childers CP-82.
- D. Code ADH-4: Adhesive for use in adhering fiberglass board or blanket insulation to pipe and equipment. 3M Company Insulation Adhesive No. 35 or 38 non-flammable adhesives.

2.6 CAULKING COMPONENTS

- A. Code CC-1: For use with foam glass and/or joint sealant applications. Flexible elastomeric vapor barrier sealant. Similar to Childers CP-76.

2.7 MASTICS

- A. Code MAS-1: Vapor barrier mastic made with an elastomeric resin. For indoor use. Similar to Childers CP-30.
- B. Code MAS-2: A non-water vapor barrier asphaltic emulsion coating, breathing type, for above ground installations. Similar to Childers CP-10.
- C. Code MAS-3: Vapor barrier mastic made with an elastomeric resin. For outdoor use.

2.8 TIE WIRE

- A. Tie wire for securing insulation in place shall be type 304 stainless steel annealed steel wire of gauge and proper spacing as recommended by the insulation manufacturer. Wire shall be drawn up tightly enough to become embedded in the insulation and the ends of the loop twisted, bent over, and pressed into the insulation so as to leave no ends protruding.

2.9 BANDING

- A. 3/8-inch x 0.02-inch type 304 stainless steel for pipe insulation.
- B. 3/4-inch x 0.02-inch type 304 stainless steel for additional insulation jackets.

2.10 WIRE MESH

- A. Wire mesh shall be one inch by No. 20 BGW hexagonal mesh galvanized.
- B. Expanded metal: Expanded metal shall be 1/2 inch Hi-Rib metal lath of copper bearing steel.

2.11 TAPE

- A. Lead foil tape, where specified, shall be 3M Company Lead Foil Tape No. 422, 4 mil thick, acrylic adhesive, 2 inch wide.

- B. Vinyl plastic tape, silver gray, flame resistant, vapor barrier sealant tape on rigid and flexible insulation material for warm or cold air ducts. Similar to 3M Company Duct Sealing Tape No. 474.
- C. Aluminum foil tape, dead soft aluminum foil, point seal on stick pin, metal patching, moisture barrier, heat reflecting and general sealing on aluminum facing foil. Similar to 3M Company Aluminum Foil Tape No. 425.

2.12 STAPLES

- A. Staples shall be galvanized clad outward clinching insulation staples.

2.13 INSULATING CEMENT

- A. Insulating cement shall be a mineral-fiber (wool) ASTM C 195 base material having essentially the same insulating characteristics as the adjacent insulation. Similar to PABCO High Temperature Insulating Cement. Insulating cement shall be applied in layers to a maximum thickness of 1/2 inch. Each layer shall be allowed to dry thoroughly before subsequent layers are applied.

2.14 FINISHING CEMENT

- A. Finishing cement ASTM C 449 shall be diatomaceous silica thermal insulating materials with a suitable proportion of heat resistant binder, hydraulic setting insulating cement capable of withstanding maximum temperature of 700 degrees Fahrenheit. When mixed with water it shall be a plastic mix suitable for trowel applications and shall present a hard, smooth and durable surface after drying. Similar to PABCO No. 127.
- B. Combination insulating and finishing cement:
 - 1. Similar to Ryder One Coat or equal.
- C. Welding studs:
 - 1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.
- D. Corner angles on insulation of ducts, plenums and equipment in finished areas shall be formed of 28 gauge, 1 inch by 1 inch aluminum adhered to heavy Kraft paper having 2 inch by 2 inch by 2 inch wings to protect external corners under glass cloth jackets.
 - 1. Corner beads shall be 26-gauge galvanized steel with 2 1/2 inch wings (exposed ducts on roof).

PART 3 – EXECUTION

3.1 INSTALLATION OF INSULATION

- A. All insulation shall be applied by experienced insulating contractors in accordance with best Trade practice.
- B. Test, inspect and clean all surfaces of ductwork to be insulated before applying insulation.

- C. Take all possible precautions to protect work of other Trades. Provide protective covering as required to accomplish this end. This Trade shall be responsible for returning all equipment and material to its original new condition and appearance where damage occurs due to his neglect.
- D. All ductwork shall have been tested and approved prior to installation of insulation.
- E. All ductwork and plenum or surfaces, where subject to condensation on the outside, shall be insulated including vapor seal finish.
- F. All surfaces to be insulated shall be clean, dry and free from dirt and scale when insulation is being applied. Insulation shall be dry at the time of installation and before and during the process of finished application.
- G. Butt ends will not be allowed. However, where required and approved by Architect, jacket material shall be pasted over exposed ends and banded to give a neat and finished appearance. Exposed fiberglass material will not be permitted.
- H. Surfaces of insulation shall be smooth, even and true to line with jackets drawn tight and smoothly secured. Scrap pieces of insulation shall not be used where a full length section will fit.
- I. The methods of application of insulation, finishes, adhesives, cements, accessories are generally specified under the material headings of these specifications. Where not specifically detailed, it is intended that they are equal or exceed the manufacturer's published recommendations, existing at time of bid openings, subject to the approval of the Architect.
- J. Butt covering neatly to walls, floors, ceiling. Apply band at end and position so band covers gap between surface and insulation where exposed.
- K. Fastenings: Provide where required to securely hold insulation. Apply adhesive and weld pins and/or stick clips on exposed risers to prevent slipping and turning of insulation.
- L. Thickness of insulation shall not be compromised due to piping interferences, improper installation or any other reason.

3.2 DUCTWORK EXPOSED TO WEATHER

- A. When duct installation, sealing and testing is completed by the Mechanical Contractor, the Insulation Contractor shall cover all ducts exposed to weather with insulation in accordance with the insulation specification but in no case shall this be less than 3 inch thick fiber glass rigid board insulation with vapor barrier for ductwork. Insulation shall be installed in one piece and where applicable shall have mitered corners to fit tightly over the sheet metal. The exterior ductwork on the roof must be insulated and jacketed with a minimum 3" thick rigid fiberglass board insulation with "FSKL" facing and a weatherproof jacketing system either EPDM or "Polyguard Alumaguard"-All-weather duct-wrap system. In addition, the ductwork must be "zero-leakage" construction and insulation is to be tapered and sloped for water run-off.
 - 1. EPDM duct-wrap shall be 60-mil. Ductwork to be tested to assure 0% leakage prior to installing EPDM duct-wrap material

2. Ductwork shall be 100% watertight.

PART 4 – SCHEDULES

4.1 DUCTWORK INSULATION SCHEDULE:

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket
Outside Air Intake Ducts & Relief Plenums, Supply Air Ductwork (Exposed)	Rigid Fiberglass Board Insulation 2"	FSKL	
All Supply Air Ductwork (Concealed) (Note 4)	Flexible Fiberglass w/Vapor Barrier 2"	FSKL	
Louver Blank-off Panels	Rigid Fiberglass Board Insulation 3"	FSKL	
Exhaust within 15'-0" of the outside	Rigid Fiberglass Board Insulation 2"	FSKL	
Outside Ductwork supply, exhaust, return and other	Rigid Fiberglass Board Insulation 3"	FSKL	EPDM Duct-wrap or Polyguard Alumaguard
Others not scheduled with system temperatures below 60°F or above 90°F	Flexible Fiberglass w/Vapor Barrier 1"	FSKL	

A. HVAC Insulation Schedule Notes

1. Provide vapor barrier on all ductwork insulation. Ductwork exposed to weather shall be insulated with external insulation using double the thicknesses scheduled hereinbefore, up to 24 inches beyond the point where ducts (supply and return) enter the building. Provide weatherproof jacket as hereinafter specified. (EPDM Duct-wrap or Polyguard Alumaguard)
2. R=5 installed equals 2" flexible fiberglass.

END OF SECTION

SECTION 230719

HVAC PIPING INSULATION

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all piping insulation, vapor barriers, jackets, finishes, adhesives, cements, and accessories to make a complete insulated system for all piping, valves, fittings, joints, offsets, and flanges specified herein.
- B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.
- C. Hard insulation material shall be provided at all hangers.
- D. Insulate the following:
 - 1. All scheduled piping, all valves, fittings, elbows, flanges, and accessories.
 - 2. All piping exposed to weather including provision of additional weatherproof ALUMINUM jacket.
 - 3. Provide insulation jacket covers.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
1. ASTM A 666 – Standard Specification for Austenitic Stainless-Steel Sheet, Strip, Plate and Flat Bar.
 2. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.
 3. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).
 4. ASTM C 177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
 5. ASTM C 195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.
 6. ASTM C 240 – Standard Test Methods of Testing Cellular Glass Insulation Block.
 7. ASTM C 449/C 449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 8. ASTM C 518 – Standard Test method for Steady-State Heat Flux Measurements and Thermal Insulating and Finishing Cement.
 9. ASTM C 533 – Standard Specification for Calcium Silicate Block and Pipe Terminal Insulation.
 10. ASTM C 534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 11. ASTM C 547 – Standard Specification for Mineral Fiber Pipe Insulation.
 12. ASTM C 552 – Standard Specification for Cellular Glass Thermal Insulation.
 13. ASTM C 578 – Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation.
 14. ASTM C 591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 15. ASTM C 610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
 16. ASTM C 795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.

17. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM D 1056 – Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
19. ASTM D 1667 – Standard Specification for Flexible Cellular Materials – vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
20. ASTM D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
21. ASTM D 2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics.
22. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
23. ASTM E 96 – Standard Test Methods for Water Vapor Transmission Materials.
24. NFPA 225 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
25. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
26. ANSI/ASHRAE 90.1 – Energy Conservation in New Buildings.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer’s Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.
- D. Installation Graphic Details.

1.6 QUALITY ASSURANCE

- A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.
- B. Piping insulation for the various piping systems and associated equipment shall be composed of materials which are non-combustible and/or provide a fire resistive system of insulation which complies with the applicable Code having jurisdiction. Generally, it is required that fire hazard ratings shall not exceed the following, except as noted:

1. Flame Spread Rating 25 (No Exceptions)
 2. Smoke Developed Rating: 50
- C. All fire hazard ratings shall be as determined by NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials", ASTM E84 or UL 723.
- D. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.
- E. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities as to fire hazard rating.
- F. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.
- G. Where insulation is specified for piping, insulate similarly all connections, vents, drains and any piping connected to system subject to heat loss or gain. Do not cover vent petcocks, cleanouts or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.
- 1.7 REGULATORY REQUIREMENTS
- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.
- 1.8 DELIVERY, STORAGE AND PROTECTION
- A. Accept materials on site, labeled with manufacturer's identification, product density and thickness.
- B. All materials shall be stored in a dry area free from moisture and debris.
- 1.9 ENVIRONMENTAL REQUIREMENTS
- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during and after installation for minimum of 24 hours.

PART 2 – PRODUCTS

- 2.1 MANUFACTURERS ACCEPTABLE FOR PRODUCT TYPES INDICATED CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS
- A. Insulation:
1. Manville Corporation.
 2. Owens-Corning Fiberglass Corporation.

3. Armstrong World Industries, Incorporated.
 4. Certainteed Corporation.
 5. Knauf
- B. Mastics and adhesives:
1. Childers Products Company.
 2. H. B. Fuller Company, Foster Products Division.
 3. 3M Company Adhesives, Coatings and Sealers.
 4. Armstrong World Industries, Incorporated.
 5. Ruston Plant.
 6. Chicago-Mastic
 7. Insul-Coustic
 8. St. Clair Rubber
 9. Vimasco
 10. Baldwin-Ehret-Hill
- C. Pipe insulation of hanger and support:
1. Pipe Shields, Inc.
 2. Rilco Manufacturing Company.
 3. Elcen Metal Products Company.
 4. Power Piping Company.
 5. NPS Industries.
- D. PVC fitting covers:
1. Manville, Corporation.
 2. Ceel-Co.
 3. Certainteed, Corp.
 4. Cell Co. Plastics

2.2 GENERAL

- A. Adhesives and insulation materials: Composite fire and smoke hazard ratings maximum 25 for flame spread and 50 for smoke developed for pipe insulation. Adhesives to be waterproof when cured.
- B. The installation of thermal insulating materials coverings and coatings containing asbestos fibers is forbidden.
- C. Insulation shall not be chemically reactive to the metal over which it is applied. Insulation installed on steel shall be neutral or slightly alkaline. Insulation installed on aluminum shall be neutral or slightly acidic.

2.3 MATERIALS AND COMPONENTS

- A. Fiberglass insulation:
 - 1. Premolded pipe fiberglass: Recommended temperature to 850 degrees Fahrenheit with facing. Molded in one piece split or hinged circular sections in three-foot lengths for piping and tubing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 4.0 pounds per cubic foot and a K value of 0.23 at 75 degrees Fahrenheit mean temperature. Insulation furnished with facing as specified below and as indicated in insulation schedule. Insulation similar to Owens-Corning Type SSL-II. Pressure sensitive tapes using rubber based or acrylic based adhesives are not permitted.
 - 2. Pipe and tank fiberglass: Recommended temperature to 450 degrees F with facing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 3 pounds per cubic foot and a k-value of 0.27 btu in/(Hr sq.ft. degree F) at 75 degrees F main temperature. Insulation furnished with facing as specified below and as indicated in insulation schedule. Insulation similar to Manville pipe and tank insulation. Pressure sensitive tapes using rubber based or acrylic based adhesives are not permitted.
 - 3. Flexible fiberglass: Recommended temperature to 250 degrees Fahrenheit. Glass fibrous flexible blanket insulation having density of 0.75 pounds per cubic foot and a K value of 0.30 at 75 degrees mean temperature. Insulation furnished with facing as specified below and indicated in insulation schedule. Insulation and jacket similar to Owens-Corning Type SSL-II.
 - 4. Use pipe and tank fiberglass only when premolded pipe fiberglass is not available. Pipe and tank insulation shall not be used on pipe sizes 24 inches and smaller.
- B. Equipment insulation:
 - 1. Rigid fiberglass: Recommended temperature to 450 degrees F. Fiberglass rigid board having a density of 3.0 pounds per cubic foot and a K value of 0.23 at 75 degrees F mean temperature. See schedule for facing type.

2. Flexible fiberglass: Recommended temperature to 250 degrees F with facing. Glass fibrous flexible blanket insulation having a density of 0.75 pounds per cubic foot and a K value of 0.30 at 75 degrees F mean temperature.
 3. Rigid fiberglass high temperature: Recommended temperature to 850 degrees Fahrenheit. Fiberglass high temperature board having a density of 3 pounds per cubic foot and a K value of 0.30 at 200 degrees Fahrenheit mean temperature.
- C. Insulation facing:
1. Code ASJ: All service jacket composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire-retardant adhesive. Longitudinal laps and butt strips shall be a minimum of 3 inches.
 2. Code FSKL: 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Water vapor permeability 0.04 perms. Longitudinal laps and butt strips shall be a minimum of 3 inches.
- D. Additional insulation jacket:
1. ADJ-1: Approximately 6 ounce per square yard glass cloth jacket with thread count of 5 strands per square inch.
 2. ADJ-2: Approximately 2 ounce per square yard glass cloth jacket with a thread count of 10 strands by 10 strands per square inch. Jacket shall be used for covering pipe and pipe fittings.
 3. ADJ-3a: 0.016-inch-thick aluminum jacket conforming to ASTM B-209 with a 1 mil factory applied polykraft moisture barrier. Longitudinal joints shall be placed at the side of the pipe facing downward at either the 4 o'clock or 8 o'clock position so as to shed water. Aluminum fitting covers, two-piece elbows, tees, valve and flange covers, etc., with a 1 mil polykraft or acrylic vapor barrier.
 4. ADJ-3b: 0.020-inch-thick aluminum jacket conforming to ASTM B-209 with a 3 mil factory applied polykraft moisture barrier. Longitudinal joints shall be placed at the side of the pipe facing downward at either the 4 o'clock or 8 o'clock position so as to shed water. Aluminum fitting covers, two-piece elbows, tees, valve and flange covers, etc., with a 3 mil polykraft or acrylic vapor barrier.
 5. ADJ-4: 20 mil PVC jacket suitable for all types of paint. Similar to Manville Zeston 25/50.
 6. ADJ-5: shall be a Cell-Co plastic jacket with the following color-coded pattern: (When specified in Part 4 of this Section).
 - a. Hot Water: Orange
 - b. City Water: Gray

c. Other Yellow-green

7. ADJ-6 Finish jacket of an Asbestos-free and woven as high temperature, heat-resistant fiberglass fabric. Lagging Cloth having a treated weight of 18.5 oz. Material shall be suitable for a sustained operation at 1100°F. Calcium silicate piping for generator exhaust piping shall also be jacketed with corrugated aluminum.
8. ADJ-7: 0.16-inch thick type T-316 stainless steel jacket. Alloys conforming to ASTM A-240. System shall have a 3-mil polykraft vapor barrier.

E. Adhesives:

1. Code ADH-1: Fibrous adhesive, non-flammable, quick setting adhesive for calcium silicate. Similar to Childers CP-97, 98.
2. Code ADH-2: Fast-drying vinyl base coating and lagging adhesive. Similar to Childers CP-50A HV2.
3. Code ADH-3: Fast-drying neoprene base adhesive for lap joints of foil-faced facing applied over pipe insulation. Similar to Childers CP-82.
4. Code ADH-4: Adhesive for use in adhering fiberglass board or blanket insulation to pipe and equipment. 3M Company Insulation Adhesive No. 35 or 38 non-flammable adhesives.

F. Caulking components:

1. Code CC-1: For use with foam glass and/or joint sealant applications. Flexible elastomeric vapor barrier sealant. Similar to Childers CP-76.

G. Mastics:

1. Code MAS-1: Vapor barrier mastic made with an elastomeric resin. For indoor use. Similar to Childers CP-30.
2. Code MAS-2: A non-water vapor barrier asphaltic emulsion coating, breathing type, for above ground installations. Similar to Childers CP-10.
3. Code MAS-3: Vapor barrier mastic made with an elastomeric resin. For outdoor use.

H. Tie wire:

1. Tie wire for securing insulation in place shall be type 304 stainless steel annealed steel wire of gauge and proper spacing as recommended by the insulation manufacturer. Wire shall be drawn up tightly enough to become embedded in the insulation and the ends of the loop twisted, bent over, and pressed into the insulation so as to leave no ends protruding.

- I. Banding:
1. 3/8 inch x 0.02 inch type 304 stainless steel for pipe insulation.
 2. 3/4 inch x 0.02 inch type 304 stainless steel for additional insulation jackets.
- J. Wire mesh:
1. Wire mesh shall be one inch by No. 20 BGW hexagonal mesh galvanized.
 2. Expanded metal: Expanded metal shall be 1/2 inch Hi-Rib metal lath of copper bearing steel.
- K. Tape:
1. Lead foil tape shall be 3M Company Lead Foil Tape No. 422, 4 mil thick, acrylic adhesive, 2 inch wide.
 2. Vinyl plastic tape, silver gray, flame resistant, vapor barrier sealant tape on rigid and flexible insulation material for warm or cold air ducts. Similar to 3M Company Duct Sealing Tape No. 474.
 3. Aluminum foil tape, dead soft aluminum foil, point seal on stick pin, metal patching, moisture barrier, heat reflecting and general sealing on aluminum facing foil. Similar to 3M Company Aluminum Foil Tape No. 425.
- L. Staples:
1. Staples shall be galvanized clad outward clinching insulation staples.
- M. Insulating cement:
1. Insulating cement shall be a mineral-fiber (wool) ASTM C 195 base material having essentially the same insulating characteristics as the adjacent insulation. Similar to PABCO High Temperature Insulating Cement. Insulating cement shall be applied in layers to a maximum thickness of 1/2 inch at one time. Each layer shall be allowed to dry thoroughly before subsequent layers are applied.
- N. Finishing cement:
1. Finishing cement ASTM C 449 shall be diatomaceous silica thermal insulating materials with a suitable proportion of heat resistant binder, hydraulic setting insulating cement capable of withstanding maximum temperature of 700 degrees Fahrenheit. When mixed with water it shall be a plastic mix suitable for trowel applications and shall present a hard, smooth and durable surface after drying. Similar to PABCO No. 127.
- O. Combination insulating and finishing cement:
1. Similar to Ryder One Coat or equal.

- P. Welding studs:
 - 1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.

PART 3 – EXECUTION

3.1 PREPARATION

- A. No insulation shall be applied until the surfaces of the equipment to be insulated are thoroughly cleaned and until pipes and equipment to be insulated have been leak & pressure tested. Provide testing report submittal for approval by the Architect / Engineer.
- B. Insulation shall not be applied to piping or equipment until authorization is given to the Contractor by the Architect / Engineer. Contractor shall submit a request for authorization. If any insulation is applied without first obtaining authorization, it will be the Contractor's responsibility to remove the insulation and apply it again if so directed.
- C. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.
- D. The execution of the insulation work shall be in strict accordance with the best practices of the trade and with the specifications.
- E. The insulation shall be handled and applied in a manner that will not adversely affect its structural or insulating properties.
- F. The installation instructions provided by the insulation material manufacturer of all materials specified in this Section shall be followed when installing these materials. Where the specifications are in conflict with manufacturers' instructions, such conflicts shall be brought to the attention of the Architect / Engineer for a decision.
- G. Welding operations will not be permitted on certain specific items of equipment, piping and components for the application of studs, pins, support rings, angles, etc. Contractor shall obtain permission in writing from the Architect / Engineer to perform any welding.
- H. Coat to seal all insulating cement and calcium silicate surfaces with primer similar to Childers CP-53 or equal before applying any mastic coating.

3.2 PIPING INSULATION INSTALLATION

- A. Ensure insulation is continuous through interior walls. Pack around pipes with fire proof self-supporting insulation material, fully sealed. Insulation on all cold surfaces where vapor barrier jackets are specified must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, and other heat conductive parts that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- B. Insulate fittings, valves, unions, flanges, and strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with PVC or aluminum end caps.

- C. Premolded fiberglass insulation for straight pipes shall be applied, neatly fitted around piping and sealed with adhesive ADH-3. Adhesive shall be applied to only one side of each joint and shall not be applied to the pipe surface.
- D. Where two sections of pipe insulation butt together provide a 3-inch-wide butt strip of same facing material as adjacent insulation facing. Adhere neatly in place using adhesive ADH-3.
- E. All pipe elbows shall be insulated with short radial and mitered pieces of board or block insulation or premolded pieces of pipe insulation. Each piece shall be butted tightly against the adjoining piece and all joints, seams, voids and irregular surfaces shall be filled with insulating cement finished to a smooth, hard and uniform contour. Coat with MAS-1 mastic and reinforce with ADJ-2 additional jacket. In addition, place a fitted PVC cover (ADJ-4) over insulated elbow exception. Tape elbow to adjoining insulation.
- F. All valves and fittings shall be insulated with premolded fittings, sectional pipe insulation, or blocks of the same material and thickness as used for the adjacent pipe. Flange insulation shall overlap the adjoining pipe insulation by not less than the thickness of the pipe insulation. Sectional pipe covering or block insulation shall be cut to fit, and each section butted closely to the next and held in place with tie wire.
- G. Fittings on pipe lines in finished and concealed areas shall be covered with premolded fiberglass pipe fitting insulators Insul-Coustic or equal, where sizes are available, otherwise, use mitercut segments of molded pipe insulation, wire in place with joints and raw edges sealed with adhesive and smoothed out with a coat of insulating cement.
- H. On cold pipes the fittings shall be finished with (2) coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent pipe insulation. Hot pipes shall be finished in a similar manner except the mastic need not be of the vapor barrier type.
- I. Insulation shall cover the entire surface of the fittings and bodies of the valves up to and including the bonnets, and to the valve stuffing box studs, bolts, or nuts. All joints, seams, and irregular surfaces shall be filled with insulating cement. The insulated surfaces shall be covered with a 1/4-inch-thick layer of finishing cement and heavily coated with vapor barrier mastic MAS-1 for cold services and mastic MAS-2 for hot services and reinforced with ADJ-2 additional jacket. Mastic shall be trowelled to a smooth and well-shaped contour compatible with adjoining pipe insulation jackets as specified.
- J. Use ADJ-4 covers over fittings and flanges everywhere except when ADJ-3a, ADJ-3b, or ADJ-5 is specified.
- K. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship on all joints of all piping.
- L. All instrument connections for thermometers, thermocouples, gauges, test connections, flow meters, etc., on insulated pipes, vessels, or equipment shall be insulated. The insulation shall be shaped at these connections by tapering it to and around the connection with insulating cement and finishing with finishing cement, vapor barrier adhesive, applicable mastic, or caulking compound.

- M. Where removable flange and valve insulation is required or specified, installation shall conform to the following:
1. Removable flange insulation shall be made from sectional pipe insulation of the same thickness as that on the adjoining pipe or from block insulation 1/2 inch thinner than the pipe insulation and finished with insulating cement. Insulation jackets shall be the same as adjoining pipe insulation unless indicated otherwise.
 2. When flange covers are made from sectional pipe insulation, they shall enclose the flanges and be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. Secure the flange cover in place with stainless steel banding.
 3. When flange covers are made from block insulation, they shall be made in two halves. Each half shall consist of mitered blocks wired to 1/2 inch galvanized hardware cloth mesh. This wire frame, with its attached insulation, shall then be secured to the flanges with tie wire. The insulation cover shall be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. The whole flange cover assembly shall be finished with 1/2 inch of insulating cement applied in two coats. After the first coat is dry, the second coat shall be trowelled to a smooth hard finish. All surfaces shall then be finished with jackets as specified in the schedule.
 4. Removable valve insulation covers shall be constructed in the same manner as for flanges with the following exception; the two part section shall be divided on the vertical center line of the valve body, bonnet, flange or joint.
 5. When specified to insulate the complete valve, the hand wheel or lug wrench shall be removed to accommodate the valve bonnet box. The valve bonnet box shall be constructed in a one piece closure, one end closed, one end opened to fit up to the valve body insulation. Securing the valve and bonnet box sections, sealing and pointing of the insulation shall be done in same manner as specified for flange covers.
 6. Unless indicated as removable, a permanent installation as previously specified shall be used.
 7. Protect insulation on piping 2 1/2" and up where supported in hangers by means of calcium silicate rigid pipe insulation or jackets. Saddles or shaped galvanized steel pieces approximately 10" long by half the circumferences of insulated pipe.
 8. All piping shall have been tested and approved prior to installation of insulation.
 9. All piping or surfaces where subject to condensation on the outside shall be insulated including vaporseal finish.

PART 4 – SCHEDULES

4.1 PIPING INSULATION SCHEDULE: (ASJ = "All-Service-Jacket")

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket*
Glycol Hot Water Heating, Glycol Systems Up to 1 1/2" 2" & Up	Molded Fiber Glass 1 1/2" 2	ASJ ASJ	
Condensation Drains & Vents, Cold Water Make-up	Molded Fiber Glass 1 1/2"	ASJ	
All outdoor piping	Two times thickness scheduled except heat traced		ADJ-3b
Horizontal Roof Drain piping below roof	Molded Fiber Glass 2"	ASJ	
Others not scheduled	Molded Fiber Glass 1 1/2"	ASJ	

*Including elbows, fittings, valves, complete system.

- A. Refer to jacket specifications for finish covering to be installed on calcium silicate insulation in finished areas.
- B. Where "Finishing Cement" finishes are scheduled, refer to specifications for Cement herein for materials, method of application, thickness, etc.
- C. Provide vapor barrier on all cold water and rainwater piping.
- D. Piping exposed to weather shall be insulated with pipe insulation using double the thicknesses scheduled hereinbefore, up to 24 inches beyond the point where pipes enter the building. Provide weatherproof jacket as hereinafter specified.
- E. Equipment drains and floor drains from cooling coils shall be insulated 6 feet downstream from connection point.
- F. Aluminum metal jacket required on roof.

END OF SECTION

SECTION 23 20 02

HVAC PIPING AND JOINTS

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install piping, fittings, flanges, unions, bolting, gaskets, welding, and threading for all main piping network, branches and connections to all HVAC equipment and systems.
- B. All systems shall be installed in accordance with local code including vent piping and relief discharge termination points.
- C. Secure and pay for all permits and local/state approvals for the installation of all components included under this Section. Arrange for all inspections.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. ASME: American Society of Mechanical Engineers
- C. NFPA: National Fire Protection Association
- D. ANSI: American National Standards Institute
 - 1. A13.1: Scheme for Identification of Piping Systems
 - 2. B16.1: Cast Iron Pipe Flanges and Flanged Fittings
 - 3. B16.3: Malleable Iron Threaded Fittings
 - 4. B16.4: Cast Iron Threaded Fittings
 - 5. B16.5: Pipe Flanges and Flanged Fittings
 - 6. B16.9: Factory Made Wrought Steel Butt Weld Fittings

7. B16.15: Cast Bronze Threaded Fittings
 8. B16.18: Cast Copper Alloy Solder Joint Pressure Fittings
 9. B16.20: Metallic Gaskets for Pipe Flanges
 10. B16.21: Non Metallic Flat Gaskets for Pipe Flanges
 11. B16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
 12. B16.24: Cast Copper Alloy Pipe Flanges and Flanged Fittings Class 150, 300, 400, 600, 800, 1500 and 2500
 13. B182.1 Square and hex bolts and screws
 14. B182.2 Square and hex nuts
 15. B16.39: Malleable Iron Threaded Pipe Unions
 16. B16.42: Ductile Iron Pipe Flanges and Flanged Fittings
 17. B31.9: Building Service Piping
 18. B36.10: Welded and Seamless Wrought Steel Pipe
 19. Z49.1: Safety in Welding and Cutting
- E. ASTM: American Society for Testing and Materials
1. A 47: Ferritic Malleable Iron Castings
 2. A 53: Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
 3. A 74: Cast Iron Soil Pipe and Fittings
 4. A 105/A105M: Forgings, Carbon Steel, for Piping Components
 5. A 106: Seamless Carbon Steel Pipe for High-Temperature Service
 6. A 135: Electric-Resistance-Welded Steel Pipe
 7. A 153: Zinc Coating (Hot Dip) on Iron and Steel Hardware
 8. A 183: Carbon Steel Track Bolts and Nuts
 9. A193: Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
 10. A194: Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service
 11. A197: Cupola Malleable Iron
 12. A 234/A234M: Pipe Fittings of Wrought Carbon Steel and Alloy / Rev A: Steel for Moderate and Elevated Temperature
 13. A 307: Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength
 14. A 536: Ductile Iron Castings
 15. A 568: Steel, Sheet Carbon and High-Strength Low-Alloy / Rev A: Hot-Rolled and Cold-Rolled, General Requirements
 16. A 795: Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
 17. B 32: Solder Metal
 18. B 75: Seamless Copper Tube

19. B 88: Seamless Copper Water Tube
20. F 36: Compressibility and Recovery of Gasket Materials
21. F 37: Sealability of Gasket Material
22. F 38: Creep Relaxation of a Gasket Material
23. F 146: Fluid Resistance of Gasket Materials
24. F 104: Non-metallic Gasket Materials
25. F 152: Tension Testing of Nonmetallic Gasket Materials

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional information.
- B. Product Data: Include data on pipe materials, steam/condensate specialties, pipe fittings and accessories. Provide manufacturers catalogue information and mill certificates.
- C. Welders Certificate: Include welder's certification of compliance with ASME (BPV IX).
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Project Record Documents: Record actual locations of all piping, valves, traps and valve tag numbers.
- F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.
- G. Provide piping plans to a minimum scale of ¼" - 1'-0".

1.6 QUALITY ASSURANCE

- A. Installer: Company specializing in performing work of the type specified in this section, with documented experience.
- B. Welders: Certify in accordance with ASME (BPV IX).

1.7 REGULATORY REQUIREMENTS

- A. Conform to ASME B31.9 code for installation of piping systems including specialties.
- B. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
- C. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Protect piping systems and specialties from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL

- A. Do not install piping when environmental conditions are outside the specific limitations of the referenced codes and manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Provide all piping, fittings, flanges, couplings, unions, bolting, gaskets, welding, threading and soldering for main piping network, branches and connections to equipment as shown on the drawings and as required to provide complete systems. All piping, fittings and accessories shall conform to the appropriate Service Pipe Schedule as specified hereinafter.
1. Acceptable manufacturers contingent on compliance with the specifications.
 - a. Pipe
 - 1) Steel
 - a) U.S. Steel
 - b) AK Steel
 - 2) Copper
 - a) Cambridge Lee
 - b) Cerro
 - b. Fittings
 - 1) Welded Fittings
 - a) Anuil
 - b) Weld Bend
 - c) Hackney
 - 2) Cast Iron Fittings
 - a) ITT Grinnel
 - b) Flagg
 - c) Ward
 - 3) Copper Fittings
 - a) Cambridge Lee
 - b) Cerro
- B. General
1. All pipe and fitting shall be new, first quality material suitable for continuous operation under the conditions specified. All material shall be in conformance with ANSI Standards.
 2. All pipe shall be a product of the United States of America. Mill certificate shall be provided as required.
 3. All piping shall be clearly marked with material specification.
 4. All pipe and material shall comply with the requirements and recommended practices of ASME B31.9 Building Service Code (latest Edition and Addenda).
 5. Elbows shall be long radius ANSI B16.9 unless otherwise specified.
 6. Fittings shall be used at all branch connections from headers.

7. Acceptable fittings shall be tees. "Weldolets", and "Threadolets" will also be allowed as specified. Fishmouth or shaped nipples will not be allowed.
8. Provide drains at low points and vents at high points of all piping systems and between pumps and check valves.
9. All pipe and fittings with threaded ends shall have IPS threads cut clean and true and in conformance with the ANSI B1.20.1.
10. Threaded pipe and fittings shall be made up with special care to avoid marring or damaging pipe and fitting surfaces.
11. All threaded joints in steel and iron pipe shall be made up with pipe thread compound or other compound suitable for design temperature and pressure of piping. All threaded joints in copper pipe shall be made up with Teflon pipe tape, petroleum gas grade, wound on male threads, clockwise as viewed from end of pipe.
12. Provide brass, bronze steel or cast ductile iron (as appropriate) dielectric unions or flanges between dissimilar pipe materials to prevent galvanic action, as required. Gaskets shall be suitable for operation up to design temperature of the piping.
13. No joints shall be "backed-off" to align pipe and fittings.
14. Gauge lines shall be stainless steel with compression fittings.
15. Piping for compressed air for controls shall be copper.
16. Use "Never-Freeze" Copper Anti-Seize by Frederickseal or similar on all flange bolts. Torque all bolts to suitable values using torque wrenches.

2.2 SERVICE PIPE SCHEDULE

Service	Type	Grade	Wall		Joints (Minimum Sch. Shall match Wall)		Test Pressure PSIG
			to 10"	12" & Up	2" and Less	2½" & Up	
Glycol Hot water supply and return	A53 Seamless or ERW	A or B	Sch.40	Standard 0.375"	Threaded	Butt Welded	125
Make-up and fill	Hard Drawn Copper	ASTM B88	Type L		95-5 Solder	Silver Brazed	125
Miscellaneous drains to 2"	Hard Drawn Copper	ASTM B88	Type L		DWV 95-5 Solder		125
Other piping	A53 Seamless or ERW	A or B	Sch.80	Extra Strong 0.5"	Threaded Malleable	Butt Welded	125

Note 1: Glycol Hot water piping, 2" and smaller, may be hard drawn Type L copper tubing with wrought copper fittings and 95-5 non-lead solder at the option of the contractor.

2.3 FITTINGS

A. For Steel Pipe

1. 2 1/2" and Larger, Butt Welded
 - a. Butt weld, same weight as piping.
 - b. ANSI A234 WPB
 - c. ANSI B16.9
 - d. Branch Connections:
 - 1) Equal to main and to (2) pipe sizes smaller shall be welded tees.
 - 2) Three (3) pipe sizes and smaller than main:
 - a) 2 1/2" and larger: Weldolets or Tee
 - b) To 2": Thread-O-Lets, or Tee.
2. 2" and Smaller Screwed
 - a. Cast Iron: A126 ANSI B16.1, B16.4
 - 1) 125 lb., wsp
 - 2) 250 lb., wsp where noted

B. For Copper Tubing

1. Solder Joint: Wrought Copper, ANSI B16.22 or Cast Bronze B16.18.
 - a. 2" and less
 - 1) 95-5 non-lead alloy.

2.4 FLANGES

A. For Steel Pipe

1. Welded: Weld neck, ANSI B16.5.
 - a. 150 lb. Wsp
2. Match connecting flange class and facing.

2.5 FLANGE GASKETS

- A. One-piece ring type 1/16" thick, except as noted.
- B. Suitable for temperature, pressure and service of system.
- C. Compressed compound fiber type for the following:
 1. Hot water.
- D. For Joints of Dissimilar Metals
 1. Isolating gaskets, sleeves, and washers between flanges, bolts and nuts.
 2. Gaskets, similar to DuPont Teflon.

2.6 UNIONS

A. For Steel Pipe

1. Malleable iron 300 lb. Wsp

- a. Ground Jacket Seat: Brass-to-iron, black or galvanized to match piping.

PART 3 – INSTALLATION

3.1 PIPING INSTALLATION

- A. Provide all piping systems as shown on the drawings and otherwise required to make a complete, workable and neat job, installing all valves, appurtenances, , unions and gaskets. The Contractor shall use care arranging all piping as shown on the drawings and shall carefully examine the arrangements where offsets are indicated and shall follow details as shown.
- B. All piping shall be run to true alignment generally parallel or perpendicular to adjacent building walls, floors and ceilings and with uniform grades and spacing so as to present a neat and workmanlike appearance.
- C. Care shall be paid to the exact locations for all piping and equipment with respect to equipment, ducts, conduits, slabs, beams and lighting fixtures, so as to provide maximum access to all mechanical and electrical equipment in the buildings. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner. The drawings and specifications covering other work to be done in the buildings shall be carefully studied and arrangements made to avoid conflict.
- D. The drawings shall be followed where they are definite and provided such procedure causes no objectionable conditions or does not conflict with other Trades, Laws, Regulations or recommendations of equipment manufacturers. The drawings are intended to indicate the sizes of piping connections and if certain sizes are omitted, or unclear, obtain additional information before proceeding.
- E. Rough in for all equipment requiring connections to the Mechanical work. Obtain all necessary data on exact locations, sizes, connections, fittings and arrangements and exact routings as may be required for proper installation.
- F. Bushings shall not be used for reducers. Reducing fittings shall be used for all changes in pipe size and shall be as follows:
 1. Horizontal water piping: Eccentric flat on top for venting.
 2. Vertical water: Concentric.
- G. Unions, or flanges shall be provided in conjunction with all equipment, coils, control valves and specialties in all pipelines and at all points necessary to provide reasonable access to the piping systems.
- H. Ends of all pipes shall be reamed clean and all pipes shall be straightened before erection and measures shall be taken to preserve this cleanliness after erection.
- I. Support piping independently at all equipment so that the equipment is not stressed by piping weight or expansion.
- J. Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation.
- K. Provide dielectric unions, waterway fittings or flanges between dissimilar pipe materials to prevent galvanic action as required.

- L. Provide proper provision for expansion and contraction in all portions of pipe work, to prevent undue strains on piping or apparatus connected. Provide double swings at riser transfers and other offsets to take up expansion. Arrange riser branches to take up motion of riser. Branch runouts to equipment shall have a minimum of (3) elbows, adequately spaced.
- M. All piping connections to equipment shall be made with offsets. Provide with unions, and/or flanges so arranged that the equipment can be serviced or removed without dismantling the piping. If equipment, when commissioned, becomes air bound or stratified, all necessary modifications to the piping system required to rectify the condition permanently shall be made to piping and equipment, furring, floors, walls, etc., at the Contractor's expense.
- N. Pipe pitch, unless otherwise indicated on the drawings, shall be as follows:
 - 1. Water Piping:
 - a. Up to 1" pipe: 1" in 40'-0", up in direction of flow.
 - b. 1 1/4" larger: 1" in 100'-0", up in direction of flow.
- O. Drain connections at low points in water piping and where noted:
 - 1. In equipment rooms:
 - a. To 3" pipe: 3/4" ball valve.
 - b. 4" to 8": 1 1/2" ball valve.
 - c. 10" and larger: 2 1/2" ball valve.
- P. Automatic air vents at high points and where required to expel air:
 - 1. Rated for a maximum operating temperature of 240°F at 150 psig. Nell & Gossett No. B7, Taco 418 Hy-Vent or Amtrol 706. Provide a ball valve on the system side of the air vent. Provide a copper drain line down to 6" above mechanical room floors. Vents installed above ceilings shall be piped to the nearest utility sink or floor drain.
- Q. Copper tubing and galvanized steel shall not be mixed in any one run of piping, except as otherwise specified herein.
- R. During construction, temporarily close open ends of pipes with sheet metal caps or duct tape to prevent debris from entering piping systems.
- S. Joints in piping systems, for all services, shall be made tight and leakproof against test pressures. Leaks in screwed or flanged joints which cannot be eliminated by normal wrench tightening methods shall be repaired at the joint. Under no circumstances shall caulking be allowed. No joints shall be backed off to align pipe fittings.
- T. Provide extra heavy pipe for nipples where unthreaded portion of pipe is less than 1 1/2" long. Use of close nipples is not permitted.

3.2 WELDING

- A. All welding done under this Contract shall be performed by experienced welders in a neat and workmanlike manner. All welding done shall be in accordance with ASME B31.9 Building Service Piping Code (latest Edition and Addenda). The Contractor shall furnish to the Owner for approval and record the following:
 - 1. Welding Procedure Specifications (WPS) for each procedure to be used
 - 2. Procedure Qualification Record (PQR)

3. Welding Operator Qualification Tests (WPQ) for each welder to be employed.
- B. Documents shall be on forms similar to the forms referenced in the ASME Boiler & Pressure Vessel Code, Section IX, latest edition. These records shall be furnished to the Owner for this project not less than (2) weeks, prior to any welding. All welders to be employed by the Contractor on this work shall be certified in accordance with the above. The Mechanical Contractor shall test welders to these procedures within (3) months of the work beginning to certify them for this work. The above forms shall be clearly marked specifically for the Contractor's use and certified by the appropriate personnel. Documents prepared for other's use are not allowed. Failure to provide these forms to the satisfaction of the Owner, or his representative, will result in the replacement of the Mechanical Contractor with one who can meet these requirements, at no additional cost to the Owner. No delays or cost increases to the overall project schedule will be accepted due to non-compliance with the above by the Mechanical Contractor.
- C. Mitered elbows are not permitted. Odd angle elbows shall be cut from long radius elbows.
- D. The weld reinforcement shall be not less than 1/16" nor more than 1/8" above the normal surface of the joined sections. The reinforcement shall be crowned at the center and shall taper on each side to the surface being joined. The exposed surface of the weld shall present a workmanlike appearance and shall be free of depressions below the surface of the joined members.
- E. No welding of any kind shall be done when the temperature of the base metal is lower than 50°F. Material to be welded during freezing temperatures shall be made warm and dry before welding is started. Temperature of metal shall be "warm to the hand", or approximately 60°F.
- F. Welds will be inspected visually by supervisory representatives of the Architect and the Contractor. Any weld judged defective by the Architect from a visual inspection shall be cut out and tested in the presence of the Owner or his representative. In the event any welder consistently produces a high percentage of unsatisfactory production welds, he shall be discharged at the request of the Owner, even though he is able to produce satisfactory welds when especially tested. Removal and replacement of test coupons and samplings shall be done at the expense of the Contractor. The Owner reserves the right to test any welds ultrasonically or radiographically for full penetration.
- G. Paint all external surfaces of welds with a high temperature paint prior to insulation being applied.
- H. Store all 7018 electrodes in rod oven once original container is opened.
- I. Welds in all high-pressure steam and high temperature hot water (350°F or greater) shall be X-ray tested. This X-ray shall be performed by an independent testing company. Testing company shall employ certified weld inspectors. The welds shall meet the X-ray requirements in ANSI B31.1. The independent inspection services shall be provided by the Mechanical Contractor.
- J. Provide fire watches required by state and local authorities and fire departments.

3.3 CLEANING AND BLOWING OUT

- A. The equipment and piping installed under this Section shall be blown out under pressure and cleaned of foreign matter, through temporary connections where necessary, before the system is placed in service. Precautions shall be used to prevent foreign matter from getting into equipment and piping during construction. The supplier of water treatment equipment and chemicals shall recommend and furnish chemicals for the purpose of cleaning and blowing out of all systems. All chemicals, materials, instruments, and labor shall be provided by the Contractor.
- B. The surfaces of all equipment and piping shall be clean upon completion of the work.
- C. All pipeline strainers shall be cleaned immediately before being turned over to the Owner for acceptance.
- D. During cleaning process, hammer welds to remove scale, weld slag and other debris.

3.4 TESTING

- A. Furnish all labor, material, instruments, supplies and services and bear all costs for the accomplishment of the tests herein specified. Correct all defects appearing under test and repeat the tests until no defects are disclosed; leave the equipment clean and ready for use.
- B. Perform all tests other than herein specified which may be required by Legal Authorities or by Agencies to whose requirements this work is to conform.
- C. Furnish all necessary testing apparatus, make all temporary connections, and perform all testing operations required, at no additional cost to the Owner.
- D. All equipment and piping installed under this Contract shall be tested and found tight. Insulated or otherwise concealed piping shall be tested before being closed in. All leaking joints shall be corrected, retested, and found tight. Such tests shall conform to the requirements of Local Codes but shall not be less than the equivalent of the tests called for herein. Threaded joints that leak shall not be seal-welded to correct leakage.
- E. Tests performed shall not relieve the Contractor of his responsibility for leaks which may develop after the tests are made.
- F. All piping systems shall be subjected to a hydrostatic test at the scheduled test pressure for a period of (4) hours without drop in pressure.
- G. Tests of piping systems shall be conducted before connections to equipment are made and before piping is covered, buried or otherwise concealed.
- H. Systems found to have leaks shall be subjected to further tests when faulty joints have been repaired or replaced.
- I. Welded joints shall be subjected to a hammer test while under pressure.
- J. Glycol Hot water piping shall be hydrostatically tested to the test pressures scheduled. Equipment and devices which would be damaged at the test pressure, shall be removed, or blanked off during testing.

END OF SECTION

SECTION 23 20 10

REFRIGERANT & COOLING CONDENSATE PIPING

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field refrigerant piping for HVAC systems.
- B. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.
- C. Definitions:
 - 1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
 - a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
 - b. High side means the parts of a refrigerating system subjected to condenser pressure.
 - 2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 840 degrees F but less than the melting temperatures of the joined parts.

1.2 RELATED WORK

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - 1. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.3 QUALITY ASSURANCE

- A. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.
- B. Products shall comply with UL 207 "Refrigerant-Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrically Operated Valves."

1.4 SUBMITTALS

- A. Submit in accordance with specification Section 23 05 00, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Shop Drawings:

1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
 - a. Tubing and fittings
 - b. Valves
 - c. Strainers
 - d. Moisture-liquid indicators
 - e. Filter-driers
 - f. Flexible metal hose
 - g. Liquid-suction interchanges
 - h. Oil separators (when specified)
 - i. Gages
 - j. Pipe and equipment support
 - k. Refrigerant and oil
 - l. Pipe/conduit roof penetration cover
 - m. Soldering and brazing materials
2. Layout of refrigerant piping and accessories, including flow capacities, valves locations, and oil traps slopes of horizontal runs, floor/wall penetrations, and equipment connection details.

- C. Certification: Copies of certificates for welding procedure, performance qualification record and list of welders' names and symbols.
- D. Design Manual: Furnish two copies of design manual of refrigerant valves and accessories.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):
 - 495-1999 (R2002)..... Standard for Refrigerant Liquid Receivers
 - 730-2005 Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
 - 750-2007 Thermostatic Refrigerant Expansion Valves
 - 760-2007 Performance Rating of Solenoid Valves for Use with Volatile Refrigerants
- C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):
 - ANSI/ASHRAE 15-2007 Safety Standard for Refrigeration Systems (ANSI)
 - ANSI/ASHRAE 17-2008 Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)
 - 63.1-95 (RA 01) Method of Testing Liquid Line Refrigerant Driers (ANSI)
- D. American National Standards Institute (ANSI):
 - ASME (ANSI)A13.1-2007 Scheme for Identification of Piping Systems
 - Z535.1-2006 Safety Color Code

- E. American Society of Mechanical Engineers (ASME):
 - ANSI/ASME B16.22-2001 (R2005)
Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)
 - ANSI/ASME B16.24-2006 Cast Copper Alloy Pipe Flanges and Flanged Fittings,
Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)
 - ANSI/ASME B31.5-2006 Refrigeration Piping and Heat Transfer Components
(ANSI)
 - ANSI/ASME B40.100-2005 Pressure Gauges and Gauge Attachments
 - ANSI/ASME B40.200-2008 Thermometers, Direct Reading and Remote Reading
- F. American Society for Testing and Materials (ASTM)
 - A126-04..... Standard Specification for Gray Iron Castings for Valves,
Flanges, and Pipe Fittings B32-08 Standard Specification
for Solder Metal
 - B88-03 Standard Specification for Seamless Copper Water Tube
 - B88M-05 Standard Specification for Seamless Copper Water Tube
(Metric)
 - B280-08..... Standard Specification for Seamless Copper Tube for Air
Conditioning and Refrigeration Field Service
- G. American Welding Society, Inc. (AWS):
 - Brazing Handbook
 - A5.8/A5.8M-04 Standard Specification for Filler Metals for Brazing and Braze
Welding
- H. Federal Specifications (Fed. Spec.)
 - Fed. Spec. GG
- I. Underwriters Laboratories (U.L.):
 - U.L.207-2009 Standard for Refrigerant-Containing Components and
Accessories, Nonelectrical
 - U.L.429-99 (Rev.2006) Standard for Electrically Operated Valves

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Refrigerant Piping: For piping up to 4-inch use Copper refrigerant tube, ASTM B280, cleaned, dehydrated, and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer. For piping over 4-inch use A53 Black SML steel.
- B. Cooling Condensate Water Piping: Copper water tube, ASTM B88M, Type B or C (ASTM B88, Type M or L).
- C. Fittings, Valves and Accessories:
 - 1. Copper fittings: Wrought copper fittings, ASME B16.22.
 - a. Brazed Joints, refrigerant tubing: Cadmium free, AWS A5.8/A5.8M, 45 percent silver brazing alloy, Class BAg-5.
 - b. Solder Joints, water and drain: 95-5 tin-antimony, ASTM B32 (95TA).
 - c. Press-on fittings are not acceptable.
 - 2. Steel fittings: ASTM wrought steel fittings.
 - a. Refrigerant piping – Welded Joints.

3. Flanges and flanged fittings: ASME B16.24.
4. Refrigeration Valves:
 - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.
 - b. Pressure Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; UL listed. Forged brass with nonferrous, corrosion resistant internal working parts of high strength, cast iron bodies conforming to ASTM A126, Grade B. Set valves in accordance with ASHRAE Standard 15.
 - c. Solenoid Valves: Comply with ARI 760 and UL 429, UL-listed, two-position, direct acting or pilot-operated, moisture and vapor-proof type of corrosion resisting materials, designed for intended service, and solder-end connections. Fitted with suitable NEMA 250 enclosures of type required by location and normally open holding coil.
 - d. Thermostatic Expansion Valves: Comply with ARI 750. Brass body with stainless-steel or non-corrosive non-ferrous internal parts, diaphragm and spring-loaded (direct-operated) type with sensing bulb and distributor having side connection for hot-gas bypass and external equalizer. Size and operating characteristics as recommended by manufacturer of evaporator and factory set for superheat requirements. Solder-end connections. Testing and rating in accordance with ASHRAE Standard 17.
 - e. Check Valves: Brass or bronze alloy with swing or lift type, with tight closing resilient seals for silent operation; designed for low pressure drop, and with solder-end connections. Direction of flow shall be legibly and permanently indicated on the valve body.
5. Strainers: Designed to permit removing screen without removing strainer from piping system and provided with screens 80 to 100 mesh in liquid lines DN 25 (NPS 1) and smaller, 60 mesh in liquid lines larger than DN 25 (NPS 1), and 40 mesh in suction lines. Provide strainers in liquid line serving each thermostatic expansion valve, and in suction line serving each refrigerant compressor not equipped with integral strainer.
6. Refrigerant Moisture/Liquid Indicators: Double-ported type having heavy sight glasses sealed into forged bronze body and incorporating means of indicating refrigerant charge and moisture indication. Provide screwed brass seal caps.
7. Refrigerant Filter-Dryers: UL listed, angle or in-line type, as shown on drawings. Conform to ARI Standard 730 and ASHRAE Standard 63.1. Heavy gage steel shell protected with corrosion-resistant paint; perforated baffle plates to prevent desiccant bypass. Size as recommended by manufacturer for service and capacity of system with connection not less than the line size in which installed. Filter driers with replaceable filters shall be furnished with one spare element of each type and size.

8. Flexible Metal Hose: Seamless bronze corrugated hose, covered with bronze wire braid, with standard copper tube ends. Provide in suction and discharge piping of each compressor.
9. Oil Separators: Provide for condensing units, as shown. All welded steel construction with capacity to eliminate a minimum of 95 percent of the oil from the hot gas flowing through it. Provide manufacturer's published ratings for minimum and maximum refrigeration tonnage corresponding to this oil separating efficiency. Separator shall be equipped with a float valve to prevent return of the hot gas to crankcase and shall have isolating stop valves so it can be opened and services without pumping out any other part of the system. ASME construction or UL listed.
10. Receivers: Conform to AHRI 495, steel construction, equipped with tapping for liquid inlet and outlet valves, pressure relief valve and liquid level indicator.

2.2 GAGES

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Celsius scale in 1-degree (Fahrenheit scale in 2-degree) graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gages shall be provided in thermal wells located 5 to 7 feet above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 7 feet above the finished floor.
- B. Vacuum and Pressure Gages: Comply with ASME B40.100 and provide with throttling type needle valve or a pulsation dampener and shut-off valve. Gage shall be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Each gage range shall be selected so that at normal operating pressure, the needle is within the middle-third of the range.
 1. Suction: 30 inches Hg vacuum to 250 psig.
 2. Discharge: 0 to 500 psig.

2.3 PIPE SUPPORTS

- A. Refer to specification Section 23 05 29.

2.4 REFRIGERANTS AND OIL

- A. Provide EPA approved refrigerant and oil for proper system operation.

2.5 PIPE INSULATION FOR DRAINAGE PIPING HVAC SYSTEMS

- A. Refer to specification Section 23 07 19, HVAC PIPING INSULATION.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
 - 1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
 - 2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
 - 3. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing.
 - 4. Use copper tubing in protective conduit when installed below ground.
 - 5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.
- B. Joint Construction:
 - 1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
 - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
 - b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
 - c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
 - d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.
- C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
- D. Pipe relief valve discharge to outdoors for systems containing more than 100 lbs of refrigerant.

- E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material. For firestopping insulated piping refer to Section 23 05 84, THROUGH PENETRATION FIRESTOP SYSTEMS.

3.2 PIPE AND TUBING INSULATION

- A. Refer to specification Section 23 07 19.
- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

3.3 SIGNS AND IDENTIFICATION

- A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.
- B. Systems containing more than 110 lb of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 1/2 inch in height designating:
 - 1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
 - 2. Signs on all exposed high pressure and low-pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

3.4 FIELD QUALITY CONTROL

- A. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.
- B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. Perform tests in the presence of Resident Engineer. If the test fails, correct defects and perform the test again until it is satisfactorily done, and all joints are proved tight.
 - 1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
 - 2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68 degrees F minimum.

- C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

3.5 SYSTEM TEST AND CHARGING

- A. System Test and Charging: As recommended by the equipment manufacturer or as follows:
1. NOTE: The following refrigerant system tests are for field fabricated refrigerant piping systems. The tests do not apply to packaged, unitary equipment which is charged at the factory. Where applicable condensing temperature is over 130 degrees F, equipment and piping will be capable of withstanding leak pressure tests at not less than the design pressure corresponding to the condensing pressure during the higher ambient conditions (refer to ANSI/ASHRAE 15 & 34).
 2. After all components of the refrigerant system have been installed and connected, subject the entire refrigeration system to pneumatic, evacuation, and startup tests as described herein. Submit a schedule, at least 2 weeks prior to the start of related testing, for each test. Identify the proposed date, time, and location for each test. Conduct tests in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Provide all material, equipment, instruments, and personnel required for the test. Provide the services of a qualified technician, as required, to perform all tests and procedures indicated herein. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 6 copies of the tests report in bound 8 1/2 by 11-inch booklets documenting all phases of the tests performed. The report shall include initial test summaries, all repairs/adjustments made, and the final test results.
- B. Preliminary Procedures
1. Prior to pneumatic testing, equipment which has been factory tested and refrigerant charged as well as equipment which could be damaged or cause personnel injury by imposed test pressure, positive or negative, shall be isolated from the test pressure or removed from the system. Safety relief valves and rupture discs, where not part of factory sealed systems, shall be removed and openings capped or plugged.
- C. Pneumatic Test
1. Pressure control and excess pressure protection shall be provided at the source of test pressure. Valves shall be wide open, except those leading to the atmosphere. Test gas shall be dry nitrogen, with minus 70-degree F dewpoint and less than 5 ppm oil. Test pressure shall be applied in two stages before any refrigerant pipe is insulated or covered. First stage test shall be at 10 psi with every joint being tested with a thick soap or color indicating solution. Second stage tests shall raise the system to the minimum refrigerant leakage test pressure specified in ANSI/ASHRAE 15 & 34 with a maximum test pressure 25 percent greater. Pressure above 100 psig shall be raised in 10 percent increments with a pressure acclimatizing period between increments. The initial test pressure shall be recorded along with the ambient temperature to which the system is exposed. Final test pressures of the second stage shall be maintained on the system for a minimum of 24 hours. At the end of the 24-

hour period, the system pressure will be recorded along with the ambient temperature to which the system is exposed. A correction factor of 0.3 psi will be allowed for each degree C F change between test space initial and final ambient temperature, plus for increase and minus for a decrease. If the corrected system pressure is not exactly equal to the initial system test pressure, then the system shall be investigated for leaking joints. To repair leaks, the joint shall be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, re-melting, or back-welding/brazing shall not be acceptable. Following repair, the entire system shall be retested using the pneumatic tests described above. The entire system shall be reassembled once the pneumatic tests are satisfactorily completed.

D. Evacuation Test

1. Following satisfactory completion of the pneumatic tests, the pressure shall be relieved, and the entire system shall be evacuated to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature shall be higher than 35 degrees F. No more than one system shall be evacuated at one time by one vacuum pump. Once the desired vacuum has been reached, the vacuum line shall be closed, and the system shall stand for 1 hour. If the pressure rises over 500 micrometers after the 1-hour period, then the system shall be evacuated again down to 300 micrometers and let set for another 1 hour period. The system shall not be charged until a vacuum of at least 500 micrometers is maintained for a period of 1 hour without the assistance of a vacuum line. If during the testing the pressure continues to rise, check the system for leaks, repair as required, and repeat the evacuation procedure. During evacuation, pressures shall be recorded by a thermocouple-type, electronic-type, or a calibrated-micrometer type gauge.

E. System Charging and Startup Test

1. Following satisfactory completion of the evacuation tests, the system shall be charged with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system shall operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. The entire system shall be tested for leaks. Fluorocarbon systems shall be tested with halide torch or electronic leak detectors.

F. Refrigerant Leakage

1. If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system shall immediately be isolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. Under no circumstances shall the refrigerant be discharged into the atmosphere.

G. Contractor's Responsibility

1. At all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps shall include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time shall more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year shall be repaired in accordance with the requirements herein at no cost to the Owner including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

END OF SECTION

SECTION 232500
CHEMICAL WATER TREATMENT
(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all equipment, controls, chemicals, labor and accessories to make a complete system for chemically treating the HVAC hydronic systems specified herein. Reuse the existing water treatment systems as much as possible and tie into those systems to treat the new piping systems being installed.
- B. All chemicals shall be environmentally safe and compatible.
- C. The Mechanical Contractor shall engage the services of a nationally recognized water treatment manufacturer with local representative of such manufacturer to provide a complete water treatment service, designed to minimize corrosion and scale formation in all water systems. This service shall include providing the equipment, controls, chemical feed pumps, shot feeders, all chemicals and consulting analysis service for the initial start-up of each system.
- D. The Mechanical Contractor shall provide complete electrical control interlocking wiring for all chemical feeding and control equipment, for a complete system. All electrically driven equipment, such as pumps, shall be provided with starters and disconnect switches under this Contract.
- E. Before the EXISTING boilers are put into service the entire HVAC piping system shall be tested, cleaned, flushed and treated. This includes all hydronic equipment throughout the building and on roof, not just the boiler room. Boiler manufacturer shall approve condition of water before boilers are placed back into service.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. EPA Regulation.
- B. FDA Requirements.

- C. ASTM: American Society for Testing and Materials.
 - 1. D596-83 - Standard methods of reporting results of analysis of water.
- D. NEMA: National Electric Manufacturers Association.
- E. NFPA: National Fire Protection Association.
- F. UL: Underwriters Laboratory Inc.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Shall be in accordance with all other specified requirements as well as those following.
- C. Product Data: Submit manufacturer's technical product data, indicating chemical treatment materials, chemicals and equipment. This shall include MSDS and technical data sheets as well as all EPA, FDA, and or other environmental approvals.
- D. Shop Drawings: Submit the initial manufacturer of all components and drawings indicating system schematics, equipment locations, and control schematics. In addition a clear concise written sequence of operation shall be provided.
- E. Water analysis.
- F. A complete scale drawing of the equipment installation
- G. Submit manufacturer's installation instructions.
- H. Submit reports indicating pre-cleaning completed and submit analysis of system water after cleaning and after treatment.
- I. Submit reports indicating start-up of system is completed and is operating properly.
- J. Submit an Operations Manual providing equipment manuals, product MSDS and technical data sheets, treatment log sheets, testing program, and description of operating parameters.
- K. Product Data: Provide chemical treatment materials, chemicals and equipment including electrical characteristics and connection requirements.
- L. Shop Drawings: Indicate system schematic, equipment locations, control schematics, electrical characteristics and connection requirements.
- M. Manufacturer's Installation Instructions: Indicate placement of equipment in systems, piping configuration and connection requirements.
- N. Manufacturer's Field Reports: Indicate start-up of treatment systems when completed and operating properly. Indicate analysis of system water after cleaning and after treatment.
- O. Certificate: Submit certificate of compliance for authority have jurisdiction indicating approval of chemicals and their proposed disposal.
- P. Project Record Documents: Record actual locations of equipment and piping, including sampling points and location of chemical injectors.
- Q. Operations and Maintenance Data: Include data on chemical feed pumps, agitators and other equipment including spare parts lists, procedures and treatment programs. Include step-by-step instructions on test procedures including target concentrations.

1.6 QUALITY ASSURANCE

- A. The water treatment company shall have at least (5) years' experience in the treating and servicing of systems as outlined above. All service must be supervised by a chemist or a chemical engineer. The water treatment company shall have full time service located within the trading area of the job site. Manufacturers shall be insured for not less than \$10,000,000.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum five (5) years of documented experience and approved by manufacturer.

1.7 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.
- B. Products Requiring Electrical Connection: Listed and classified by UL testing firm and acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 MAINTENANCE SERVICE

- A. Service Period: Provide chemicals and service program for a period of one (1) year from start-up date of condensing equipment, including the following:
 - 1. Initial water analysis of water supply and recommendations.
 - 2. Systems start-up assistance.
 - 3. Training of operating personnel.
 - 4. Periodic field service and consultation.
 - 5. Customer reports and log sheets.
 - 6. Laboratory technical assistance.
- B. Provide monthly technical service visits to perform field inspections and make water analysis on site. Detail findings in writing on proper practices, chemical treating requirements and corrective actions needed. Submit two copies of field service report after each visit.
- C. Provide laboratory and technical assistance services during this maintenance period.
- D. Include two (2) hour training course for operating personnel, instructing them on installation, care, maintenance, testing and operation of water treatment systems. Arrange course at startup of systems.
- E. Provide onsite inspections of equipment during scheduled or emergency shutdown to properly evaluate success of water treatment program and make recommendations in writing based upon these inspections.

1.9 MAINTENANCE MATERIALS

- A. Supply sufficient chemicals for treatment and testing during warranty period.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable manufacturers contingent upon compliance with the specifications.
 - 1. Diversy Corp.
 - 2. Nalco Chemical Company

3. Betz Laboratory
4. Barclay Chemical, Inc.
- B. Description of Work
 1. The HVAC Contractor shall engage the services of a nationally recognized water treatment manufacturer or local representative of such manufacturer to provide a complete water treatment service, designed to minimize corrosion and scale formation in all water systems. This service shall include providing the equipment, controls, chemical feed pumps, bypass feeders, all chemicals and consulting analysis service for the initial clean out and start-up period of each system as needed. Reuse the existing water treatment equipment as much as possible. The intent is to tie-into the existing piping systems.
 2. Service Period: Provide chemicals and service program for period of (1) year from start-up date of condensing equipment, including the following:
 - a. Initial water analysis of water supply and recommendations.
 - b. Systems start-up assistance.
 - c. Training of operating personnel.
 - d. Periodic field service and consultation.
 - e. Customer reports and log sheets.
 - f. Laboratory technical assistance.
- C. Quality Assurance
 1. The water treatment company shall have at least (5) years' experience in the treating and servicing of systems as outlined above. All service must be supervised by a chemist or a chemical engineer. The water treatment company shall have full time service located within the trading area of the job site. Manufacturers shall be insured for not less than \$10,000,000.
 2. Codes and Standards
 - a. UL and NEMA Compliance: Provide electrical components required as part of condenser water treatment equipment, which are UL listed and labeled and comply with NEMA standards.
 - b. NEC Compliance: Comply with National Electrical Code as applicable to installation, electrical connections, and ancillary electrical components of condenser water treatment equipment.
 - c. Chemical Standards: Provide only chemical products which are acceptable under state and local pollution control regulations.
 - d. Provide any and all necessary safety and government approval literature on recommended products and assure compliance with federal, state and local regulations.

2.2 PRE-CLEANING

- A. The HVAC Contractor shall closely coordinate with the water treatment company to insure that each piping system is properly cleaned prior to placing in use and that no system is filled with water without proper water treatment chemicals being added.
 1. Pre-cleaning chemical shall be TSP based and shall contain a flash rusting protection package. Disposal shall be to an approved waste treatment system.

2. Procedures

- a. Flush all systems and then install precleaning chemicals to remove construction deposits such as pipe dope, oils, loose mill scale, and other extraneous materials.
- b. Add recommended dosages and circulate for 6 to 8 hours.
- c. Drain and flush until total alkalinity of rinse water is equal to make-up water.
- d. Remove, clean, and replace strainer screens.
- e. Refill with clean water to start treatment procedures.

2.3 GLYCOL HOT WATER SYSTEMS (CLOSED LOOP)

A. Equipment (Reuse existing bypass shot feeder tank)

B. Chemicals

1. Glycol Hot Water (for loops operating at temperatures exceeding 120°F)
 - a. Provide a nitrite-based program designed to provide metal corrosion and scale protection. Program must be designed to provide corrosion rates of not more than 5 mpy for mild steel and 1 mpy for copper.
 - b. Provide pre-mixed solution of 65% water and 35% inhibited propylene glycol-based heat transfer fluid with corrosion inhibitors & pH buffers - Dowfrost from Dow Chemical Co. or equal to fill piping systems.

C. Chemicals

1. Provide an organic sequestrant, polymer scale and corrosion inhibitor as determined by make-up water and system conditions. Maintain control limits of product as specified by manufacturer and pH of not less than 7.5.
2. Provide (2) EPA registered non-oxidizing biocides for algae, slime and bacteria control.
3. Provide pH correction chemical (if necessary) as determined by water analysis.

2.4 PROPYLENE GLYCOL SYSTEMS

- A. Provide complete initial fill of 35% propylene glycol / 65% water for all glycol systems. Propylene glycol solution shall be Dowfrost as manufactured by Dow Chemical Co. or Union Carbide. Top off, test and adjust system solution after all piping systems have been tested and received. Refer to details on the drawings for automatic glycol fill system schematic.
- B. Re-use or provide new tanks which shall be 50 gallon H.D., self-supporting natural polyethylene having vertical embossed graduations, stainless steel cover divided at midpoint with full diameter stainless steel piano hinge and drilled for pump mounting, suction line, fresh water fill, agitator and liquid level monitor. Tank shall be CCS, CB50 or equal.

- C. Re-use existing or provide a chemical injection pump shall be 110 volt, minimum 1/3 HP drive, 3/8" positive displacement, to be used for charging of glycol and future additional inhibitor. Pump is to have a bronze housing with stainless or bronze liquid drivers and internal, discharge pressure gauge, and adjustable internal relief valve set so as not to exceed normal system operating pressures. Output is to be at least 5.0 gallons per minute at 100 psi. The pump discharge line is to be fitted with a ball or swing check valve to prevent system backflow (zero flow leakage) when valves are open to main headers. Unless otherwise specified, pump operation shall be initiated by a switch controlled 110 volt circuit. Pumps shall be CCS P283A series. Provide an electric transfer pump system to transfer concentrated propylene glycol to the moving tank. Provide a pre-pressurized diaphragm tank, pressure tank at least 15 gallons in size to maintain pressure on the main fluid system.
- D. Accessory Switch: Provide adjustable pressure switch to prevent operation of glycol chemical pump above system PRV settings, as manufactured by Mercoid DA-31, United or approved equal.

PART 3 - EXECUTION

3.1 EQUIPMENT START-UP, FOLLOW-UP AND TRAINING

- A. The Water Treatment Contractor shall provide:
 - 1. Recommendations in writing for all chemical types to be used in each system depending on local water quality and suitability. Chemicals shall be listed in generic terms.
 - 2. Recommendation in writing on procedures, logs book entry and correct chemical applications.
 - 3. Complete training of maintenance and operating personnel.
 - 4. Start-up consisting of at least (3) days with weekly visits for the first month of operation.
 - 5. After start-up, monthly visits at least every (30) days for a period of (1) year to analyze all water systems. Each analysis to be submitted in writing containing all results and recommendations to the Owner for corrective action.
 - 6. A microbiological dip slide culture kit shall be provided and testing, including incubation, shall be performed.
 - 7. Monthly Service
 - a. Provide weekly service checks during initial start-up month and bi-weekly service during the 2nd month.
 - b. Run control tests and submit a written service report covering all aspects of chemical treatment.
 - c. Recommended changes in chemical feed rate or blowdown/bleed schedule as indicated by control tests.

3.2 OTHER SERVICE

- A. Provide in-service training of operating engineers on product testing and chemical performance.
 - 1. Operator Training: Train operating personnel in use, operation, and maintenance of all water treatment systems.

2. A program administration manual shall be furnished encompassing all systems covered in this Section.
 3. Three days of training for operating personnel shall be priced including all expenses. Document in bid tabulation form.
- B. Inspect boiler water surfaces at their regular inspection intervals.
- C. Provide all laboratory reports on corrosion or deposit analysis as needed.
- D. Make available all test kits and testing reagents to assure accurate test results.
- E. Provide all log books for all equipment rooms so test results may be recorded. Log Books should contain:
1. Product technical data sheets
 2. Product Material Safety Data Sheets
 3. Equipment Literature
 4. Program Operating & Testing Parameters
 5. Chemical Testing and Blowdown/Bleed Log Sheets
- F. System Testing and Follow Up
1. Chemical treatment representative shall visit the site once every month during the guarantee period. The representative shall check and adjust water treatment system operation during each visit, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.
 2. At each inspection during the guarantee period, samples of the water systems shall be taken by the chemical treatment representative. The samples shall be analyzed by an independent testing laboratory and certified. The analysis made on the water shall be submitted to owner. The analysis report shall include recommendations as to any changes in the water treatment required.
- G. Provide any and all necessary safety and government approval literature on recommended products to assure compliance with federal, state and local regulations.
- 3.3 INSTALLATION
- A. Reuse existing chemical treatment equipment.
- B. Provide hose end drain valves at low points in piping.
- 3.4 PIPING SYSTEMS PREPARATION
- A. General: After piping systems are erected and proven free of leaks provide services for piping systems flushing, cleaning, disinfecting, purging, rinsing and treating in accordance with specification.
- 3.5 CLEANING
- A. Each new water system shall have an industrial strength cleaner added and circulated for a minimum of 24 hours when the system is initially filled with water. Cleaner shall be equal to Barclay Flushout.

- B. After a complete flushing, each system shall be chemically treated with an inhibitor. The Water Treatment Contractor shall provide the proper amount of cleaner and inhibitor for each system, supervise the cleaning procedure and issue a written report to the Owner and Architect that each system has been properly cleaned, chemically treated and tested. The Mechanical Contractor shall perform the cleaning and flushing procedure under the supervision of the Water Treatment Contractor. The result of the initial tests shall be included in the report. All test apparatus, equipment and labor shall be provided by the Mechanical Contractor under this Section. Tests and cleaning will be witnessed by the Architect and Owner's representatives. Notify all parties 48 hours in advance of commencement of work.

END OF SECTION

SECTION 233100

SHEET METAL WORK AND ACCESSORIES

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 01 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install a complete system of air distribution, including accessories, to all areas indicated on the contract documents.
- B. Create, coordinate and submit ¼" scale Coordination Drawing in accordance with Section 23 05 00.
- C. Provide all ductwork, fittings and accessories to make a complete and operational system in all respects.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A 1008/A 1008M – Standard Specification for Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

3. ASTM A 1011/A 1011M – Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.
4. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
5. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
6. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
7. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
8. ASTM C 443 – Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
9. ASTM C 443M – Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric).
10. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
11. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
12. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease-laden Vapors from Commercial Cooking Equipment.
13. SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.
14. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.
15. UL 181 – Factory-Made Air Ducts and Connectors.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: Provide data for duct materials, duct connectors and all accessories. Include sound attenuator test data in accordance with ASTM E477.
- C. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Architect, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed and fabrication drawings have been reviewed and coordinated. MERELY SUBMITTING COPIES OF THE SMACNA PRESSURE CLASS TABLES DOES NOT COMPLY WITH THIS REQUIREMENT.
- D. Provide scaled ductwork fabrication drawings. Fabrication drawings shall be double line and as a minimum include elevations, dimensions, sizes, all offsets rises and drops, air distribution devices.

- E. Provide scaled ductwork coordination drawings for all floors and systems in accordance with Section 230500, Submittals.
- F. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA- HVAC Air Duct Leakage Test Manual.
- G. Manufacturer's Installation Instructions: Indicate special procedures for glass fiber ducts.
- H. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed recommended fabrication and installation requirements.
- I. Project Record Documents: Record actual locations of ducts, duct fittings and all accessories. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- A. All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.
- B. **No Ductmate, Ward, Nixon or similar factory made slip-on connections will be permitted.**

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealants when temperature is less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.8 MASSACHUSETTS BUSINESS LICENSURE (271 CMR)

- A. The Sheet Metal Contractor must have a business licensure, according with the state requirements of 271 CMR, for projects within Massachusetts.

PART 2 - PRODUCTS

2.1 SHEET METAL WORK

- A. General
 - 1. Acceptable Manufacturers (Provided they are in compliance with these specifications)

a. Sheet Metal

- 1) All ducts and fittings shall be manufactured by a sheet metal fabrication company whose primary business experience is the manufacture of commercial and industrial quality ducts and fittings. Sheet Metal Contractor shall have adequate experience of building ductwork of the types required for this project as well as successful experience with projects of similar scope. Bids from sheet metal shops which do not meet the specified requirements shall not be acceptable.

b. Sheet Metal Accessories

- 1) Access Doors
 - a) Ruskin
 - b) Air Balance
 - c) Hart and Cooly
 - d) Ductmate
- 2) Flexible Connectors
 - a) Ventlock
 - b) Elgen Manufacturing
 - c) Duro Dyne
 - d) Ventglass
- 3) Flexible Ductwork
 - a) Clevepak Corp.
 - b) Flexible Technologies
 - c) Unaflex Rubber Corp.
 - d) Flexmaster
- 4) Fire Dampers
 - a) Ruskin
 - b) Prefco
 - c) Air Balance
 - d) Greenheck Fan Corp.
 - e) Nailor Industries
 - f) Pottorff
- 5) Automatic Dampers Airfoil
 - a) Ruskin
 - b) Greenheck Fan Corp.
 - c) Nailor Industries
 - d) T.A. Morrison & Co. Inc. (TAMCO)
 - e) Pottorff

- 6) Balancing Dampers (OBD)
 - a) Ruskin
 - b) Young Regulator
 - c) Prefco
 - d) Greenheck Fan Corp.
 - e) Nailor Industries
 - f) Pottorff

- 7) Small Balancing Damper less than 48x12
 - a) Ruskin
 - b) Young Regulator
 - c) Ventlock
 - d) Duro Dyne

- 2. Unless otherwise noted, all supply, return and exhaust air ductwork of all types shall be constructed of galvanized sheet metal based on the "Pressure Class" indicated in the "Minimum SMACNA Construction Standards" table found hereinafter.

- 3. The drawings are diagrammatic and indicate the arrangements of the principal apparatus, ductwork and piping and shall be followed as closely as possible. Because of the scale of the drawings, it is not possible to show all offsets, rises, drops, rises, fittings, accessories, etc. The Contractor shall carefully investigate the structure, finish conditions, and the work of other trades affecting the work and arrange ductwork, piping, equipment, accessories, etc. accordingly. Provide the best possible arrangement so as to provide the maximum headroom and access to apparatus while providing the minimum resistance to airflow. This work and any extra fittings and offsets required shall be included in the project without extra charge.

- 4. In addition to sheet metal ductwork provided under this Contract furnish and/or install accessories and devices furnished by others, including but not limited to smoke detectors. Provide and install miscellaneous sheet metal work including safing, mixing baffles, and blank off panels at unused louver areas.

- 5. All duct systems specified to be installed under this Contract, shall conform to the drawings, specifications, Standards, details and recommendations of the latest Edition of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"; and "Round and Industrial Duct Construction Standards" (hereinafter referred to as Duct Manual). Where the requirements under this Section exceed the requirements of the Duct Manual, the specification shall govern. Wherever the word "should" appears, replace with the word "shall".

- 6. The Sheet Metal Contractor shall submit duct fabrication standards and methods of installation, in compliance with SMACNA and these specifications, for review and approval by the Architect, clearly indicating the combination of metal gauges and reinforcement intended for use for each pressure classification. Duct fabrication shall not be allowed until a satisfactory review of this Standard has been performed. MERELY SUBMITTING COPIES OF THE SMACNA PRESSURE CLASS TABLES DOES NOT COMPLY WITH THIS REQUIREMENT.

7. All galvanized steel sheet metal shall conform to ASTM A653/A653M (G-90) having not less than 1.25 oz. of zinc on each side of each square foot of sheet. All other duct materials shall be as hereinafter specified as applicable to this Contract.
8. The Sheet Metal Contractor shall install all duct mounted smoke detectors.
9. The Sheet Metal Contractor shall furnish and install all plenums with automatic or manual dampers attached to louvers.
10. There will be no supply and/or return air system ductwork internally lined unless otherwise noted.
11. The Sheet Metal Contractor shall clean and provide temporary caps on all ductwork during installation to prevent dust, dirt and debris from entering ducts during construction, including during shipping, handling and storage in the field.
12. All shop applied fabrication labels shall be applied to the exterior of the ducts. The Sheet Metal Contractor shall remove any material applied to the inside of the ducts before installation.
13. All inline fans shall have companion flanges intake and discharge for removal for servicing.

2.2 DUCT CONSTRUCTION

A. Duct Construction Schedule

Minimum SMACNA Construction Standards						
Ductwork Location	Pressure Class Inches W.G.	Seal Class	Leakage Class	Material	Sound Lining	Table Notes
Supply from Air Handling units to terminal boxes	±6	A	4	G-90	No	
Supply from terminal boxes to outlets	±2	A	4	G-90	No	
Supply from Air Handling units constant volume systems	±4	A	4	G-90	No	
Toilet exhaust	-3	A	4	G-90	No	
General exhaust	-3	A	4	G-90	No	
Plenums	±4	A	4	Same as Ducts	As Indicated	2
Other	±3	A	4	G-90	No	2

2.3 ADDITIONAL CONSTRUCTION REQUIREMENTS

A. Minimum Requirements

1. The minimum gauge for any steel duct over 2" or under -2" pressure class shall be 24 gauge except when specified heavier.

2. The minimum diameter of any tie rod shall be 1/2".
 3. The maximum tie rod spacing shall be 42" unless specifically engineered in accordance with the SMACNA Industrial Rectangular Duct Standard.
 4. When tie rods intersect, they shall be welded to each other.
 5. No ductwork shall be constructed to less than ± 2 " w.g. This means nothing is constructed to a standard between -2 " w.g. and $+2$ " w.g.
 6. **Duct dimensions indicated are clear inside dimensions. The sheet metal dimensions shall be increased to accommodate internal liner where liner is required.**
- B. All joints and seams in all ductwork and casings shall be sealed to SMACNA Seal Class "A". In finished areas, sealing compound shall be neatly applied to exposed ductwork and bands shall be provided over, to cover the sealant.
1. Some SMACNA constructions may not be suitable for the leakage classes specified even though they may meet the pressure class and should not be used.
 2. Seal class A Welded means all welded (i.e. transverse joints, longitudinal seams, spiral seams, fire dampers, volume dampers or any accessories) and in addition it means continuously welded.
 3. All sealants, adhesives and coatings shall be of approved kinds and qualities for each point of application, complying with recommendations for the use and storage.
 4. The method of installation and materials for sealing the ductwork shall be submitted by the Sheet Metal Contractor for review and approval by the Architect, as part of the ductwork construction standards and installation submittal.
- C. All longitudinal seams in all ductwork in excess of $+2$ " w.g. or less than -2 " w.g pressure class shall be made with formed Pittsburgh locks.
- D. Grooved seam/flat lock/pipe lock joining methods is restricted to 2" W.G. pressure class only.
- E. Button punch-snap lock seams are not to be used.
- F. Concealed stainless steel ductwork shall have an ASTM mill rolled No. 1 or No. 2 D finish. Exposed stainless steel ductwork shall have an ASTM mill rolled No. 2 B finish, or higher grade as required by the Architect, with all welds ground smooth and final brushed with stainless steel wire brushes. All welds on exposed stainless-steel ductwork shall be free of stain, burn-through, or discoloration to the satisfaction of the Architect.
- G. Tie rods shall not be used in any plenum or large duct requiring internal access or use as an access pathway.

- H. All ductwork required to be removable shall be companion flanged SMACNA Type T-22 for ductwork constructed to SMACNA Metal Duct Standard and companion flanged in accordance with Industrial Standards for ductwork required to be constructed to Industrial Standards.
- I. Elbows
1. All dust collection ductwork elbows shall be a centerline radius equal to (2) duct widths or diameters. No reduction shall be allowed.
 2. Radius elbows shall be used wherever possible. Where it is impossible or impractical to install a 1.5 times width to centerline radius of elbow (full radius elbow) lesser radii configurations shall be used, each with "radius-proportional" splitter vanes permanently installed within. No radius shall be less than 1.0 times the width. Provide square elbows in rectangular ducts with double thickness vanes with a minimum radius of 4 1/2". Square elbows may only be used when radius elbows will not fit and where specifically approved by the Architect prior to fabrication and/or as required by coordination shop drawings. All offsets shall be of the radius type.
- J. Auxiliary drain pans.
1. Provide 1 1/2" deep auxiliary drain pans under any units with cooling coils located above hung ceilings.
 2. Pans shall be 6" larger than equipment in all directions.
 3. This includes but not limited to all fan coil units.
 4. Drains shall be piped to floor drains or utility sinks.
- K. Provide baffles and/or diffusion plates as required in all air handling units, to ensure proper air mixing, coil velocities and air distribution across filters or coils as determined in the field by the Architect, at no additional cost to the Owner.
- L. It is the intent of this specification to provide a duct system with minimum resistance to airflow. All take-offs shall be throated and transitions made as gradually as possible. "Bullhead" or sharp take-offs shall not be acceptable.
- M. In addition to SMACNA requirements, ductwork in return systems without boxes, ductwork in supply systems without boxes, ductwork in exhaust systems without boxes, ductwork in any Constant Volume System and/or ductwork downstream of VAV, supply, return or exhaust boxes or valves shall be provided with:
1. Volume dampers in all branch takeoffs and in all main branches and ducts of all ductwork systems (supply, return and exhaust) for properly regulating and balancing airflow to all terminal outlets, for all duct sizes, whether shown on the drawings or not. **The above requirement is mandatory.**
 2. Where the duct take-off to air devices are installed above drywall ceilings and/or where noted on the drawings, provide the following volume dampers with remote cable operators. Operators shall be installed within the neck of the air device for access through the removable core of the air device. Dampers and operators shall be similar to as manufactured by Young Regulator.

- a. Provide manual adjustable rectangular opposed blade dampers with factory installed locking hand quadrants extended 2" for all dampers installed in externally insulated duct.
 - b. Dampers shall be manufactured approximately 5/16" smaller in width and 1/8" smaller in height than size of duct in which they are installed; e.g., nominal damper size is 24" x 10", actual size is approximately 23-11/16" x 9-7/8".
 - c. Damper frame shall be constructed of #6063 extruded aluminum reinforced channel with minimum thickness of .050". Opposed damper blades shall be #6063 extruded aluminum with minimum thickness of .50" and shall include reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings and shall be driven by stainless steel connecting slide linkage controlled by 3/8" square steel control shaft. When installed in stainless steel duct systems, the dampers shall be constructed of all stainless-steel components.
 - d. Provide Young Regulator Bowden Cable Control kit for remote, internally mounted, worm gear operator for all inaccessible volume dampers. Provide stainless steel cable and control wire.
- N. All rectangular dampers shall be opposed blade, and each shall be controlled by an approved galvanized locking quadrant indicating the damper position, as detailed on the drawings.
1. Volume dampers installed into ductwork that is specified to be externally insulated shall have extended activator/handle rods with extension bracket such that adjustment of the damper handle will not disturb the insulation.
- O. Submit the sheet metal shop drawings to the Balancing Contractor of the project for his review and placement of dampers with the final balancing procedures and requirements in mind.
1. Coordinate the location and areas with the Balancing Contractor and fabricate the ductwork system accordingly.
 2. Provide any and all balancing dampers required by the balancing contractor at no additional cost.
- P. In addition to SMACNA requirements, all round ductwork, if used in lieu of rectangular supply and/or return/exhaust systems shall conform to SMACNA.
1. The use of flat oval ductwork shall be acceptable only with prior written approval of the Architect. **Note:** Flat oval shall not be used under negative pressure.
 2. Round duct shall be manufactured of spiral lock seam. Ductwork up to 12"Ø and 2" w.g. pressure class can be manufactured with longitudinal lock seams.
 3. All tees shall be conical.

4. All laterals shall be straight.
5. All taps through 10" diameter in size shall have a machine drawn entrance and all fittings shall have longitudinal seams, continuous-welded. Both sides of all welds shall be primed with zinc chromate.
6. All tap entrances shall be free of weld build-up.
7. Elbows in diameters 3" through 10" shall be 2-section stamped or pleated elbows. Larger elbows shall be gored construction. Elbows shall be fabricated to a centerline radius of 1.5 times the diameter. All gored elbows shall be fabricated according to the following schedule:

<u>Elbows</u>	<u># of Gores</u>
Up to 35°	2
36° to 71°	3
Over 71°	5

8. All field joints in diameters through 48" shall be made with a 2" long slip-fit or sleeve coupling provided assembly is not hindered. Ductwork over 48", and for all sizes where disassembly and removal is required, shall be joined with Vanstone or shop fabricated flanges.
9. All flanges and taps into spiral ducts shall be factory or shop fabricated and installed as hereinbefore specified. Shipment of loose flanges or taps for field installation shall be avoided.
10. All access doors for round duct shall be furnished by the access door manufacturer. Round duct access doors shall be of low leakage sandwich type suitable for systems up to 8" pressure, positive or negative. Round duct access doors shall be insulated and shall be equivalent to Ruskin model ARDD.
11. Unless specifically noted otherwise or required by special constraints, all elbows on ductwork changing direction from vertical to horizontal shall be 1.5 times radius.

2.4 ACCESS DOORS

- A. Provide access doors and frames in all supply, exhaust and return ductwork as required, to permit access to:
 1. Automatic dampers
 2. In-box heating coils
 3. Fire dampers
 4. In-duct coils
 5. All plenums

6. In-duct humidifiers
 - a. Provide sight doors
 7. Other similar equipment
 8. Fan Bearings enclosed in ducts.
 9. Duct smoke Detectors
 - a. Provide sight doors
 10. For cleaning and inspection purposes
 11. Where indicated on the drawings
- B. Door Size
1. Ductwork
 - a. Minimum 16" x 12"
 - b. In ducts smaller than 12" they shall be 10" x 6" less than duct width except:
 - 1) Terminal Box heating coil door may be 10" x 6"
 - c. Vacuum cleaning access door shall be 12" round.
 2. Plenums
 - a. Shall be 20" x 56"
 - 1) 18" x 45" door may be used only when 20" x 56" will not fit.
 - b. Larger door shall be provided if required for equipment removal. Coordinate with equipment.
- C. Door Construction
1. Doors shall match material type and gauge of the duct system in which they are installed. This includes hardware such as bolts.
 2. Minimum gauge shall be 20.
 3. Pressure tested to ± 15 " wc
 - a. Leakage shall be zero at ± 10 " wg
 4. Provide a neoprene gasketed around their entire perimeter.

5. Where sight doors are required, a wire reinforced safety glass shall be utilized.
 - a. All humidifiers
6. Insulated or lined ductwork shall have insulated door
7. Insulated plenums shall have insulated door
8. Insulated doors shall be double wall.
9. Insulation between the metal panels shall be of the same thickness as the duct or panel adjacent to the access doors.
10. Plenum access doors shall be hung on heavy hinges and shall be secured in the closed position by means of latches.
11. Ductwork access doors shall be clamp type with a retaining chain or cable.
12. Ductwork access doors shall be similar to Ductmate Sandwich access door.
13. All plenum hinge doors shall be submitted with test (provide E leakage) data before approval.
14. All fire damper access doors in all positive pressure supply ductwork of +3" w.g. or greater construction:
 - a. Shall be of the pressure relief (negative pressure) spring loaded type. Design shall incorporate self-closing spring latch or be complete with secure retainer chain and "D" handle.
 - b. These doors shall be mounted downstream (after shutoff) of fire dampers, fire/smoke dampers or smoke dampers or similar automatic shutting devices.
 - c. These doors shall be of the automatic reset type and similar to Ruskin model ADHP-3.

2.5 FLEXIBLE CONNECTIONS (AHUS FANS)

- A. Provide flexible connections of 4" minimum fabric width
 1. Between ductwork and the inlets and outlets of all fans.
 2. Equipment equipped with fans
- B. The connections shall be placed as close to the equipment as practical except at fan suction connections and the clear gap at rest shall be not less than 3". At fan suction connections, locate flexible duct connection at least 3 duct diameters away from fan inlet connection.
- C. There shall be no tension of the fabric under static or dynamic loads

- D. All fabric for flexible duct connections to equipment shall be a minimum of 22 oz. glass fabric, double coated with neoprene, fire retardant, waterproof, airtight, and approved by UL, similar to Ventfabrics or Ventglass.
- E. Exterior flexible connection shall be insulated type similar to Duro Dyne.
- F. Flexible connections shall be fabricated from approved flameproofed fabric conforming to NFPA 90A. Asbestos shall not be acceptable.
- G. Flexible connections shall be installed further upstream from fan powered equipment (in the main duct size) to prevent obstruction of the fan inlet due to suction of the fabric into the airstream.
- H. Ductwork shall be increased in size where the flexible connections are located to prevent fully drawn in connections from blocking any duct area. Submit detail for review.

2.6 BLANK OFF PANELS FOR UNUSED LOUVER AREAS

- A. Provide minimum 20-gauge sheet metal blank off panels for all unused louver areas:
 - 1. All louver areas not enjoined or connected to an active plenum.
- B. Exterior/visible face of blank off panel shall be cleaned and painted flat black, prior to installation.
- C. Panels shall be screwed to louver frames and caulked to provide a weathertight seal.
- D. Provide insulation of blank off panels. See specification Section 23 07 13 - Ductwork insulation.

2.7 FLEXIBLE DUCTWORK

- A. General
 - 1. Flexible duct runs must not exceed 5'-0" in length. Flexible duct shall not exceed a maximum of 1/2" sag per linear foot when installed horizontally.
 - 2. Flexible ductwork shall be supported at a maximum spacing of 2'-6", and as detailed on the drawings. Ductwork must not be compressed. Duct elbows must not exceed 45°.
- B. Flexible Duct (Rigid)
 - 1. Flexible duct shall be similar to Flexmaster Triple Lock Buck Duct Flexible Air Duct. Flexible duct (insulated) shall be UL 181, Class 0 listed air duct and constructed in accordance with NFPA 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
 - 2. Triple Lock Buck Duct shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock that is mechanically performed without the use of adhesives to make a durable airtight seam. A double lock is not acceptable.

3. Insulated flex shall have a gray fire-retardant polyethylene outer jacket with an 8 oz. density, 1 1/2" thick fiberglass insulation blanket, factory wrapped.
4. The flexible duct shall be supported as required.
5. Flexible ductwork shall be rated at 12" positive pressure. Duct from 3" to 16" shall have a negative pressure 12" and duct from 18" to 20" shall have a negative pressure of 8".
6. All flexible duct shall be individually cartoned and labeled for delivery to the job site for maximum protection.
7. Provide:
 - a. Where indicated in construction greater than +2" or less than -2".
 - b. Upstream of supply boxes.
 - c. Downstream or upstream of exhaust boxes when allowed.

C. Flexible Duct (Fabric)

1. Flexible duct shall be similar to Flexmaster Type 2. Flexible duct (insulated) shall be UL 181, Class 1 listed air duct and constructed in accordance with NFPA 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
2. Duct fabric shall be of a heavy duty coated fiberglass cloth fabric. The fabric material shall be mechanically locked to the outside helix. (Use of adhesives to lock fabric in place is unacceptable.) The helix is constructed of a corrosive resistant galvanized steel, formed and mechanically locked to the duct fabric on the outside to prevent tearing of the flexible duct.
3. Insulated flex shall have a gray fire-retardant polyethylene outer jacket with an 8 oz. density, 2" thick fiberglass insulation blanket, factory wrapped. Thermal insulation; R=5
4. The flexible duct shall be supported as required to prevent sagging. Flexible duct with excessive sagging will not be approved.
5. Flexible ductwork shall be rated at 12" positive pressure and 10" negative pressure. Negative pressure for 14"R and 16"R shall be 5" and negative pressure for 18"R shall be 1".
6. All flexible ducts shall be individually cartoned and labeled for delivery to the job site for maximum protection.
7. Provide:
 - a. Where indicated in ± 2 " duct construction, except exhaust.
 - b. Downstream of supply boxes.

2.8 DAMPERS

A. General

1. The minimum damper requirements shall be as indicated in the following table:

Damper Construction Table						
Type	Approach Velocity (FPM)	Pressure Rating	Instantaneous Pressure Rating	UL555S Leakage Class	Blade Type	Listing
Fire dampers in ducts greater than +2" w.g. or less than -2" w.g. (FD)	2,000	4"w.g.	10" w.g.	N/A	OBD 3V	UL555 Dynamic
Other fire dampers (FD)	2,000	4" w.g.	8" w.g.	N/A	Curtain or OBD	UL555 Dynamic
Isolation dampers (at units)	4,500	8" w.g.	20" w.g.	I	Air Foil	
Automatic dampers (AD)	4,500	6" w.g.	14" w.g.	I	Air Foil	N/A
Balancing dampers in ducts wider than 48" and/or deeper than 12" (VD or as specified)	2,500	4" w.g.	N/A	N/A	OBD	N/A
Balancing damper in ducts less than 48" by 12" (VD or as specified)	2,500	2"	N/A	N/A	OBD	N/A

2. Dampers in stainless steel ducts shall be stainless steel.

B. Automatic Dampers

1. All automatic dampers shall be furnished by the Sheetmetal Contractor. Dampers shall be single or multiple blades as required. Dampers shall be installed by the Sheetmetal Subcontractor, under the supervision of the Temperature Control Subcontractor. All blank-off plates and conversions necessary to install smaller or larger than duct size dampers shall be the responsibility of the Sheetmetal Subcontractor. All dampers shall be equal to RuskinModels CD-50 (rectangular) or CDR-25 (round).
2. All damper frames shall be constructed of extruded aluminum with 5" x 1" x 1.25" extruded aluminum and shall have flanges for duct mounting. All multiple damper sections must have jackshafts.
3. Damper blades shall not exceed 6" in width. All blades shall be of extruded aluminum airfoil type construction, fabricated from 6063-T5 aluminum. Blades shall be suitable for high velocity performance, ultra-low leakage type, with leakage not greater than 6.2 cfm/sq.ft. at 4" w.g. pressure differential for 48" x 48" damper size, as published and certified under AMCA Certified Ratings Program. Damper leakage shall be less than 0.1% of total CFM at maximum damper system velocity.

4. All damper bearings shall be made of nylon or molded synthetic, bushings that turn in the bearings are to be oil impregnated sintered metal.
5. Replaceable butyl rubber seals shall be provided with the damper. Seals shall be installed along the top, bottom and sides of the frame and along each blade edge. Seals shall provide a tight closing, low leakage damper. Leakage and flow characteristic charts must be submitted to the Engineer prior to approval of dampers.
6. The HVAC Contractor shall provide an access door upstream and downstream of each automatic damper location.

C. Fire Dampers

1. Fire dampers, smoke dampers and combination smoke/fire dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire and/or smoke rated partitions. Devices shall be of the appropriate service for the partition class into which they are installed. Exact requirements and type of partition shall be coordinated with the Architect.
2. All dampers shall meet the requirements of NFPA 90A and further shall be tested, rated and labeled in accordance with UL 555 (6th Edition), UL555S (4th Edition) and UL555C (1st Edition).
3. All dampers shall be tested, rated and labeled as "Dynamic Rated" for closure against airflow in the following configuration:
 - a. Vertical mount (horizontal airflow): Ducted and unducted.
 - b. Horizontal mount (airflow up): Ducted and unducted.
 - c. Horizontal mount (airflow down): Ducted and unducted.

Note: Static rated dampers shall not be allowed.

4. Each damper shall be rated to close against maximum design airflow at its installed location, with 400 fpm and .5 in wg. safety factors and against 4" w.g. maximum pressure across the closed damper.
5. All dampers of all ratings and types shall be of the nominal 100% face area type, with blade package and all frame components out of the airstream. These dampers shall include the required oversize enclosures which shall be sealed by the damper manufacturer for the appropriate duct pressure class into which they are installed. All such dampers shall have appropriate rectangular, flat oval or round duct collars to facilitate connection of mating ductwork. The Contractor shall be responsible for any additional sealing of duct collars and connections required to maintain the duct seal class requirements but shall not jeopardize the UL breakaway connection when utilized.
6. The Contractor shall indicate the location and rating of all dampers on his shop drawings and shall provide access doors at each location of sufficient size and type to permit access to the damper components. A list of fire dampers shall be provided for review. The Contractor shall be solely responsible to coordinate all locations of duct access doors and dampers of all types.

7. Contractor shall include damper manufacturer's installation instructions as part of the damper submittal. These instructions shall describe the applicable requirements for damper sleeve thickness; retaining angles; sealing; duct-to-sleeve connections; preparation of wall, floor or ceiling openings; and all other requirements to provide an installation equivalent to that tested by the damper manufacturer during the UL 555, UL555S and UL555C qualification procedures. Contractor shall detail any proposed installations that deviate from these manufacturer's instructions and explain the needed deviations. All fire, smoke and ceiling radiation damper installations shall comply with the manufacturer's installation instructions. Any submitted deviations must be acceptable to the appropriate authority having jurisdiction.
8. Fire Dampers
 - a. Fire dampers shall be provided as shown on the drawings and wherever Architectural drawings indicate fire-rated partitions to the following schedule:

Partition Assembly Fire Rating	Penetration Type	Damper Rating
1 Hour	Ducted and Sprinklered	No damper; duct sleeved and packed only
1 Hour	Ducted and Non-Sprinklered	1.5 Hour
1 Hour	Open (Transfer)	1.5 Hour
1.5 to 2 Hours	Ducted or Open	1.5 Hour

*No open transfer will be permitted through these partitions.

- b. Fire damper sleeves shall be manufactured with a metal sleeve of appropriate length and thickness for the required damper installation as shown in the table below:

<u>Maximum Duct I.D.</u>	<u>Sleeve Gauge (U.S.)</u>
Up to 84"	20 gauge
85" & Up	18 gauge
 - c. Fusible link temperature rating for all fire dampers shall be 212°F or 50°F above the highest system temperature, whichever is greater.
 - d. Dampers in stainless steel ducts shall be stainless steel.
 - e. Dampers located in welded systems shall be rigidly connected with welded connections (not breakaway).
 - f. Large fire dampers may require motor operator to comply with code if this is required. Mechanical Contractor shall provide power and connections from electrical panel.

Device	Furnished By	Installed By	Actuator By	Actuator Type	End Switches	Control Air	Control Wires	Power	UL Assembly
Automatic Damper (AD) (When noted to be electric)	ATC	HVAC	ATC	Electric	ATC	N/A	ATC	ATC	No
Fire Damper (FD)	HVAC	HVAC	If Req'd Damper Manufacturer	If Req'd Electric	If Req'd Damper Manufacturer	N/A	N/A	If Req'd Div 23	Yes

2.9 OUTSIDE AIR INTAKE PLENUMS

A. The HVAC/Sheetmetal Contractor shall furnish and erect all insulated double wall sheet metal outside air plenums upon a curb constructed by the Prime Contractor.

1. Furnish and install factory or field fabricated acoustic thermal plenums as shown. The plenums shall be mounted on level concrete curbs.
 - a. The panels shall be 4" minimum 4" thickness, with interior perforated panel sheets of 22 gauge galvanized steel with 3/32" diameter openings spaced on 3/16" center staggered centers. The exterior solid panel sheets shall be 18 gauge galvanized steel. The panels shall contain a sound retardant and absorbent fill. Internal panel reinforcement shall be a minimum of 18 gauge galvanized steel. Spot welds shall be maximum 2" on center. Door panels shall be constructed of solid 18 gauge galvanized steel. Spot welds shall be maximum 2" on center. Door panels shall be constructed of solid 18 gauge galvanized steel both sides. Doors shall be supplied 2'-0" wide by 5'-0" high or 3'-0" wide by 6'-0" high as shown. Each door shall be supplied with a continuous air/sound seal around the sill, jamb and head. Doors shall have (2) hinges and latches with inside release handles to open against air pressure. Openings for fan and duct connections where required shall be provided by the plenum manufacturer. Pipe and conduit penetrations shall be located and cut in the field and sealed in accordance with the manufacturer's instructions. Roof channels, aprons, wall joiners and floor channels shall be formed to prevent a direct path for sound and air leakage. The plenum housing shall be so designed and constructed to withstand the actual fan operating pressures, both positive and negative.
 - b. Panels shall have a maximum heat transfer "K" factor of 0.10. Plenum design shall meet the combustion requirements established by AST< E84, not exceeding the following:
 - 1) Flamespread Classification: 20
 - 2) Smoke Developed Rating: 20
 - 3) Fuel Contributed: 15
 - c. Acoustic transmission loss of the panels and components, when tested per ASTM E90-70, and sound absorption coefficients, when tested per ASTM C423-72 shall be at least:

<u>Octave Band</u>	<u>TL</u>	<u>Absorption</u>
2	23	0.89
3	30	1.20
4	42	1.16
5	51	1.09
6	59	1.01
7	58	1.03
8	58	0.93

PART 3 - EXECUTION

3.1 SHEET METAL INSTALLATION

- A. All ductwork shall be installed to true alignment, generally parallel or perpendicular to adjacent building walls, floors and ceilings, so as to present a neat and workmanlike appearance. All fabricated, stored and installed ductwork shall be protected with removable caps, plastic or other means to prevent dirt, water and debris from entering duct system. The Sheet Metal Contractor shall be responsible for maintaining a clean duct system and shall clean and/or replace any ductwork identified by the Owner or Architect as being deficient or dirty. The Sheet Metal Contractor shall be responsible for all costs associated with the temporary protection cleaning and/or replacement of ductwork. All fabrication labels shall be applied to the exterior of the duct. The Sheet Metal Contractor shall be responsible for the removal of all internal labels if such labels were incorrectly applied.
- B. Care shall be paid to the exact locations of all sheet metal work with respect to equipment, ducts, conduits, piping, slabs, beams, columns, ceiling suspension systems, lighting fixtures and electrical, plumbing and fire protection systems in the building. Close coordination and cooperation shall be exercised with other Trades in locating the piping and equipment in the best interests of the Owner.
- C. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements shall be made to avoid conflict.
- D. The drawings shall be followed where they are definite and provided such procedures do not cause objectionable conditions for equipment provided installed under this Contract. The drawings are intended to indicate the sizes of ductwork and if certain sizes are omitted or unclear, obtain additional information before proceeding.
- E. Locate and size all openings for ductwork in the building construction. Provide all sleeves as hereinbefore specified.
- F. Provide access doors in ductwork at the following locations:
 - 1. Both sides of all coils
 - 2. Fire dampers
 - 3. Both sides of automatic dampers
 - 4. Humidifiers
 - 5. Both sides of filters

6. At all exhaust and intake plenums, doors shall allow full body access in all plenums over 4'-0" tall.
 7. Otherwise indicated or specified
- G. Provide labels with a minimum of 1" high red letters on white background. Each access door shall be labeled as follows (or worded as required by Code):
1. Fire Damper
 2. Automatic Damper
 3. Filter Access
 4. Coil Access
- H. The installation of special items of equipment in the duct systems, including automatic dampers, thermostats, thermometers, duct airflow measuring devices and other related controls, shall be done by this Contractor under the direct supervision of the manufacturer of such controls.
- I. All elbows, tees and branch takeoffs in round ductwork shall be made of the same materials as the ductwork.
- J. Duct connections to equipment shall be in no case smaller than the equipment openings.
- K. All openings for pitot tube traverses shall be fitted with neat removable plugs or caps. As a minimum, such openings shall be provided at every fan inlet and at such other points as may be required for airflow measuring and balancing. Coordinate the location of plugs and caps with the Balancing Contractor.
- L. All internally lined duct sections and joints shall be closely inspected by the contractor before and after each piece is erected. Loose edges, open joints, damaged areas and other defects shall be sealed securely so as to insulate all metal surfaces and so as to endure without falling in the presence of moving air. All liner applications shall comply with SMACNA "Duct Liner Application Standard".
- M. Provide other miscellaneous sheet metal work shown on the drawings including blanking off portions of louvers not required for the specific usage and diffusion plates or mixing air scoops to allow for air mixing where job conditions require the provision of same. All above work shall be provided as part of this Contract at no extra cost to the Owner.
- N. Where applicable and as approved by the Architect, all exposed ductwork shall be installed in a workmanlike manner to result in a neat appearance with no visible penetrations, screws, or other sheet metal imperfections.
- O. Install all UL classified devices in accordance with their UL approved installation sheets.

3.2 DUCT HANGERS AND SUPPORTS

- A. Provide suitable angle iron/strap hangers and supports inside the mechanical shafts, mechanical rooms and in ceilings of the buildings, and on the roof(s) as shown on the drawings (Architectural/HVAC). This work shall be performed as required by job conditions and as instructed by the Architect in the field to support all air distribution ductwork and devices in both horizontal and vertical planes.
- B. When hanging and supporting the ductwork, the following shall be complied with:
1. Except as otherwise noted, ductwork up to 42" in greatest dimension shall be hung by using sheet metal bands secured as a minimum at (2) locations to the vertical sides of the ductwork and at (1) location under the duct.
 2. All support systems shall be compatible with the building structure as approved by the Architect.
 3. Where ductwork major axis dimension is larger than 42", ductwork shall be hung by using rods of not less than 3/8" soft steel secured to angle iron trapeze support frame around ductwork with threaded nuts for securement and adjustment. All rods used on ductwork exposed in finished spaces shall be plain smooth rods threaded only at the ends.
 4. Ductwork shall be securely attached to the building construction. The hanger design and spacing shall be governed by the major duct dimension and shall be in accordance with SMACNA Duct Manual, except as modified hereinbefore. Vertical ductwork shall be supported at each floor level in an approved manner using angles or channels attached to the ducts. The installation, when complete and under operating conditions, shall be free from chatter or vibration. If necessary to achieve this, additional supports and/or bracing shall be furnished without extra cost to the Owner. Supports and bars and similar items shall be primed and painted structural steel. Touch up with aluminum paint any surfaces where galvanizing is destroyed on indoor ductwork, zinc primer on exposed ductwork with a final coat of aluminum paint. Provide vibration isolation hangers where specified under Vibration Isolation Section of these specifications.
 5. The Sheet Metal Contractor shall provide all supplemental steel required to support the ductwork in shafts, mechanical rooms or on the floor where structural steel is not properly positioned. Beam clamps shall be double sided.
 6. The maximum hanger spacing shall be 10'-0" on centers and additionally on each side of an elbow or change-in-direction fitting.
 7. In addition to the above, provide supports on each side of any duct mounted device, fans, coils, flow measuring stations, framed dampers, etc., to permit removal of the device without disconnecting adjacent duct sections.
 8. Provide angle sway bracing to the structure wherever lateral loads would be imposed on the ductwork, including but not limited to:
 - a. Elbows downstream of fan discharges.
 - b. Ductwork exposed to the weather subject to wind loads.

3.3 SHEETMETAL TESTING

A. General

1. All ductwork that is required to be tested shall be tested on regular intervals as the job proceeds and shall be completed prior to enclosure in shafts, above ceilings or behind walls.
2. The Sheet Metal Contractor shall keep an up-to-date log of the ductwork tested for review by the Architect. The Sheet Metal Contractor shall notify all other Contractors when the testing is completed and accepted to permit enclosure of ducts.
3. The Sheet Metal Contractor shall furnish and install all blank off plates, blind flanges, safing, etc., necessary to isolate each section of duct being tested for leakage.
4. The Sheet Metal Contractor shall submit for review all proposed testing procedures, sample report, and equipment to the Engineer prior to proceeding. Additionally, the Sheet Metal Contractor shall notify the Engineer when testing is to occur so that the test can be witnessed at the Engineer's option.
5. All test equipment shall be calibrated per ANSI Standards prior to testing. Certified test reports shall be submitted to the Architect prior to commencement of the testing.
6. Testing Procedure
 - a. The testing procedure shall be in accordance with SMACNA "HVAC Air Duct Leakage Test Manual".
 - b. The test pressure shall be the specified construction pressure of the duct system.
7. Scope of Testing
 - a. All ductwork (regardless of pressure class) that will be in inaccessible areas including, but not limited to, all ducts within shafts, above hard ceilings, and those that will be made inaccessible by the work of other Trades. (This shall include ± 2 " w.g. construction.)
 - b. All ductwork constructed to greater than +2" w.g. or less than -2" w.g.
 - c. All other sheet metal in duct systems constructed to ± 2 " w.g. shall be tested under normal fan pressure and shall not leak sufficiently to cause audible leaks or blowing detectable by hand. **If, in the opinion of the Architect, the ductwork does not appear to be constructed and/or sealed to the approved shop standards, the Architect may request any or all of this ductwork to be tested at the specified construction pressure.**

- d. Allowable Leakage
- 1) The total allowable leakage shall be less than specified leakage class with no audible leaks.
 - 2) If no leakage class is listed elsewhere, the system shall meet leakage Class 4.

END OF SECTION

SECTION 23 37 00

REGISTERS, GRILLES AND DIFFUSERS

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all registers, grilles and diffusers including opposed blade dampers, frames and other accessories to make a complete system of air distribution. Coordinate with equipment schedules.
- B. All materials shall be new and manufactured for the specific purpose of distributing and controlling air flow.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. ADC 1062: GRD – Test Code for Grilles, Registers and Diffusers; 1984.
 - 2. AMCA 500 – Test Method for Louvers, Dampers and Shutters; 1989.
 - 3. ASHRAE 70 – Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
 - 4. NFPA 90A – Installation of Air Conditioning and Ventilating Systems; 1993.

5. SMACNA (DCS) – HVAC Duct Construction Standard – metal and Flexible; 1995.

1.5 SUBMITTALS

- A. See Section 23,05,00 and General Conditions for Additional Requirements.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application and noise level.
- C. Project Record Documents: Record actual locations of air outlets and inlets.
- D. Submit air terminal performance data including static pressure, throw, velocity, airflow and acoustical performance. Data must indicate compliance with referenced Codes and Standards specified herein.
- E. Manufacturer shall review requirements of outlets as to size, finish and type of mounting before submitting shop drawings and schedule of outlets.
- F. Manufacturer shall check location of outlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement before submitting shop drawings.

1.6 QUALITY ASSURANCE

- A. Manufacturer shall certify cataloged performance and ensure correct application of air outlet types.
- B. Manufacturer shall be responsible for examining application of each outlet and shall guarantee that each will provide comfortable space conditions without drafts at noted capacity.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable manufacturers contingent on compliance with specifications.
 1. PRICE
 2. NAILOR
 3. TITUS
 4. TUTTLE & BAILEY
- B. All air distribution devices shall be of steel or aluminum construction unless otherwise specified herein or scheduled on the drawings.
- C. Distribution devices, except where such devices are specified or scheduled to be steel extruded aluminum, shall be factory primed and finish painted by the manufacturer in a color as approved by the Architect during shop drawing review, unless otherwise noted.
- D. All diffusers, grilles and registers must be compatible with the designed ceiling/wall type. Refer to architectural drawings for exact details of ceiling/wall construction.

2.2 DIFFUSERS, REGISTERS AND GRILLES SHALL BE OF TYPE AS HEREIN SPECIFIED

A. Types A (Ceiling Supply)

1. Ceiling supply air diffusers shall be similar to Price Model SPD.

B. Description:

1. Furnish and install Price model SPD – steel, square plaque ceiling diffusers of sizes and mounting types designated by the plans and air distribution schedule.

C. Construction:

1. Diffusers shall be steel construction, and shall consist of a seamless, one-piece, precision formed backpan that incorporates a round inlet collar of sufficient length for connecting rigid or flexible duct.
2. An inner plaque assembly shall be incorporated and shall drop no more than ¼ inch below the ceiling plane to assure proper air distribution performance.
3. The inner plaque assembly shall be completely removable from the room side to allow for full access to any dampers or other ductwork components located near the diffuser neck.
4. The diffuser shall integrate with all duct sizes shown on the plans without affecting the face size and appearance of the unit.
5. The face panel shall have smooth edges and rounded corners to blend with the back cone.
6. The diffuser ceiling module size shall be 12 x 12 inches.

D. Paint Specification:

1. Paint finish shall be:
 - a. All components shall have a baked-on powder coat finish.
 - 1) The paint finish must demonstrate no degradation when tested in accordance with ASTM D1308 (covered and spot immersion) and ASTM D4752 (MEK double rub) paint durability tests.
 - 2) The paint film thickness shall be a minimum of 2.0 mils.
 - 3) The finish shall have a hardness of 2H.
 - 4) The finish shall withstand a minimum salt spray exposure of 500 hours with no measurable creep in accordance with ASTM D1654, and 1000 hours of exposure with no rusting or blistering as per ASTM D610 and ASTM D714.
 - 5) The finish shall have an impact resistance of 80 inch-pounds.

- E. Mounting Frame:
 - 1. The diffuser mounting frame shall be suitable for lay-in or surface mount applications with the following frame style: Tee-Bar grid mounted.
- F. Options:
 - 1. Insulated Back pan:
 - a. R6 – The diffuser back pan shall be externally insulated with a molded heavy-duty foil/scrim vapor barrier with an R-value of six. The insulation shall meet the requirements of UL 181 and NFPA 90A.
- G. Volume Damper:
 - 1. The diffuser shall be supplied with a steel volume control damper:
 - a. Full flow damper, diffuser mounted (VCR8E)
- H. Type B (Return and Exhaust)
 - 1. General return/exhaust registers shall be similar to Price Model SPD and shall be made of steel with (1) set of fixed blades, 42° deflection. Provide with countersunk holes and suitable frame to match ceiling or wall construction.
- I. Air Screens/Wire Mesh
 - 1. Mesh shall be 3/4" square pattern, 1/16" galvanized wire, interwoven, welded or secured to frame.
 - 2. Frames shall be 1" by 1" by 1/8" galvanized steel angles for duct sizes through 24"; 1 1/2" x 3/16" for duct sizes between 25" and 48"; and, 2" by 2" by 3/16" for ducts larger than 48", continuous around perimeter of screen.

PART 3 - INSTALLATION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instruction.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry and lighting arrangement.
- C. Install diffusers to ductwork with airtight connections.
- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 23 37 23

ROOF ACCESSORIES

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install a complete system of equipment roof curbs, adapter curbs, spring isolator curbs, pipe & duct roof supports, pipe penetration chase houses, including accessories, at all areas indicated on the contract drawings.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as follows:
 - 1. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel; 1994.
 - 2. ASTM A 366/A 366M – Standard Specification for Steel, Sheet, Carbon, Cold Rolled, Commercial Quality; 1991.
 - 3. ASTM A 569/A 569M – Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

4. ASTM A 653/A 653M – Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process.
5. ASTM A 666 – Standard Specification for Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
6. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
7. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
8. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
9. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
10. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease-laden Vapors from Commercial Cooking Equipment.
11. SMACNA (DCS) – HVAC Duct Construction Standards – Metal and Flexible.
12. UL 181 – Factory-Made Air Ducts and Connectors.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide data for materials and products.
- C. Prepare and submit scaled manufacturer's drawings.
- D. Manufacturer's Installation Instructions.

1.6 QUALITY ASSURANCE

- A. Manufacturer shall have adequate experience of building products of the types required for this project.
- B. Construction & attachment to the building structure shall be rated for applicable wind speed ratings as per the following codes & standards:
 1. Massachusetts building code 780 CMR 1604.11
 2. International Building Code (IBC)
 3. American Society of Civil Engineers Standards ASCE7-05 & ASCE7-10

PART 2 - PRODUCTS

2.1 GENERAL

- A. Acceptable Manufacturers subject to compliance with the specification:
1. Prefabricated Insulated Roof Curbs:
 - a. Cambridgeport
 - b. TRANE
 - c. Buckley
 - d. Greenheck
 - e. CurbCo
 2. Roof Equipment Support Curbs/Beams/Rails
 - a. Cambridgeport
 - b. Buckley
 - c. CurbCo
 - d. Greenheck
 3. Prefabricated Pipe Chase Housing
 - a. Alta Products LLC (Alta-Sigrist)
 - b. Roof Penetration Housings LLC (Vault)
 - c. Thybar Corp
 - d. Roof Products & Systems Inc (RPS)
 4. Pipe Supports
 - a. EATON – (Dura-Blok)
 - b. Cooper – (B-Line)
 - c. Unistrut Service Co.
 - d. C-Port
 5. Adapter Curbs.
 - a. TRANE
 - b. Cambridgeport
 - c. Thybar
 - d. CurbCo
 - e. Micrometl
 - f. AES Industries
 6. Spring Vibration Isolation Curbs
 - a. Kinetics Noise Control
 - b. CP - Novia
 - c. Mason Industries

- d. Cambridgeport
- e. Vibro-Acoustics

2.2 PREFABRICATED INSULATED ROOF CURBS

A. General

1. Provide roof curbs for sheet metal duct penetration roof mounted fans, gravity intake, exhaust and relief hoods of types and sizes as shown on the drawings and as hereinafter specified. Roof curbs shall be as manufactured by the approved fan or hood manufacturer.
2. Refer to other Sections of this specification and Section 23 05 00 for General Requirements and Conditions.
3. Roof curbs shall be suitable for field flashing by the Contractor.
4. Designed to withstand a minimum wind loading as required per 780CMR1604.11.

B. Materials

1. Roof Curbs
 - a. Roof curbs shall be prefabricated, acoustical type, constructed of 16-gauge aluminum, pre-insulated with insulation protected from erosion.

2.3 ROOF EQUIPMENT SUPPORT CURBS/RAILS

- A. Furnish and install a series of roof equipment support curbs (or rails) similar to the product as manufactured by CambridgePort or approved equal.
 1. Roof curbs shall be suitable for field flashing by the Contractor.
- B. Each support curb/beam shall be bolted/connected to the roof deck/structure, to assure that the supports for piping/ductwork can withstand a wind loading as required per 780CMR1604.11.
- C. The side of each beam shall provide a surface to allow the roofing material to be applied to for waterproofing their system, independent from the duct/pipe installation.

2.4 PREFABRICATED PIPE CHASE HOUSING

- A. Furnish and install a series of roof equipment support curbs (or beams) similar to the product as manufactured by Alta Products LLC (Alta-Sigrist) or approved equal.
- B. Design Features
 1. Boundary bumps – 4 per front/back
 2. Starter dimples – (Indicates where to drill out 2.25" dia. Holes for installing Sigrist Exit Seals)
 3. Lid attachment flange (2" vertical overlap)
 4. Curb attachment flange (3" vertical overlap)
 5. Thermal Break – Fully insulated housing, lid and curb
- C. Housing Specifications
 1. Material: Aluminum
 2. Wall thickness: 0.080
 3. Exterior Finish: 2mil. Thick UV protected powder coating

4. Finish color: Tan (Medium)
 5. Fasteners: Stainless steel
 - D. Five (5) Standard Sizes
 1. Small, Medium, Large, Tall-Mini, Tall-Medium
 - E. Optional Features
 1. Power outlet box cut-out
 2. Hose bibb cut-out
 3. Both cut-outs are supplied with cover plates and gasket
- 2.5 PIPE SUPPORTS
- A. Furnish and install a series of roof equipment support curbs (or rails) similar to the product as manufactured by EATON – B-LINE (Dura-Blok) or approved equal.
 - B. Materials
 1. Curb base must be made of 100% recycled rubber and polyurethane prepolymer with a uniform load capacity of 500 pounds per linear foot of support. In addition, each base to have a reflective red stripe.
 2. Dimensions: 6-inches wide by 4 inches tall by 30.8 inches long.
 3. Steel frame: Steel, 14ga strut galvanized per ASTM A653 or 12ga strut galvanized per ASTM A653 for bridge series.
 4. Attaching hardware: Zinc-plated threaded rod, nuts and attaching hardware per ASTM B633.
 5. Any products claiming to be a similar, like, or equal must demonstrate (meet or exceed) the same physical and performance characteristics as specified below:
 - a. Density: 0.52 oz/cu in ASTM C642
 - b. Durometer Hardness: 67.2A ± 1 ASTM D2240
 - c. Tensile Strength: 231 psi minimum ASTM D412
 - d. Compression Deformation: 5% at 70psi and 72°F ASTM D395
 - e. Brittleness at Low Temp: -50°F ASTM D746
 - f. Freeze and thaw when exposed to deicing chemicals: No loss after 50 cycles ASTM C672
 - g. Coefficient of Thermal Expansion: 8×10^{-6} in/in/°F (min) ASTM C531
 - h. Weathering: 70 hours at 120°F ASTM D573
 - 1) Hardness retained: 100% (±5%)
 - 2) Compressive strength: 100% (±5%)
 - 3) Tensile strength: 100% (±5%)
 - 4) Elongation retained: 100% (±5%)

C. Type of Rooftop Supports

1. Rubber block supports – Dura-Blok™ model # DBP base dimensions: 6-inch wide by 4-inch tall by 9.6-inch length. Accessories are fastened directly into rubber material with weather resistant type 12 lag screws.
2. Continuous block channel supports – Dura-Blok™ DB-Series or DB6-Series:
3. Dimensions 6-inch wide by 6.5-inch tall by 30.8-inch length. Assembly has 1" gaps between blocks for free flow of water. Standard strut accessories can be used for attachment.
4. Bridge channel supports – Dura-Blok™ DB10-Series; Dimensions 6-inch wide by 5 5/8-inch tall by 36.0-inch length. Standard strut accessories can be used for attachment.
5. Extendible height support – Dura-Blok™ model DBE 10-12, height to suit application: 8-inch, 12-inch or 16-inch (200 pound maximum load). Base to be 9.6 inches in length or otherwise specified sizes available. Heavier loads may require CLDP load distribution plate.
6. Roller supports– Dura-Blok™ DBR10 Series & DBR Series: DBR10 Series is sized for pipe up to 3 1/2 inches, with vertical adjustment up to 12 inches.
7. DBR Series is sized for 2-inch pipe sizes.
8. Elevated single pipe supports– Dura-Blok™ DBM Series: [Copper] or [Steel] pipe sizes 2-inch.

2.6 ADAPTER CURBS

- A. Standard features: Heavy gauge galvanized steel, fully welded, one piece construction, sloped for positive water runoff, welds are micro sealed and primed painted after fabrication, fully insulated, with internal reinforcing to support equipment loads, modified for existing roof curbs.

2.7 SPRING VIBRATION ISOLATION CURB

- A. See Specifications 23 05 99.2.3.C

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The drawings shall be followed where they are definite and provided such procedures do not cause objectionable conditions for equipment provided installed under this Contract. The drawings are intended to indicate the sizes of curbs, intake/exhaust houses and if certain sizes are omitted or unclear, obtain additional information before proceeding.
- B. Locate and size all openings for ductwork in the building construction. Provide all sleeves as hereinbefore specified.
- C. The installation shall be done under the direct supervision of the manufacturer.
- D. Duct connections to equipment shall be in no case smaller than the equipment openings.
- E. Install all UL classified devices in accordance with their UL approved installation sheets.

3.2 ROOF CURB INSTALLATION

- A. The roof curbs shall be installed in accordance with the manufacturer recommendations, contract drawings, and reviewed submittals.
- B. All roof openings shall be reinforced with miscellaneous steel as per the requirements of the Structural engineer.
- C. Installed to withstand a wind loading as required per 780CMR1604.11.
- D. Flashed, counter-flashed and sealed watertight. Coordinate all roof installation requirements with the Roofing Contractor.

3.3 EQUIPMENT CURB/BEAM INSTALLATION

- A. The equipment roof curb/beam shall be installed in accordance with the manufacturer recommendations, contract drawings, and reviewed submittals.
- B. Installed to withstand a wind loading as required per 780CMR1604.11.
- C. Flashed, counter-flashed and sealed watertight. Coordinate all roof installation requirements with the Roofing Contractor.

3.4 DUCT PENETRATIONS, GRAVITY INTAKE, EXHAUST AND RELIEF HOOD INSTALLATIONS

- A. Ductwork roof penetrations, gravity intake, exhaust and relief hoods shall be installed in accordance with the manufacturer recommendations, contract drawings, and reviewed submittals.
- B. Installed to withstand a wind loading as required per 780CMR1604.11.
- C. Flashed, counter-flashed and sealed watertight. Coordinate all roof installation requirements with the Roofing Contractor.

3.5 ADAPTER CURB INSTALLATION

- A. Before removing the existing unit, verify the dimensions of the existing curb O.D. & the new unit with the enclosed drawings. (Note that the curb adapter is oversized by 1-1/2" in both directions.)
- B. Have a licensed professional turn off and disconnect all utilities from the old unit.
- C. Remove the old unit and verify the return & supply sizes and locations with the enclosed drawings.
- D. Remove all the old gasket material from the existing curb and replace with the new gasket material that is supplied with the curb.
- E. Set curb adapter on the existing curb in the proper orientation.
- F. Remove lifting lugs from curb if need be.
- G. Apply gasket material to the top rails and perimeter of the new curb adapter.
- H. Install equipment rail; if applicable, shimming may be required (shims supplied by others).
- I. Set new unit on curb adapter.
- J. Have a licensed professional reconnect necessary utilities to the new rooftop unit and verify utilities are connected before turning back on.
- K. Installed to withstand a wind loading as required per 780CMR1604.11

END OF SECTION

SECTION 23 39 00

FANS AND ACCESSORIES

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all fans of the various types, arrangement and sizes specified herein and as scheduled on the drawings.
- B. Fans shall include all motors, drives, curbs, flashing, special coatings and accessories.
- C. Furnish and install automatic dampers with all fans.
- D. Furnish and install all roof curbs and automatic dampers. Installed to withstand a wind loading as required per 780CMR1604.11.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 - ELECTRICAL AND FIRE ALARM

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. AMCA 99 – Standards Handbook; 1986.

2. AMCA 261 – Directory of Products Licensed to Bear the AMCA Certified Ratings Seal; 1995.
3. AMCA 300 – Test Code for Sound Rating Air Moving Devices; 1994.
4. AMCA 301 – Method of Publishing Sound Rating Air Moving Devices; 1994.
5. NEMA MG 1 – Motors and Generators; 1993 (and Revision 1).
6. UL 705 – Power Ventilators; 1994.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Submit certified curves showing fan performance with system operating points plotted on curves.
- C. Submit motor data sheets including motor efficiency and power factor at various loadings of nameplate horsepower. Motor efficiency and power factor shall be shown for 100%, 75% and 50% of nameplate horsepower. Submit data on efficiency and power factor required for motors 1 HP and above only. Motors shall have premium efficiency motors with minimum efficiency on motors listed in specification.
- D. Submit bearing sizing calculations for each similar size and type of fan. Fan bearing calculations shall be based on fan at maximum operating conditions including belt pull. Calculations shall be done for both fan bearings and motor bearings. Calculations required on centrifugal fans, vent sets in-line fans, wall mounted propeller fans and vane axial fans only.
- E. Submit sound power levels for each size and type of fan. Sound levels shall be in all (8) octave bands for discharge of fan, inlet to fan, and radiated noise through casing.
- F. Submit certified shop drawings indicating all dimensional data, and operating and maintenance clearances.

1.6 QUALITY ASSURANCE

- A. Fans shall conform to most recent AMCA Bulletins regarding construction and testing. Fans shall be tested and rated per AMCA and shall be selected in proper operating range without motor overloading and fan surge.
- B. Manufacturers must prove experience in the production of similar products of this type for at least ten (10) years prior.
- C. Fans shall be air and sound certified in accordance with AMCA 210 and 300 and shall bear the AMCA seal.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. and other testing firm acceptable to the authority having jurisdiction and all suitable for the purpose specified and indicated.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers acceptable contingent upon product's compliance with the specifications are as follows:
 - 1. Centrifugal Fans
 - a. Loren Cook Co.
 - b. Buffalo Forge Co.
 - c. Greenheck Fan Corp.
 - d. Twin City Fan
 - 2. Roof Mounted Centrifugal Fans (Hurricane Rated)
 - a. Greenheck Fan Corp.
 - b. Loren Cook Co.
 - c. ACME Fan Co.
 - d. Twin City Fan
 - 3. Up-Blast Roof Mounted Centrifugal Fans (Hurricane Rated)
 - a. Greenheck Fan Corp.
 - b. Loren Cook Co.
 - c. ACME Fan Co.
 - d. Twin City Fan
- B. Selection and Balancing
 - 1. Provide and install items as listed in equipment schedules, as shown on drawings, and as specified, complete in all respects to the functions intended.
 - 2. Provide fans capable of accommodating static pressure variations of $\pm 10\%$.
 - 3. Provide balanced variable sheaves for motors 15 HP and under, and fixed sheaves for 20 HP and over.

4. Statically and dynamically balance fans in the field to eliminate vibration or noise transmission to occupied areas of the building. Provide certificate of compliance from manufacturer.
5. Provide OSHA and ANSI approved belt guards on interior mounted belt driven fans. Provide weatherproof ventilated housing for exterior mounted fans.
6. Provide safety, bird or insect screen where inlet or outlet is exposed.
7. All fans shall be manufactured in accordance with this specification even where techniques are required which are not considered standard by that manufacturer.
8. Verify fan arrangement with the Contractor including motor location for servicing and discharge arrangements for proper airflow.
9. Where fixed speed sheaves are specified for a particular fan, provide (2) additional sheaves (one motor and one drive) as necessary for final air balancing.
10. All (direct drive) fan shafts (which are connected to a variable speed controller) must be complete with a factory mounted shaft grounding brush/device.

C. Painting

1. Each fan component shall be thoroughly cleaned, degreased and deburred before the application of a rust preventive primer.
2. Two (2) coats of a rust preventive primer shall be applied under a topcoat of air-dried epoxy or enamel. Minimum coating thickness shall be 5 to 6 mils. The final coat shall be applied after final assembly to all surfaces.

D. Exterior Mounted Fans

1. All fans that are scheduled to be mounted in exterior conditions must be capable of withstanding a wind loading as required per 780CMR1604.11, in terms of fan construction, fan mounted details, fan support details and roof curb arrangements.

2.2 UP-BLAST ROOF MOUNTED CENTRIFUGAL FANS

A. Fans shall be identical construction to roof mounted centrifugal fans above, except for the following:

1. Fan discharge arranged to discharge the air vertically, away from the roof, using a wind band housing constructed of heavy gauge aluminum.
2. Motor drive compartment shall be ventilated using outside air. A direct connected breather tube shall be used ensuring contaminated air is not induced.

3. Refer to Roof Curb Section herein. Fan and curb assembly shall be rated to withstand a wind loading as required per 780CMR1604.11.

PART 3 - FAN INSTALLATION REQUIREMENTS

3.1 INSTALLATION

- A. Fans shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.
- B. Fans shall be installed so as to ensure easy accessibility for service or removal or replacement of all components such as, but not limited to, fans, motors, belts, drives, bearings, dampers, actuators, isolators, and field connections.
- C. The HVAC Contractor shall install all motors and drives shipped loose. Fans shall be installed and tested, and shall be made fully operational by the HVAC Contractor.
- D. Provide fixed sheaves as necessary for final air balancing. The Contractor shall install the fixed sheave after balancing with the Contractor to adjust the fans.
- E. Manufacturer shall include the adjustment of pitch for adjustable pitch fans as required by balancing.
- F. Set roof mounted fans on sound absorbing insulated curbs. Coordinate installation with Roofing Contractor. Curbs shall be provided by the HVAC Contractor. The HVAC Contractor shall provide all counter flashing.
- G. Mount vent sets and vane axial fans located on roof to inertia bases as required under Vibration Isolation Section.
- H. Make all penetrations through roof or vertical walls watertight. Submit methods of sealing to Architect/Engineer for review and approval.
- I. All fans shall have flexible inlet and outlet couplings to prevent vibration transmission to ductwork.
- J. The Contractor shall assemble all loose parts including motors and drive assemblies on site and shall vibration balance the fans in the field. Field adjustment including belt alignment, wheel balancing, belt tension, greasing of bearings, installation of belt guards, and other loose parts shall be provided by the HVAC Contractor.

3.2 COORDINATION

- A. The Contractor shall coordinate the fan arrangement with the coordinated ductwork layout prior to ordering the fan. The Contractor shall provide all labor and materials necessary to change fan arrangement in the field when fan arrangement does not match ductwork.
- B. The inlet and discharge ductwork shall have a minimum straight run of (2) fan diameters upstream and downstream of the fan. The Contractor shall notify the Engineer in writing if these conditions cannot be achieved. Installation of improper inlet/discharge conditions without the review of the Engineer shall be corrected in the field at no cost to the Owner.

- C. The discharge duct arrangement shall comply with AMCA recommended layouts for elbows after fans.
- D. The Contractor shall provide all supplemental steel, supports, rods and hangers necessary to hang or mount fans. Supports shall include thrust restraint as required by the fan manufacturer.
- E. The fan manufacturer and Contractor shall coordinate the fan orientation for tubular centrifugal fans and shall verify that the fan support and bearings are supplied for the coordinated fan orientation (horizontal or vertical). The Contractor shall revise the fan in the field if job conditions require changing of orientation, at no cost to the Owner.
- F. The Contractor shall receive and inspect all fans and motors to make sure that all fans are received without defect. All defective or damaged fans shall be returned to the manufacturer by the Contractor for replacement.
- G. The Contractor shall properly protect all equipment to prevent damage from water, dirt, etc. Protection shall include temporary plastic wrap to keep equipment in original factory condition. Fans used for temporary ventilation during construction shall be totally cleaned and refurbished prior to turnover to the Owner.
- H. The HVAC Contractor shall mount and vibration balance all fans. The Electrical Contractor shall furnish and install power wiring to the fan motor and verify proper fan rotation. The HVAC and Electrical Contractors shall coordinate the starter requirements to ensure that the proper starter is installed for non-standard motors. The ATC Contractor shall wire all interlocking wiring to the fan including smoke detector wiring for fan shutdown.
- I. The HVAC Contractor shall mount all automatic control dampers on the fan either shipped loose or provided by the ATC Contractor.
- J. The HVAC Contractor shall mount all field mounted flow measuring devices on the inlet or discharge of the fan prior to fan installation.

END OF SECTION

SECTION 23 41 00

FILTERS

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Provide filters, filter frames, filter housings, and filter gauges of size, capacity, location and types shown and scheduled on the drawings and hereinafter specified.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. ARI 850 – Commercial and Industrial Air Filter Equipment.
 - 2. ASHRAE 52.1 – Gravimetric and dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 3. ASHRAE 52.2, Method of Testing General Ventilation Air-cleaning Devices For Removal Efficiency by Particle Size. (Minimum efficiency Reporting Value.)
 - 4. MIL-STD-282 – Filter Units, Protective Clothing, Gas-Mask Components, and Related Products; Performance – Test Methods; current edition.
 - 5. UL 586 – Test Performance of High Efficiency Particulate, Air Filter Units.

6. UL 867 – Electrostatic Air Cleaners.
7. UL 900 – Test Performance of Air Filter Units.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Manufacturer's Instructions; Indicate installation instructions and recommendations.
- D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: company specializing in manufacturing the Products specified in this section with minimum five (5) years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 PREFILTERS TYPE "A" (MERV = 8)

- A. Acceptable manufacturers subject to compliance with the specifications:
 1. Flanders (Type 62R)
 2. Camfil/Farr
 3. Purolator Air Filter (MK80D)
 4. American Air Filters
- B. Prefilter shall be 4" thick: throwaway, medium efficiency, pleated, disposable type as shown on the drawings. Each filter shall consist of a non-woven fabric media, support grid and enclosing frame. The filter shall be UL listed as Class II. Filter media shall be of the non-woven fabric. The filter media shall have an average efficiency of 30% to 35% and an average arrestance of 90% to 92% in accordance with ASHRAE 52-1, and MERV 8 Rating per ASHRAE 52.2.
- C. The effective filter media shall be at least 7.0 sq.ft. of media per 1.0 sq.ft. of filter face area
- D. Initial resistance at 500 fpm approach velocity shall not exceed 0.35" w.g (7.0 sq ft per 1.0 sq ft face area, 11 pleats per linear ft. Filter thickness – 4".

- E. The media support shall be a welded wire grid or expanded metal with an effective open area of at least 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull-away. The media support grid shall be formed in such a manner that it affects radial pleat design, allowing total use of filter media.
- F. The enclosing frame shall be constructed of a rigid, heavy duty, high wet strength beverage board, with diagonal support members bonded to the air entering and exiting side of each pleat to ensure plate stability. The inside periphery of the enclosing frame shall be bonded to the filter pack, thus, eliminating the possibility of air bypass.
- G. Provide holding frames, factory fabricated of a minimum of 16-gauge steel and equipped with gaskets and (4) spring type positive sealing fasteners. Fasteners shall be capable of being attached or removed without deforming the gaskets and without the use of tools. Frames shall be dimpled for proper centering and shall be designed so that filters of other efficiencies and depths can be used, at the owner's discretion, merely by change of fasteners.
- H. Prefilters Type "A1"
 - 1. Same as type "A" except:
 - a. 2" thick
 - b. Shall contain at least 4.6 sq ft. per 1.0 sq ft face area, 14 pleats per linear foot.
 - c. Initial resistance at 500 fpm approach velocity shall not exceed 0.30" w.g.

2.2 FINAL FILTER TYPE "C" (MERV-13)

- A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
 - 1. Flanders Rigid Air - 95
 - 2. Camfil/Farr (Riga Flo/200)
 - 3. Purolator Air Filter (Aerocell-95)
- B. Air filter shall be 12" deep, high performance, deep pleated, totally rigid.
- C. Filter media shall consist of a completely synthetic, electrostatic ally charged microfiber graded mat, with a light spun bonded top sheet and a heavyweight spun bonded support scrim. The filter shall have an average efficiency of 90-95% on ASHRAE 52.1-92 MERV 13 per 52.2. It shall have an average arresstance of not less than 99.5% on that standard. Filters shall be UL listed as Class II.
- D. Initial resistance at 500 fpm approach velocity shall not exceed 0.70" w. g.

- E. The media support shall be a welded wire grid with an effective open area of at least 96%. The welded wire grid shall be bonded to the filter media to eliminate the possibility of media oscillation and media pull-away. The media support grid shall be formed in such a manner that it affects a tapered radial pleat design. The grid shall be designed to support the media both vertically and horizontally.
- F. Contour stabilizers shall be galvanized steel and shall be permanently installed on both the air entering and air exiting sides of the filter media pack to ensure that the tapered radial pleat configuration is maintained throughout the life of the filter. There shall be four contour stabilizers on the air entering side and six on the air exiting side. The filter shall be capable of withstanding 10" w.g. pressure drop without noticeable distortion of the media pack.
- G. The enclosing frame shall be constructed of galvanized steel. It shall be assembled in such a manner that a rigid and durable enclosure for the filter pack is effected. The media pack shall be mechanically and chemically bonded to the inside periphery of the enclosing frame, thus eliminating the possibility of air bypass. The enclosing frame shall be equipped with galvanized steel protective diagonal support braces on both the air entering and air exiting sides of the filter. The diagonal support braces shall be mechanically fastened to each contour stabilizer. (Cardboard is not permitted).
- H. Final Filter Type "C1"
 - 1. Same as C except offering is 80- 85%
 - 2. Initial resistance at 500 fpm approach velocity shall not exceed 0.50" w.g.
- I. Final Filter Type "C2"
 - 1. C-2 Same as C except offering is 60- 65%
 - 2. Initial resistance at 500 fpm approach velocity shall not exceed 0.35" w.g.

2.3 FILTER HOLDING RACK – SIDE ACCESS

- A. General
 - 1. Provide side access, one or two-stage filter system similar to Flanders Sureseal, consisting of a housing, access doors, tracks. Housing shall accommodate any 2" prefilter and various final filters with efficiencies of 45%-95%, per ASHRAE 52-76.
- B. Leakage
 - 1. Leakage at rate airflow, upstream to downstream of filter, holding frame, and slide mechanism shall be less than 1% at 3" w.g. differential. Leakage into housing from ambient atmosphere at rated airflow shall be less than 0.5% at 3" w.g. negative. Manufacturer shall submit substantiating test reports.

C. Housing

1. Housing shall be factory fabricated and assembled of 16-gauge galvanized steel with corner posts of Z-channel bracing to eliminate racking. Each housing shall be equipped with two (2) access doors and 1.5" standing flanges with prepunched holes to facilitate field installation. Flanges shall be notched to provide water runoff. Housings must be weatherproof and suitable for rooftop/outdoor installation.

D. Access Doors

1. Access doors shall be constructed of a minimum of 16-gauge galvanized steel and positioned to facilitate removal and replacement of filters from either side of the housing. Each door shall be equipped adjustable and replaceable positive seating latches and replaceable hinges. The peripheral gasket material shall be of high memory sponge neoprene. Holding frame to door contact shall be gasketed with 1"x1.25" polyurethane foam to effect a leak proof seal.

E. Tracks

1. Tracks shall be field adjustable and replaceable, heavy gauge, anodized aluminum extrusion designed to accommodate Camfil/Farr Universal Holding Frames. Each extrusion shall be equipped with a replaceable, non-woven pile encased, aluminum backed, polypropylene finned seal providing an air barrier between the extrusion and Universal Holding Frame.

PART 3 - EXECUTION

3.1 FILTER, FILTER FRAMES, FILTER HOUSING AND FILTER GAUGES

- A. Filters, filter frames, filter housings, and filter gauges shall be installed in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.
- B. Filters shall be installed so as to ensure easy accessibility for service, removal and replacement of filters.
- C. No system shall be operated without filters.
- D. During temporary ventilation:
 1. The units shall not be operated without filters. Provide the following temporary filters during initial start-up and temporary operation.

Specified filter

Temporary Filter

- | | | |
|----|--------|--------|
| a. | TYPE A | TYPE A |
| b. | TYPE C | TYPE C |

2. Prior to Owner occupancy, all temporary filters shall be replaced with the specified filter.
- E. Prior to air balance, install design set of per- and final filters in air handling units, and leave (1) new spare set of filters with the Owner.

END OF SECTION

SECTION 23 74 13

PACKAGED ROOFTOP AIR CONDITIONING UNITS

(Part of 23 00 01, Filed Sub-bid)

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

- A. Package roof top unit.
- B. Heat exchanger.
- C. Refrigeration components.
- D. Unit operating controls.
- E. Roof curb.
- F. Electrical power connections.
- G. Operation and maintenance service.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 - ELECTRICAL AND FIRE ALARM

1.4 REFERENCES

- A. NFPA 90 A & B - Installation of Air Conditioning and Ventilation Systems and Installation of Warm Air Heating and Air Conditioning Systems.

- B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- C. AHRI 360 - Commercial and Industrial Unitary Air Conditioning Equipment testing and rating standard.
- D. ANSI/ASHRAE 37 - Testing Unitary Air Conditioning and Heat Pump Equipment.
- E. ANSI/ASHRAE/IESNA 90.1-1999 - Energy Standard for New Buildings Except Low-Rise Residential Buildings.
- F. ANSI Z21.47/UL1995 - Unitary Air Conditioning Standard for safety requirements.
- G. California Energy Commission Administrative Code - Title 20/24 - Establishes the minimum efficiency requirements for HVAC equipment installed in new buildings in the State of California.
- H. AHRI 210/240 - Unitary Air-Conditioning Equipment and Air- Source Heat Pump Equipment.
- I. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
- J. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air Conditioning Equipment.
- K. ANSI/NFPA 70-1995 - National Electric Code.

1.5 SUBMITTALS

- A. Submit unit performance data including capacity, nominal, and operating performance.
- B. Submit Mechanical Specifications for unit and accessories describing construction, components, and options.
- C. Submit shop drawings indicating overall dimensions as well as installation, operation and services clearances. Indicate lift points and recommendations and center of gravity. Indicate unit shipping, installation and operating weights including dimensions.
- D. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety, and start-up instructions.
- E. Shop drawings submitted for approval shall be accompanied by a copy of the purchase agreement between the Contractor and an authorized service representative of the manufacturer for check, test and start up and first year service.

1.6 DELIVERY, STORAGE and HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

- B. Protect units from physical damage. Leave factory-shipping covers in place until installation.

1.7 WARRANTY

- A. Provide parts warranty (excluding refrigerant) for one year from start-up or 18 months from shipment, whichever occurs first.
- B. Provide five-year extended warranty for compressors.
- C. Provide five-year heat exchanger limited warranty.

1.8 REGULATORY REQUIREMENTS

- A. Unit shall conform to ANSI Z21.47/UL1995 for construction of packaged air conditioner
 - 1. In the event the unit is not UL approved, the manufacturer must, at his expense, provide for a field inspection by a UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.
- B. Conform to Canadian Standards Association (CAN/CSA-2.3/CAN/CSA C22.2 #236) for construction of packaged air conditioner
 - 1. In the event the unit is not CSA approved, the manufacturer must, at his expense, provide for a field inspection by a CSA representative to verify conformance to CSA standards. If necessary, contractor shall perform modifications to the unit to comply with CSA, as directed by the CSA representative, at no additional expense to the Owner.

1.9 EXTRA MATERIALS

- A. Provide one set of filters.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. The contractor shall furnish and install package rooftop unit(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. APPROVED MANUFACTURERS
 - 1. Trane: (Basis of Design – Reference equipment schedules)
 - 2. Carrier:
 - 3. Johnson Controls / York:

4. Daiken:
5. AAon:
6. Substitutions: [10 working days prior approval required from Owner] as indicated under the general and/or supplemental conditions of these specifications. Mechanical contractor shall be responsible for electrical and mechanical changes to the structure when using a product other than the specified product. As built drawing changes are the responsibility of the mechanical contractor.

2.2 GENERAL UNIT DESCRIPTION

- A. Unit(s) furnished and installed shall be Cooling with Hot Gas Reheat Coils and Electric Heat packaged rooftop (s) as scheduled on contract documents and these specifications. Cooling capacity ratings shall be based on AHRI Standards. Unit(s) shall consist of insulated weather-tight casing with compressor(s), air-cooled condenser coil, condenser fans, evaporator coil, return-air filters, supply motors and microprocessor unit controls, Minimum MERV-13 Filters and Field installed NU-Calgon Bipolar Ionization Generators and Field installed Power Exhausters. Units to be furnished with curbs, adapter curbs and or spring isolation curbs as shown on the plans. Units to include acoustical treatments a shown on the plans. Units to include factory packaged controls, sequences, and controllers.
- B. Unit(s) shall be 100% factory run tested and fully charged with R-410A
- C. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- D. Units shall be convertible airflow design as manufactured.
- E. Wiring internal to the unit shall be colored and numbered for identification.

2.3 UNIT CASING

- A. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge.
- B. Units cabinet surface shall be tested 1000 hours in salt spray test in compliance with ASTM B117.
- C. Cabinet construction shall allow for all service/ maintenance from one side of the unit.
- D. Cabinet top cover shall be one piece construction or where seams exists, it shall be double-hemmed and gasket-sealed.
- E. Access Panels: Water- and air-tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.

- F. Units base pan shall have a raised 1 1/8-inch-high lip around the supply and return openings for water integrity.
- G. Insulation: Provide 1/2-inch-thick fiberglass insulation with foil face on all exterior panels in contact with the return and conditioned air stream. All edges must be captured so that there is no insulation exposed in the air stream.
- H. Provide openings either on side of unit or through the base for power, control, condensate, and gas connections.
- I. The base of the unit shall have 3 sides for forklift provisions. The base of the units shall have rigging/lifting holes for crane maneuvering.

2.4 AIR FILTERS

- A. Air Filters: Factory installed filters shall mount integral within the unit and shall be accessible through access panels. Minimum MERV-13 filters shall be provided with the unit.

2.5 FANS AND MOTORS

- A. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
- B. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
- C. Provide units 5 tons and below with direct drive, multiple speed, dynamically balanced supply fans.
- D. Provide units 6 tons and above with belt driven, supply fans with adjustable motor sheaves.
- E. Outdoor and Indoor Fan direct drive shall be permanently lubricated and have internal thermal overload protection.
- F. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- G. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.

2.6 ELECTRIC HEATING SECTION

- A. Provide heavy duty nickel chromium heating elements internally wired. Heater shall have pilot duty or automatic reset line voltage limit controls and any circuit carrying more than 48 amps shall have fuse protection in compliance with N.E.C.
- B. Heater shall be internal to unit cabinet.
- C. Heater shall be UL and CSA listed and approved and provide single point power connection.

2.7 EVAPORATOR COIL

- A. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- B. Provide an independent expansion device for each refrigeration circuit. Factory pressure tested at 450 psig and leak tested at 200 psig.
- C. Provide a removable, reversible, cleanable double sloped drain pan for base of evaporator coil constructed of PVC.

2.8 HOT GAS REHEAT DEHUMIDIFICATION

- A. Dehumidification with hot gas reheat

Factory installed hot gas reheat allows application of dehumidification. Initiation of reheat is performed by an input to the RTOM module from either a relative humidity sensor or a humidi-stat type device. These connections are made through the low voltage terminal strip located in the unit control panel. Actuation of the reheat is accomplished by energizing a valve that allows refrigerant hot gas to flow through the hot gas reheat coil.

- B. Dehumidification is allowed only when the outside air temperature is above 40F or below 100F. Dehumidification is not allowed if there is an active call for heating . If, during a dehumidification cycle, there is a call for heating, the dehumidification cycle is terminated. The economizer outside air damper is also driven to minimum position during dehumidification.
- C. In the absence of a zone humidity sensor input, an on/off input from a zone humidistat is used to initiate or terminate the dehumidification cycle. A relative humidity sensor takes priority over a humidistat.
- D. Dehumidification takes priority over a single call for cooling on dual compressor units. Cooling takes priority over dehumidification on single compressor units.
- E. Heating or 2nd stage cooling takes priority over dehumidification.
- F. Sequence of Events

Single compressor units -

On a call for dehumidification, the reheat valve is energized, and the compressor is turned on. When the humidity control setpoint is satisfied, the valve is de-energized, and the compressor is turned off. If there is a call for cooling from the space temperature controller, i.e. zone sensor or thermostat while in reheat, the reheat valve is de-energized and the compressor continues to run. The three-minute minimum compressor on and off times are still active during compressor operation. On certain units the use of a two-speed condenser fan motor is required to maintain proper airflow. For those applications, if the unit is in the reheat mode, and the outside air temperature is below 70 degrees, the motor changes to low speed. Once the reheat mode is terminated, or the temperature goes above 75 degrees, the condenser motor will revert back to high speed. This speed variation is only functional during the reheat mode.

Dual compressor units –

On a call for dehumidification, the reheat valve is energized and both compressors are turned on. When the humidity control setpoint is satisfied, the valve is de-energized and both compressors are turned off. If there is a call for 1st stage cooling while in the dehumidification mode, no action takes place. If there is a call for 2nd stage cooling, the reheat valve is de-energized, and the unit reverts to the cooling mode. If 2nd stage cooling is satisfied and there is still a call for dehumidification, the reheat valve will once again be energized, as well as turning 2nd stage compressor back on. The three-minute minimum on and off times are still active during compressor operation. In other words, 2nd stage cooling take priority over a call for dehumidification.

- G. In addition to the normal sequence of events, there is a purge sequence in the ReliaTel RTRM module that changes the state of the refrigeration cycle. During a cooling or dehumidification cycle, if the given cycle remains in that state for 90 accumulated minutes without changing to the other state, a purge time algorithm in the RTRM, will force the system to switch to the other state for three minutes. If during the the 90 minute period the refrigeration cycle changes from one state to the other based on a call from a temperature controller or humidity sensor, the timer is reset and starts counting again.

2.9 CONDENSER SECTION

- A. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced. Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.

2.10 REFRIGERATION SYSTEM (R410A)

- A. Compressor(s): Provide scroll compressor with direct drive operating at 3600 rpm. Integral centrifugal oil pump. Provide suction gas cooled motor with winding temperature limits and compressor overloads.
- B. Units shall have cooling capabilities down to 0 degree F as standard. For field-installed low ambient accessory, the manufacturer shall provide a factory-authorized service technician that will assure proper installation and operation.
- C. Provide each unit with 1 or 2 refrigerant circuit(s) factory-supplied completely piped with liquid line filter-drier, suction and liquid line pressure ports.
- D. For heat pump units, provide reversing valve, discharge muffler, flow control check valve, and electronic adaptive demand defrost control on all units.

2.11 OUTDOOR AIR SECTION

- A. Provide 100% return air.
- B. Provide economizer with reference enthalpy control.
- C. Provide adjustable minimum position control located in the economizer section of the unit.

- D. Provide spring return motor for outside air damper closure during unit shutdown or power interruption.
- E. Power Exhaust Control (Standard)
 - 1. The power exhaust fan is started whenever the position of the economizer dampers meets or exceed the power exhaust setpoint when the supply fan is on.
 - 2. The setpoint potentiometer is on the RTOM and is factory set at 25%.

2.12 OPERATING CONTROLS

- A. Provide microprocessor unit mounted DDC control which when used with an electronic zone sensor provides proportional integral room control. This UCM shall perform all unit functions by making all heating, cooling, and ventilating decisions through resident software logic.
- B. Provide factory-installed indoor evaporator defrost control to prevent compressor slugging by interrupting compressor operation.
- C. Provide an anti-cycle timing and minimum on/off between stages timing in the microprocessor.
- D. Economizer Preferred Cooling (if supplied with economizer) - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.

2.13 STAGING CONTROLS

- A. Provide programmable electronic microcomputer-based zone control.
 - 1. Zone control shall incorporate:
 - a. Automatic changeover from heating to cooling.
 - b. Set-up for at least 2 - sets of separate heating and cooling temperatures per day.
 - c. Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - d. Switch selection features including Fahrenheit display, 12 or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
 - e. Smart Fan Operation: Allows the unit fan operation to default to the Auto Mode during unoccupied periods, regardless of the Fan switch position.

- f. Economizer Minimum Position Override: Allows the unit controller to override and close the minimum position setting on the economizer damper during unoccupied time periods.
2. Zone sensor display shall be capable of:
- a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indication: heating, cooling, low battery, and fan on.
 - h. Provide remote temperature sensor capability.
 - i. Provide mixed air sensor in supply air to close outside air damper.

2.14 BUILDING MANAGEMENT SYSTEM

- A. Interface control module to Energy Management System to be furnished and mounted by rooftop unit manufacturer. Through this interface module, all Energy Management functions (specified in Energy Management Section) shall be performed. See Building Automation and Automatic Temperature Control System Specifications. The interface module with necessary controls and sensors shall all be factory mounted (not field mounted). If not furnished by rooftop unit manufacturer, this shall be furnished by Energy Management System Contractor for factory mounting by rooftop unit manufacturer in rooftop unit and rated for service up to 140 F. The only field connection to Energy Management System shall be a single communication link. Provide BACnet MS/TP compatibility.
- B. Control Functions: Include unit scheduling, occupied/unoccupied mode, start-up and coast-down modes, nighttime free-cool purge mode, demand limiting, night setback, discharge air set point adjustment, timed override and alarm shutdown, clogged filter switch, and return/supply air smoke detector.
- C. Diagnostic Functions: Include supply fan status.
- D. Provide capabilities for Boolean Processing and trend logs as well as "templated" reports and logs.

2.15 UNIT PERFORMANCE REQUIREMENTS

- A. See provided schedule

2.16 ROOF CURB

- A. Contractor shall provide factory supplied roof curb, 16 gauge perimeter made of zinc coated steel with supply and return air gasketing and wood nailer strips. Ship knocked down and provided with instructions for easy assembly.
- B. Curb shall be manufactured in accordance with the National Roofing Contractors Association guidelines.

PART 3 EXECUTION

3.1 EXAMINATION

- H. Contractor shall verify that roof is ready to receive work and opening dimensions are as shown in submittal.
- I. Contractor shall verify that proper power supply is available.

3.2 INSTALLATION

- A. Contractor shall install in accordance with manufacturer's instructions.
- B. Mount units on factory-built roof mounting frame providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.

PART 4 SEQUENCE OF OPERATIONS

4.1 PACKAGED ROOFTOP UNITS (RTU)

- A. Microprocessor controller - Each RTU shall be controlled by a stand-alone microprocessor-based controller with resident control logic. The controller will interface with the BAS and the inputs and outputs in the points list to accomplish the following temperature control and energy conservation strategies.
 - 1. Occupied Mode - All unit functions will be enabled for normal heating and cooling operation. Unit defaults to default temperature setpoints in the unit microprocessor when communication with BAS is lost.
 - 2. Occupied Space Temperature Control - When in occupied mode as described above, the dedicated unit control shall operate stages of heating and cooling to maintain space temperature setpoint. Setpoints may be set by one of the following methods:
 - a. Remotely through BAS by the system operator.
 - b. Locally through the thermostat by the occupant.
 - c. Locally through the thermostat by the occupant within limits defined through the BAS by the system operator;
 - d. Operator may designate wild card setpoints to apply to any or all of the RTU's through the BAS.

- B. Optimal Start Mode - When the unit is turned on by the BAS for optimal start, heating or cooling is provided as required. The outside air dampers, if provided, remains closed, in heating mode or mechanical cooling mode, until occupied time. Economizer cycle, if supplied, will be available if required.
- C. Coast down Mode - When the unit is turned "OFF" by the BAS for optimal stop, the supply fan remains "ON/AUTO", the outside air damper remains in minimum position for ventilation, and utilizes the unoccupied setpoints.
- D. Demand Limit Mode - Through the BAS a user defined Demand Limit Mode shall be available. User defines maximum off time and temperature to ensure occupant comfort.
- E. Night Setback Temperature Control - When the BAS selects unoccupied mode, the unit shall be controlled to maintain user defined unoccupied heating and cooling setpoints. Adjustable start and stop temperature differentials will prevent short cycling. The outdoor air damper remains closed during heating night setback operation, if provided.
- F. Economizer - Each RTU when equipped will measure comparative enthalpy and select lowest total heat air stream to meet cooling demands. When using return air, the outside air damper will be position at a minimum position. The minimum position will be adjustable by the operator or through the BAS software.
- G. Nighttime Free-Cool Purge Mode - An "economizer only" cooling cycle shall be provided during unoccupied hours when outdoor air conditions are suitable and the zone requires cooling.
- H. Low Ambient Compressor Lockout - Compressor operation shall be disabled below a user defined outdoor air temperature.
- I. Timed Override - When a timed override is initiated by the user, the unit will return to its user defined normal occupied mode for the user determined period of time.
- J. Fire Shutdown - The unit will shut down in response to a customer supplied contact closure to the BAS indicating the presence of a fire or other emergency condition.
- K. Heat Pump Auxiliary Heat Lockout - Heat pump auxiliary heat operation shall be prevented above a user defined outdoor air temperature.
- L. Emergency Heat Mode(Heat Pump units) - Shall be selectable at BAS. In emergency heat mode, compressors shall be locked out and auxiliary heat shall control for space comfort.
- M. Unit status report - For each RTU unit, the BAS shall provide an operating status summary of all sensed values (zone temperature, discharge temperature, etc.) setpoints and modes.
- N. Supply Air Tempering - When the unit is in the heat mode, but not actively heating, if the supply air temperature drops 10 degrees or more below the heating setpoint, heat is turned on until supply air temperature rises to a point 10 degrees above the heating setpoint.

- O. Alternating Lead/Lag - (Dual Compressors Models Only), During periods of part load operation, each compressor cycles alternatively as circuit number one in order to equalize wear and run time.
- P. Economizer Preferred Cooling - Compressor operation is integrated with economizer cycle to allow mechanical cooling when economizer is not adequate to satisfy zone requirements. Compressors are enabled if space temperature is recovering to cooling setpoint at a rate of less than 0.2 degrees per minute. Compressor low ambient lockout overrides this function.
- Q. Diagnostic/Protection - The BAS system shall be able to alarm from all sensed points from the rooftop units and diagnostic alarms sensed by the unit controller. Alarm limits shall be designated for all sensed points.

END OF SECTION

SECTION 23 82 16

COILS

(Part of 23 00 01 Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Provide coils of size, capacity, location and type shown and scheduled on the drawings and as hereinafter specified.
- B. Coil capacities, pressure drops and selection procedures shall be certified in accordance with ARI 410 (latest edition).
- C. Furnish and install coils to make a complete and operational system.
- D. All equipment shall be new and shall be of the type, style, size and capacities as scheduled.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:

- a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. ARI 410 – Forced-Circulation Air-Cooling and Air-Heating Coils.

2. SMACNA (DCS) – HVAC Duct Construction Standards, Metal and Flexible.
3. NFPA 70 – National Electrical code.

1.5 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Provide ARI Calculations.
- D. Manufacturer’s Instructions: Indicate installation instructions and recommendations.
- E. Provide detail drawings and each coil and recommended installations.
- F. Project Record Documents: Record actual locations of components.
- G. Operation and Maintenance Data: Include manufacturer’s descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listings.
- H. Warranty: Submit manufacturer’s warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriter’s Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

1.7 PRODUCT, STORAGE AND HANDLING

- A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions to the Contractor.
- B. The Contractor shall provide adequate locked storage space and shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.

PART 2 - PRODUCTS

2.1 UNIT HOT WATER HEATING AND HOT WATER REHEAT COILS.

- A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

1. GREENHECK
 2. TRANE
 3. Aerofin
 4. Heat Craft
- B. Fins shall be continuous aluminum configured plate fin type, with full fin collars for accurate spacing and maximum fin tube contact with a maximum (10) fins per inch. Minimum fin thickness shall be 0.095".
- C. Tubes shall be copper expanded into fin collars for permanent fin tube bond and expanded into header for leak tight joint at 300 psig air pressure under water. Headers shall be gray cast iron, hydrostatically tested to 400 psi before assembly. All standard coils shall be proof tested at 300 psig and leak tested at 200 psig air under water.
- D. Casings shall be 16 gauge, continuous coated galvanized steel with fins recessed into channels to minimize air bypass, with 3/8" holes on 3" centers in top and bottom channels for mounting.
- E. Coils shall have rows as scheduled on the drawings, 5/8" o.d., 0.035" thick tubes and same-end connections. Each tube-to-header shall be joint reinforced with brass bushing. Bronze, spring type turbulators shall be provided to attain required capacity at the available GPM and entering water temperature.
- F. Coils must be fully drainable.

2.2 IN-DUCT HOT WATER HEATING COILS.

- A. Acceptable manufacturers subject to compliance with the specifications shall be as follows:
1. GREENHECK
 2. Trane
 3. Aerofin
 4. Heat Craft
- B. Water heating coil shall be of the extended surface type, constructed of copper tubing minimum 5/8" o.d., 0.035" thick, and having plate fins of aluminum extending at right angles to the tubes.
- C. Tubes shall be pressure bonded into the fin collars by expanding the tubes. No solder bonding shall be used. All copper-to-copper joints shall be made with high temperature silver brazing material.
- D. Plate fins shall be corrugated. Fins shall be spaced no closer than (12) per inch integral spacing collars that cover the tube surface.
- E. Hot water coils shall be tested for 250 psig, maximum 300°F, and 400 psig air pressure under water.
- F. Access doors shall be installed upstream and downstream of coil for cleaning access.

2.3 COOLING COILS.

- A. Acceptable manufacturers subject to compliance with the specification shall be as follows:
 - 1. TRANE
 - 2. Aerofin
 - 3. Heat Craft
 - 4. TSI
- B. Primary surface shall be round seamless 0.025" thick, 5/8" o.d. copper tubes on 1 1/2" centers, staggered in the direction of airflow. All joints shall be brazed. Tube bends shall be 0.035 thick.
- C. Secondary surface shall consist of aluminum plate type fins for higher capacity and structural strength. Spinal fins will not be acceptable. Fins shall have a minimum thickness of 0.095" with full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer with a maximum (10) fins per inch. Bare copper tube shall not be visible between fins. Fins shall have no openings punched in them so as to accumulate lint and dirt. Tubes shall be mechanically expanded into fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Tubes that have been expanded through the use of hydraulic expansion methods will not be acceptable.
- D. Casing and tube supports shall be constructed of stainless steel with 3/8" diameter bolt holes for mounting on 8" centers. Casing shall be a minimum of 16 gauge stainless steel, reinforced flange of a minimum of 1 1/2" deep flange.
- E. Coil header shall be of copper materials using seamless copper tubing with intruded tube holes to permit expansion and contraction without creating undue stress or strain. Coil size shall be determined by coil manufacturer based upon the most efficient coil circuiting. Vent connections at the highest point to ensure proper venting and drain connections shall be provided at the lowest point to ensure complete drainage and prevent freeze-up.
- F. Coils shall have foam sealing strip located between casing channels and fins along top and bottom to arrest air bypass and water carryover.
- G. The complete coil core shall be pressure tested with 315 lbs. air pressure under warm water and shall be suitable for operation at 250 psig working pressure. Individual tube test and core tests before installation of headers will not be considered acceptable. Cooling coils shall be circuited for drainability and for service without removing individual plugs from each tube. Use of internal restrictive devices to obtain turbulent flow will not be acceptable since they prevent complete draining of the coil.
- H. The manufacturer shall furnish coil capacities as outlined in the tabulation. Capacities shall be verified with an ARI approved computer selection method.
- I. The unit manufacturer shall provide separate drains from pan under each coil section. Drains from multiple, stacked coil pans shall be routed individually to drain outlet, not cascaded from one coil pan to the next lower pan.

- J. Cooling coils shall be mounted to allow removal of any coil individually without disturbing any other coils.
- K. Drain pans and support members shall be stainless steel. Coil drain pans shall allow for condensate removal upstream or downstream of all coils including recirculation units.
- L. Each individual coil module shall have a limited height of up to 36".
- M. Coils shall be fully drainable.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coils shall be installed in accordance with manufacturer recommendations, Contract Drawings, and specifications.
- B. Coils shall be installed such that coils can be completely drainable.
- C. Coils shall be installed so as to ensure easy accessibility for service or removal and replacement of control valves, shut-off valves, strainers and coils.
- D. Each coil shall have a vent at the high point.
- E. Provide union at each coil connection.

3.2 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units.

END OF SECTION

SECTION 23 82 40

DX MINI-SPLITS SYSTEM

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all terminal heat transfer units of the type, size and capacity as scheduled.
- B. Units shall be UL and AGA listed in accordance with the specific unit's heat transfer design and construction.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION
 - c. Division 26 - ELECTRICAL AND FIRE ALARM

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
 - 1. UL 1025-89 – Electric Air Heaters.
 - 2. ASHRAE 90.1 – Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
 - 3. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.

4. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.

1.5 SYSTEM DESCRIPTION

- A. Furnish and install all radiation, unit heaters, radiant panels, controls, piping, wiring, enclosures, access doors, etc. to make a complete and operational system.
- B. All enclosures shall be installed with aligning strips, plaster frames and end trims so as to provide a neat architectural finish.
- C. All equipment shall be new and shall be of the type, style, size and capacities as scheduled. All radiation enclosures shall be continuous and of the same finish and style as adjacent enclosures.

1.6 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide typical catalog of information including arrangements.
- C. Shop Drawings:
 - 1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers and comparison of specified heat required to actual heat output provided.
 - a. Indicate cross sections of cabinets, grilles, bracing and reinforcing, mounting details and insulation if required and typical elevations.
 - b. Indicate flows, pressure drops (including interconnecting piping for radiant panels), heat outputs and mean temperatures.
 - c. Indicate mechanical and electrical service locations and requirements.
- D. Manufacturer's Instructions: Indicate installation instructions and recommendations.
- E. Project specific installation instructions and details.
- F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets and ceiling panels required for access or valving.
- G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listings.
- H. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.

- B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

1.8 PRODUCT, STORAGE AND HANDLING

- A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions to the Contractor.
- B. The Contractor shall provide adequate locked storage space with shelving for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.
- C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received and shall send copies of these receipts to the Architect.

1.9 WARRANTY

- A. See General Conditions for additional warranty requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Mitsubishi-Multi City (Basis of Design – Reference equipment schedule)
- B. Daiken
- C. Sanyo
- D. Fitjisu
- E. Toshiba

2.2 SYSTEM DESCRIPTION

- A. The heat pump air conditioning system shall be similar to a Mitsubishi Electric (Variable Refrigerant Flow Zoning) System.

2.3 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

2.4 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendation.

2.5 WARRANTY

- A. The units shall be covered by the manufacturer's limited warranty for a period of three (3) year from date of installation.

2.6 SPLIT-SYSTEM

- A. The Air Conditioner system shall be a Mitsubishi Electric split system with Variable Speed Inverter Compressor technology. The system shall consist of a ceiling cassette indoor section that shall include a four (4) way grill with integral return and be equipped with a wired, wall mounted, remote controller and a matched capacity, horizontal discharge, single phase outdoor unit.
- B. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 6 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.
- C. Manufacturer shall have over 25 years of continuous experience in the U.S. market.
- D. Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit.
- E. Indoor Unit
 - 1. Cabinet
 - a. The indoor unit cabinet shall be a space-saving ceiling-recessed cassette type, the cabinet shall be formed from galvanized sheet metal coated with high-density foam insulation.
 - b. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, condensate lift mechanism, control circuit board, fan, and fan motor. Single branch ducting shall be allowed from cabinet. The cabinet panel shall have provisions for a field installed filtered outside air intake.
 - c. A separate grill assembly shall be attached to the front of the cabinet to provide supply air vanes in four directions and a center mounted return air section. The four-way grill shall be fixed to bottom of cabinet allowing two, three or four-way blow. The grill vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space. Grill assembly color shall be Munsell 6.4Y 8.9/0.4
 - d. The unit, in conjunction with the wired, wall-mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and integral refrigerant pipes shall be purged with dry nitrogen and capped before shipment from the factory.
 - 2. Fan
 - a. The indoor fan shall be an assembly with a turbo fan propeller, direct driven by a single motor and shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.

- c. The indoor unit shall be provided with A-Control – a system allowing the indoor unit to be powered and controlled directly from the outdoor unit using a 14 gauge (AWG) 3-wire connection plus ground providing both primary power and integrated , by-directional, digital control signal without additional connections.
- d. The indoor units shall not have any supplemental or “back-up” electrical heating elements.

F. Control

1. The control system shall consist of two (2) microprocessors, one in each indoor and outdoor unit, interconnected by A-Control. This three (3) conductor 14 ga. AWG wire with ground method shall provide power feed and bi-directional digital control transmission between the outdoor and indoor units.
2. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller display panel.
3. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and for controlling the operation of the outdoor unit.
4. Replace the wired controller with a wireless receiver PAR-SA9FA-E and provide wireless controller PAR-FA32MA-E
5. A two wire (one pair) twisted, stranded, 18 gauge (AWG), jacketed, control cable shall be used to connect the controller to the indoor unit.

G. Outdoor Unit

1. The outdoor unit shall be compatible with the three different types of indoor units (PKA - wall mounted, PCA - ceiling suspending, and PLA - four way ceiling cassette). The connected indoor unit must be of the same capacity as the outdoor unit.

Option: Twinning is allowed as described in 6.02 below.
2. Models PUY-A24NHA and PUY-A36NHA shall have the option to connect to two indoor units, within the same confined space, to improve air distribution (total capacity shall be equivalent to outdoor unit). This is described as Twinning – a single wired wall mounted remote controller must control both indoor units simultaneously.
3. The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.
4. The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle shall be required). The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.

5. System shall have a maximum refrigerant tubing length of 100 feet (30 meters) for the 12,000 and 18,000 and 165 feet (50 meters) for the 24,000, 30,000, 36,000, and 42,000 BTU/h units between indoor and outdoor units without the need for line size changes, traps or additional oil.
 6. Models PUY-A12NHA PUY-A18NHA PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be pre-charged for a maximum of 70 feet (20 meters) of refrigerant tubing. – the PUY-A42NHA shall be pre-charged for a maximum of 100 feet (30 meters) of refrigerant tubing
 7. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit must be test run at the factory.
- H. Cabinet
1. The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grill shall be of ABS plastic.
- I. Fan
1. Models PUY-A12NHA PUY-A18NHA, PUY-A24NHA, PUY-A30NHA, and PUY-A36NHA shall be furnished with an AC fan motor. Model PUY-A42NHA shall have two (2) DC fan motors
 2. The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.
- J. Coil
1. The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.
- K. Compressor
1. The compressor for models PUY-A12NHA PUY-A18NHA, PUY-A24NHA, PUY-A30NHA and PUY-A36NHA shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology.
 2. The compressor for model PUY-A42NHA shall be a frame compliant scroll compressor with Variable Speed Inverter Technology

3. All compressors shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the zone space load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain sufficient heat.
4. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

L. Electrical

1. The electrical power of the unit shall be 208volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
2. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

END OF SECTION

SECTION 25 10 00

DIRECT DIGITAL / AUTOMATIC TEMPERATURE CONTROLS

(Part of 23 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install a complete system of automatic temperature controls to make a fully operational and controllable building HVAC system.
- B. The system shall be all electric DDC (direct digital control).
- C. All system components shall be installed in accordance with local and State codes.
- D. Secure all permits and local/State approval for all components and installation as specified under this Section.
- E. Provide complete commissioning for all control system components and sequences of operation.
- F. Preparation and submission of shop drawings.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - 1. Division 25 - INTEGRATED AUTOMATION
 - 2. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - 3. Division 26 - ELECTRICAL AND FIRE ALARM
- C. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.
- D. Division 23 00 00 HEATING, VENTILATION & AIR CONDITIONING

E. Division 25 00 00 INTEGRATED AUTOMATION

F. Division 26 00 00 ELECTRICAL

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. NFPA 70 – National Electric Code.
2. UL-916 – Energy Management Systems.
3. UL-873 – Temperature Indication and Regulating Equipment.
4. FCC; Part 15, Subpart J – Class A computing Equipment.
5. UL-864 – Fire and Smoke Control.

1.5 SYSTEM DESCRIPTION

A. Furnish and install, as hereinafter specified, a combination direct digital/ electric/electronic temperature control system and Building Automation System (BAS). The system shall be comprised of a network of various independent Stand-alone Digital Controllers, electric/electronic control equipment, thermostats, sensors, controllers, valves, dampers, actuators, panels and related hardware, software and other accessory equipment, along with a complete system of electrical control wiring, and software generation to fill the intent of the specifications and provide for a complete and operable system.

B. The control systems shall be installed by competent control mechanics and electricians regularly employed by the manufacturer of the control equipment. All control equipment shall be the product of one (1) manufacturer and all components shall be capable of interfacing with the HVAC equipment. The factory trained Contractor must maintain adequate staff and offer standard services to fully support the owner in the timely maintenance, repair, and operation of the control system. Contractors who do not maintain such staff and offer services or must develop some for this project are not acceptable.

C. Bids from franchised dealers or others whose principal business is not the manufacture, installation and service of temperature control systems will not be acceptable.

D. The Contractor shall submit a copy of the manufacturer's standard software and firmware licensing agreement for the owner's signature. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets constrained within such software.

E. All products of the Building Automation System shall be provided with the following agency approvals. With the submittal documents, verification that the approvals exist for all submitted products shall be provided. Systems or products not currently offering the following approvals are not acceptable.

1. UL-916; Energy Management Systems

2. UL-873; Temperature Indication and Regulating Equipment UL-864; Subcategories UUKL, QVAX, UDTZ; Fire and Smoke Control Systems
 3. FCC; Part 15, Subpart J, Class A Computing Devices
- F. All products shall be labeled with the appropriate approval markings. System installation shall comply with NFPA, NEMA, Local and National Codes.

1.6 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings.
 1. Indicate trunk cable schematic showing programmable control unit locations and trunk data conductors.
 2. List connected data points, including connected control unit and input device.
 3. Indicate all system graphics for all controlled systems including all air handling systems, hydronic pumping systems, monitored systems, data (connected and calculated) point addresses and operator notations.
 4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems and interconnections.
 5. Indicate description and sequence of operation of operating, user and application software.
 6. Develop and provide emergency, fire, smoke management control and device response matrices in an MS Excel spreadsheet format.
 7. Show system network architecture with high level and lower-level transmission and communications network to include all addressable controllers, communication repeaters, routers, gateways, operator workstations, terminal connection ports, network servers, printers, etc.
 8. All control logic and controllable components shall be depicted and identified within each matrix developed.
 9. All UUKL components shall be depicted and identified.
- D. Manufacturer's Installation Instructions: Indicate manufacturer's installation instructions for all manufactured components.
- E. Submit brochures that contain only that information which is relative to the particular equipment or materials to be furnished. Do not submit catalogs that describe several different items other than those items to be used unless irrelevant information is marked out and relevant material is clearly marked.
- F. Specifications Compliance Statement
 1. The manufacturer shall submit a point-by-point statement of compliance with the specifications.
 2. The statement of compliance shall consist of a list of all paragraphs (line by line).
 3. Where the proposed system complies fully, such shall be indicated by placing the word "comply: opposite the paragraph number.
 4. Where the proposed system does not comply, or accomplishes the stated function in a manner different from that described, a full description of the

deviation shall be provided.

5. Where a full description of a deviation is not provided, it shall be assumed that the proposed system does not comply with the paragraph in question.
 6. Submissions which do not include a point by point statement of compliance as specified shall be disqualified.
- G. Project Record Documents: Record actual locations of control components, including control units, thermostats and sensors, trunk cable routing, junction boxes, transformers, addresses.
1. Revise shop drawings to reflect actual installation and operating sequences.
 2. Include submittal data in final "Record Documents" form.
 3. All start-up/checkout documentation shall be initial and signed by the on-site control technician with intimate knowledge of the project.
 4. Provide start-up/checkout documentations for all DDC controllers connected to the BMS network. Documentation shall include all controller points used and unused (spare). Furthermore, all final settings, calibration, coefficient values, K factors, spanning, actual spring ranges, etc., shall be indicated for all active points in use.
 5. Revise all control sequences of operation. Complete details will be given within the sequences of operation provided by the Contractor. Details shall include, but not be limited to, the following items: Control strategy, timers, delays, logic sequencing, start/stop, end devices involved, sensors involved, set points, globally commanded values, shared data between panels and controllers.
 6. Provide a separate drawing with detailed operation sequence for each UL category UUKL smoke control system. This means if there are four pressurized stairs each has its own drawing and sequence specific to that system. No system shall be a duplicate.
- H. Operations and Maintenance Data:
1. Include interconnection wiring diagrams for completed field installed systems with identified and numbered system components and devices.
 2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
 3. Include inspection period, cleaning methods, cleaning materials recommended and calibration tolerances.

1.7 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70 and Divisions 26 specifications.
- B. Design system software under direct supervision of a Professional Engineer experienced in design of this Work and licensed within the State in which the project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.
- D. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum ten (10) years of documented experience and approved by manufacturer.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters

Laboratories Inc. and testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 WARRANTY

- A. See Section 23 05 00 and General Conditions for additional requirements.
- B. The system specified herein and shown on the drawings shall be guaranteed to be free from original defects in both material and workmanship for a period of twelve (12) months of normal use and service, excepting damages from other causes. This guarantee shall become effective starting the date the Contract work is accepted as complete by the Owner and in accordance with the General Provisions/Conditions.
- C. Provide five (5) year manufacturer's warranty for field programmable micro-processor-based units.
- D. Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.9 MAINTENANCE SERVICE

- A. Provide service and maintenance of energy management and control systems for one (1) year from Date of Substantial Completion/Acceptance of System by Owner.

1.10 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software shall 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.

1.11 GENERAL

- A. Acceptable manufactures subject to compliance with the specifications
 - 1. TRANE
 - 2. ALC – Automated Logic Controls
 - 3. Johnson Controls
 - 4. Honeywell
 - 5. Siemens
 - 6. Zenergy Building Technologies
 - 7. Howse Corporation, Inc.
 - 8. Schneider (Andover)
 - 9. Schneider (Invensys)
- B. The entire system and all control components shall be powered with emergency power or UPS Battery backup power.
- C. All electrical work shall comply with Divisions 26 Specifications.

- D. All systems shall be BACnet MS/TP compatible. Provide all required Panels, Supervisors, Routers, Gateways, Controllers, Communication Thermostats, I/O Modules and Sequences of operation.

PART 2 - PRODUCTS

2.1 ELECTRIC LOW VOLTAGE WIRING

- A. Furnish all labor and material to install the necessary wiring to accomplish the successful and complete operation of the new automatic system (DDC).
- B. All electric wiring, wiring connections and all interlocking required for the installation of the temperature control system, as herein specified, shall be provided by the Contractor, unless specifically shown on the Electrical drawings or called for in the Electrical specifications.
- C. Furnish all labor and material to install necessary relays, general purpose enclosures and appurtenances to control designated devices relative to the DDC.
- D. All wiring throughout shall be concealed where possible.
- E. All conduit used shall be EMT, 3/4" minimum size or larger. Conduit sizes shall be large enough to permit the individual conductors to be readily installed or withdrawn without damage to the conductors or their insulation. Splicing of wires will be permitted only in junction boxes or pull boxes. Conduit shall be rigid up to 12'-0" AFF in mechanical rooms.
- F. Conduit shall never to be relied upon for a fault current and safety ground return conductor.
- G. All UL category UUKL portions of the system shall be in conduit.
- H. All UL category UUKL portions of the system shall be powered from emergency power.
- I. The ground system shall not be used as a current carrying conductor except for faults and noise suppression. The grounding system shall be used to control noise and transients which might affect the operation of the automation system. As such, the ground requirements shall be in excess of a grounding system used solely for physical protection minimum (Code requirement).
- J. In all cases, the bond to ground shall be as short as possible. A ground point shall be derated by one (1) point (in order of preference) for each 50'-0" of conductor run between it and the automation equipment to be grounded. Therefore, a water pipe bond located 10'-0" away will be preferable to a structural steel bond located 150'-0" away.
- K. Set screw connectors shall be galvanized or plated steel. White metal cast type will not be permitted.
- L. Flexible conduit shall be used at field devices, i.e., pressure switches, flow switches, temperature devices, etc. Convolutions shall be steel, interlocked continuously. Aluminum will not be permitted. "Liquidtight" shall be used in wet locations. Flexible connector shall be a minimum of 18" long.
- M. Only core drilling is permitted to pierce the floors in the electrical closets and elsewhere. The use of water for drilling shall be controlled by a suitable vacuum system, using

proper dams to prevent damage to floors below. The ATC Contractor shall be responsible for providing a suitable sleeve in all core drilled holes as specified herein.

N. All wiring shall be run in EMT as noted below:

- | | | |
|----|------------------------------------|-----------------------|
| 1. | Sensor to Panel (Block Wall): | In Wall Conduit (EMT) |
| 2. | Sensor to Panel (Stud Wall): | In New Conduit (EMT) |
| 3. | Sensor to Panel (Mechanical Room): | In New Conduit (EMT) |
| 4. | Panel to Front End Workstation: | In New Conduit (EMT) |
| 5. | Front End: | In New Conduit (EMT) |

O. Wiring

1. Type THHN solid #18 AWG for control wiring in dry location up to 194°F.
2. Type THWN in wet location up to 167°F (solid #18 AWG).
3. Twisted shielded pair (18 gauge), with PVC cover, Belden #8760 or approved equal.
4. Conduit is not considered as a shield.
5. All wiring associated with the control signals to the smoke damper control/sequence must be in approved conduit.
6. All signal wiring to all field devices shall be run with no splices, separately from any wiring having voltage greater than 30 volts.

P. The Contractor shall install all shielded cable and ground systems in accordance with Division 23. The installation of ground loops shall not affect any sensing or control circuits.

Q. All devices and equipment shall be mounted in minimum NEMA 1 enclosures.

R. In addition to the requirements specified above, all communication wiring cables shall include a minimum of (1) individually 100% shielded pair ([2] conductors) as unused spare conductors. Where the number of conductors and specific cable specified above for each type of communication wiring will not meet this requirement for spare conductors, Contractor shall provide approved equivalent product of Belden or other manufacturer with the necessary number of conductors and which meets the requirements specified above.

S. Low Voltage Control Wiring (30 VAC or Less)

1. Low voltage control wiring shall be minimum 16 gauge, or heavier if required, twisted pair, 100% shielded with PVC cover Belden #9316 or approved equivalent product of other manufacturers run in conduit with no splices, separate from any wiring above 30 volts.

T. Coordination of Interfacing/Interlocking

1. The Contractor shall be responsible for coordinating all required interface/interlocking software, software logic, sequencing and wiring necessary to provide a fully automated and fully functional operable system to meet or exceed the intent of the Design Engineer's Sequence of Operation. Coordination may include but not limited to the following at no additional cost to the Owner. Variable frequency drive (VFD) interlocking and wiring logic including software, relays factory/field installed wiring and/or VFD drive modifications. This would include coordination of miscellaneous points as specified under the point list in

this specification. Systems to include all points, analog, digital, pneumatic sensors wiring, software, wiring, communications gateways, etc., to connect and communicate to any Fire, Plumbing, HVAC, Lighting, ATC, Security, World Wide Web (Internet) systems installed under this project.

2.2 BUILDING AUTOMATION SYSTEM ARCHITECTURE

A. General

1. The Building Automation System shall consist of a number of Nodes and associated equipment connected by industry standard network practices. All communication between Nodes shall be by digital means only.
2. The Building Automation System network shall at minimum comprise of the following:
 - a. Operator Workstations – fixed and portable
 - b. Network processing, data storage and communication equipment including file servers.
 - c. Routers, bridges, switches, hubs, modems and the like communications equipment.
 - d. Active processing Nodes including field panels.
 - e. Intelligent and addressable elements and end devices.
 - f. Third-party equipment interfaces.
 - g. Other components required for a complete and working Building Automation System.
3. The Building Automation System shall be accessible via Enterprise Intranet and Internet browser with security protection for user access.
4. The Building Automation System shall support auto-dial/auto-answer communications to allow Building Automation System Nodes to communicate with other remote BMS Nodes.
5. The PC Workstations, File servers and principal network equipment shall be standard products of recognized major manufacturers available through normal PC vendor channels. "Clones" are not acceptable.
6. Provide licenses for all software residing in the Building Automation System and transfer these licenses to the Owner prior to completion.

B. Network

1. The Building Automation System shall incorporate a primary Tier 1 network. At the Contractor's option, the Building Automation System may also incorporate integrated secondary Tier 2 and tertiary Tier 3 networks.
2. The Building Automation System Network shall utilize an open architecture capable of:
 - a. Utilizing standard Ethernet communications and operate at a minimum speed of 10Mb/sec
 - b. Connecting via BACnet MS/TP
3. The Building Automation System network shall support both copper and optical fiber communication media.

C. Third-Party Interfaces

1. Building Automation System Contractor shall integrate real-time data from

systems supplied by other trades as required.

2. The Building Automation System shall include necessary Building Automation System hardware equipment and software to allow data communications between the Building Automation System and systems supplied by other trades.
3. The trade contractor supplying other systems will provide their necessary hardware and software and will cooperate fully with the Building Automation System Contractor in a timely manner at their cost to ensure the complete data integration.
4. The Building Automation System Contractor shall provide all necessary coordination with vendors, contractors, owners, engineers, and other representatives at no additional cost to the Owner. Provide a completed fully functional, operational, integrated and seamless communicating infrastructure system.

D. Power Fail / Auto Restart

1. Provide for the automatic, orderly and predefined shutdown of parts or all of the Building Automation System following total loss of power to parts or all of the Building Automation System.
2. Provide for the automatic, orderly and predefined startup of parts or all of the Building Automation System following total loss of power to those parts or all of the Building Automation System. Archive and annunciate time and details of restoration.
3. Provide for the orderly and predefined scheduling of controlled return to normal, automatically time scheduled, operation of controlled equipment as a result of the auto restart processes.
4. Maintain the Building Automation System real-time clock operation during periods of power outage for a minimum of 72 hours.
5. As part of this required feature of Power Fail/Auto Restart, the ATC Contractor shall furnish uninterruptible power supplies (UPS) for the entire Building Automation System networked infrastructure, including all third party interfaces, and determine feasibility, time, delays, shutdown, network traffic anticipated, etc.

E. Downloading and Uploading

1. Provide the capability to generate Building Automation System software-based sequences, database items and associated operational definition information and user-required revisions to same on designated Operator Workstations and the means to download same to the associated Application Nodes.
2. Provide the capability to upload Building Automation System operating software information, database items, sequences and alarms to the designated Operator Workstations with automatic archiving of same on the Operator Workstations. The functions of this Part shall be governed by the codes, approvals and regulations applying to each individual Building Automation System application.
3. The entire control system shall be approved and listed by UL 916 - Energy Management.
4. All DDC panels shall be powered through uninterruptible power sources (UPS) with sufficient capacity to ride through a (2) minute power interruption between transfers from normal to emergency power. UPS's and wiring shall be provided by the ATC Contractor.
5. Uploading or downloading functions performed at any location shall not affect

controllers, communications, inputs, outputs at any location or address within the Building Automation Control Architecture nor shall any controller level functions be disrupted in any manner.

F. Application Nodes (AN)

1. General

- a. The Application Nodes shall include all monitoring, control and information Nodes including field panels.
- b. Application Nodes shall be programmable and governed by the requirements of their applicable codes, approvals and regulations.
- c. The Application Nodes shall be designed, packaged, installed, programmed and commissioned in consideration of their specific service and prevailing operating conditions. They shall be proven standard product of their original manufacturer and not a custom product for this Project.
- d. A failure at an Application Node shall not cause failures or non-normal operation at any other system Application Node other than the possible loss of active real-time information from the failed Application Node.
- e. Ancillary Application Node equipment, including interfaces and power supplies, shall not be operated at more than 80% of their rated service capacity.

2. HVAC Node

- a. HVAC Node shall provide both standalone and networked direct digital control of HVAC systems.
- b. A dedicated HVAC Node shall be configured and provided for each primary HVAC system (air handler, chiller, boiler) and each terminal HVAC system (VAV Box, Unit Heater, Fan Coil Unit, Cabinet Heater, Heat Pump, Fan Powered Box, CV Box)
- c. Each HVAC Node shall be able to retain program, control algorithms, setpoints, logic and command information through the use of non-volatile memory (flash, EEPROM). Other information such as trend data, historical data schedules will be maintained for at least 72 hours in the failure and shall return to normal operation upon restoration of power.
- d. Each HVAC Node shall report its communication status to the Building Automation System. The Building Automation System shall provide a system advisory upon communication failure and restoration.
- e. For each primary HVAC system, provide means of indication of system performance and setpoints at, or adjacent to the HVAC Node.
- f. For each primary HVAC system, provide a means to adjust setpoints and start/stop equipment at, or adjacent to the HVAC Node.
- g. Provide a means to prevent unauthorized personnel from accessing setpoint adjustments and equipment control functions.
- h. The HVAC Node shall provide the ability to download and upload configuration data, both locally at the Node and via the FMS communications network.
- i. The HVAC Node shall be provided with a permanently-mounted local graphic terminal where required in the sequences of this specification. The local graphic terminal shall provide a dynamic graphical representation of the associated system status with the ability for the operator to enter commands and review data through the use of project specific drill down type menu structure with proper password protection.

- j. Each HVAC mode shall be a dedicated controller without the need to use expansion modules to accomplish the entire primary control sequences. Sharing controller, sensor, input/output data over any high level or low level network to accomplish the specified control sequences is unacceptable. Global sharing of general data such as OA-T, OA-RH OA-CO² levels between controllers over the BMS network is acceptable as long as speed of transmitting the data does not impact the HVAC mode controller ability to perform in any mode of operation.
- k. If it is determined that the HVAC mode controller cannot perform specified sequence of operation because of dependency for shared information that Contractor shall provide a higher level controller at no additional cost. This change shall be identified by separate submittal to Design Engineers.

2.3 PORTABLE OPERATOR'S TERMINAL

- A. Acceptable Manufacturers subject to compliance with the specification:
 - 1. Dell
 - 2. Apple (iPad)
 - 3. Samsung
 - 4. Lenovo
- B. Provide one (1) portable operator terminal with a minimum LCD display of 80 characters by 25 lines and a full featured keyboard. The portable operator's terminal shall be hand-held and plug directly into individual distribution control panels as described below. Provide a user friendly, English language prompted interface for quick access to system information, not codes requiring look-up charts.
- C. General
 - 1. Furnish portable operator's terminal for system. Portable operator's terminal shall allow for local accessing of program information.
 - 2. Laptop terminal portable operator's terminal shall have the following features:
 - a. Intel Pentium 4, 2.2 GHz microprocessor
 - b. Full active matrix color display with minimum 1024 x 680 resolution.
 - c. AC adapter
 - d. Battery pack / battery charger
 - e. 64 GB storage capacity
 - f. Windows 8
 - g. System memory (RAM) – 2GB
 - h. Wireless Wi-Fi
 - i. PCMCIA card modem
 - j. Audio built in
 - k. Latest version of Microsoft DOS
 - l. PCMC1A Ethernet Adapter Card with UTP/BNC connector
 - m. Equipped with both 1 Type III or 2 Type II PCMCIA Slots
 - 1) Type III 4

2) Type II PCMC1A Slots

n. Integrated pointing device

- D. Functionality of the portable operator's terminal connected at any high or lower level controller:
1. Access all controllers on the network.
 2. Backup and/or restore controller data bases for all system panels, not just the DDC controller.
 3. Display all point, selected point and alarm point summaries.
 4. Display trending, historical and totalization information.
 5. Add, modify, and/or delete any existing or new system point.
 6. Command, change setpoint, enable/disable any system point vertical or physical.
 7. Program and load custom control sequences as well as standard energy management programs.
- E. Connection of a POT on controller to a distributed control processor shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.
- F. Portable operator terminal access to controller shall be password-controlled and menu-driven.

2.4 OPERATOR WORKSTATION

A. Basic Interface Description

1. Command Entry/Menu Selection Process: Operator Workstation interface software shall minimize operator training through the use of English language prompting, English language point identification, and industry standard PC application software. The operator interface shall minimize the use of a typewriter style keyboard through the use of a mouse or similar pointing device, and "point and click" approach to menu selection. Users shall be able to start and stop equipment or change setpoints from graphical displays through the use of a mouse or similar pointing device.
2. Graphical and Text-Based Displays: At the option of the user, Operator Workstations shall provide consistent graphical or text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all workstations.

B. Computer System Access Operation Control Stations (OCS) Description: This system access workstation is also referred to as the Building Automation System "Front end".

C. Provided Workstation with:

1. Workstation shall be general purpose, commercially available, personal computer with sufficient memory and processor capacity to perform all functions described in this specification.
2. Sufficient hard drive memory storage shall be provided to accommodate all fully configured point data bases, all application databases, all graphics data bases, all user-defined reports, and all historical data archival as described in this

specification.

3. The display provided for system operation shall have a diagonal screen measurement of no less than 15" (i.e. nominal 17" unit) and a minimum display resolution of no less than 640 x 320 pixels. Separate controls shall be provided for color, contrast, and brightness. The screen shall be non-reflective.
4. Each shall include the following:
 - a. 3.0 GHz Pentium D processor with 1 GB of (SDRAM) random access memory.
 - b. 17" color monitor 1280x1024(SGVA).
 - c. SVGA video output (4 MB RAM).
 - d. 160 GB fixed disk.
 - e. HI-RES bus mouse.
 - f. (1) Printer for alarms, minimum 240 characters/seconds.
 - g. (1) Printer for reports, minimum Laser printer similar to HP 4000.
 - h. 48X Read/Write CD Rom
 - i. Campus network interface card
 - j. Zip drive
 - k. Server type platform shall have high performance RAID multiple fixed disk for hot redundancy. Provide minimum three fixed disks.
5. The operator functions provided by the system access Operator Terminal shall include, but not be limited to, the following:
 - a. Start and Stop Points
 - b. Modify Setpoints
 - c. Modify PID Loop Setpoints
 - d. Override PID Control
 - e. Change Time/Date
 - f. Add/Modify Start/Stop Weekly Scheduling
 - g. Add/Modify Setpoint Weekly Scheduling
 - h. Enter Temporary Override Schedules
 - i. Define Holiday Schedules
 - j. View Analog Limits
 - k. Enter/Modify Analog Warning Limits
 - l. Enter/Modify Analog Alarm Limits
 - m. Enter/Modify Analog Differentials
 - n. View Point History Files
6. UPS system with one hour backup.
7. The workstation shall provide access to all real or calculated points in the controller to which it is connected, or any other controller in the network. This capability shall not be restricted to a subset of predefined "global points", but shall provide totally open exchange of data between the operator terminal and any DDC panel in the network.
8. Provide English language prompting to eliminate the need for the user to remember command formats or point names. Prompting shall be provided consistent with a user's password clearance and the types of points being displayed, to eliminate the possibility of operator error. Operator shall not require the use of special templates for navigation.
9. On-line, interactive user's "Help" manuals and tutorials shall be provided. Based upon operator request, the "help" function shall provide general system

operating instructions, and specific descriptions of commands available in the currently displayed menus.

10. Identification for all real or calculated points shall be consistent for all network devices.
 11. In addition to instantaneous summaries, the Operator's Terminal shall allow a user to view a Point History file for system points. Point History files shall provide a record of value of analog points over the last 24 hours, at 30-minute intervals, or a record of the last (10) status changes for binary type points.
- D. Dynamic Color Graphic Displays: Color graphics shall be provided as specified in the Execution portion of this specification to optimize system performance analysis and speed alarm recognition.
1. System Selection/Penetration: The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration drill down scheme, menu selection, and text-based commands.
 2. Dynamic Data Displays: Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.
 3. Windowing: The windowing environment of the workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 4. Graphics Definition Package: Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
 - a. The Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
 - b. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
 - 1) Define symbols
 - 2) Position and size symbols
 - 3) Define background screens
 - 4) Define connecting lines and curves
 - 5) Locate, orient and size descriptive text
 - 6) Define and display colors for all elements
 - 7) Establish correlation between symbols or text and associated system points or other displays.
 - c. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build graphic displays that include point data from multiple DDC panels, including application specific controllers used for DDC unitary or VAV terminal unit control.

5. Graphics

- a. Provide graphic screens for each system within this project.
- b. Provide the following as a minimum:
 - 1) Each ROOFTOP air handling unit.
 - 2) Hot water system reheat coil TCV valves.
 - 3) Each exhaust fan.
 - 4) Existing boiler hot water system.
 - 5) Each ACD damper system
 - 6) Each programmable thermostat system.
 - 7) Each Bipolar Ionization Generator system
 - 8) Each piece of equipment.
 - 9) Each controlled system.
- c. Provide graphic representation of building's form and site plans locating all equipment and panels.
- d. Each hardware point shall be represented on graphic screen.
- e. Selected software points shall be represented on respective process system graph as determined by the Owner. Examples of these software points are:
 - 1) Control loop setpoint value.
 - 2) Control loop auto/manual selection.
 - 3) Lead/lag selection for pumps and other motors.
 - 4) Calculated points such as run time.
 - 5) Other vertical software points as required.
- f. The Contractor shall coordinate all required graphical modes, features, binding, logic, etc., for a complete fully functional graphical operating system. All graphical schemes shall be submitted and approved by Architect/Engineer and Owner prior to programming.

E. Database Configuration

- 1. Provide database configuration for each hardware and software point.
- 2. Specific point parameters, such as alarm limits, alarm message, point name and point description shall be as approved by the Owner.

F. Trends

- 1. Provide real time and historical trends for hardware and software points as directed by the Owner.
- 2. Archiving or transfer of trend and historical data information shall not interfere, reduce communication throughout stow network speed or reduce local controller operation by any measure, due to trend or historical data capture rates and storage routines.

G. Internet / Intranet Browser

- 1. A multi-user color graphics and textual interface shall be provided that allows customers to access their Building Automation System data via the Internet or Intranet. This interface shall use HTML-based pages to send and receive data

from a Building Automation System to a web browser.

2. Browser shall:

- a. Automatically reflect any changes made to the Building Automation System without additional programming.
- b. When installed behind a corporate firewall, shall work in conjunction with other security measures that have been implemented.
- c. Allow the user to navigate and command the Building Automation System using the same format as the Operator Workstation.
- d. Be an industry-standard browser
- e. Provide user password access control.
- f. Provide the means by which the user can create, edit and view groups of FMS data points.
- g. Provide navigation tools for moving between the views. In addition, it shall provide tools for gaining access to help and for logging out of the system.

H. Emails/Cell Phones

1. Provide the means of automatic alphanumeric paging, sending of emails and automated cell phone calls, of personnel for user-defined Building Automation System events.
 - a. System shall support both numeric and alpha-numeric pagers, using Alphanumeric, PET, or IXO Protocol at the owner's option.
 - b. Users shall have the ability to modify the phone number or message to be displayed on the pager through the system software.
 - c. System shall utilize pager schedules to send pages to the personnel that are "on-call".
 - d. Contractor shall be responsible for providing a modem for connection to the paging service.
 - e. The ATC bid must include the man-hours required to program and customize this scheduling event.

I. Reports

1. Provide real time reports for hardware and software points as directed by the Owner.
2. The ATC Contractor shall program and test all alarming and alarm report routing to final devices such as printer, computers, pagers, monitors, cell phones, www, etc. Alarming requirements and routing shall be coordinated with the Owner by first compiling and all points listing for Owner's review prior to any programming.

J. Network Speed and Transmission

1. Network speed (communication rate) 10 megabits per second (MBPS) for all level one controllers.
2. Network configurations shall be Star, Bus or mixed (Star and Bus).

PART 3 - EXECUTION

3.1 PROJECT MANAGEMENT

- A. The ATC Contractor shall designate a project manager who will be responsible for the following:
1. Construct and maintain project schedule.
 2. On-site coordination with all applicable trades and subcontractors.
 3. Authorized to accept and execute orders or instructions from Owner/Architect.
 4. Attend project meetings as necessary to avoid conflicts and delays.
 5. Make necessary field decisions relating to this scope of work.
 6. Coordination/Single point of contact.

3.2 NUMBERING/NAMING CONVENTIONS

- A. The Contractor shall collaborate with the Owner directly to determine the Owner's preference for naming conventions, etc. before entering the data in the system.
- B. As a minimum the ATC Contractor shall submit to the Architect/Engineer and Owner the layout of the network, identifying all DDC controllers. Each controller will be identified by address and system being served. All physical and software generated objects, points and attributes shall be listed along with a description.

3.3 START-UP AND DE-BUGGING

- A. When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. All testing, calibrating, adjusting and final field tests shall be completed by the installer. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power.
- B. Provide any recommendation for system modification in writing to Owner. Do not make any system modification, including operating parameters and control settings, without prior approval of Owner.
- C. The ATC Contractor will provide industry standard checkout and startup checklists for each DDC controller installed for the project. If not standard is available, the ATC Contractor shall develop a spreadsheet in MS Excel format and submit to the Engineer for approval prior to system checkout.

3.4 INSTRUCTION AND ADJUSTMENT

- A. The Contractor shall provide factory-trained instructor to give full instructions to the owner designated personnel in the operation of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. The Contractor shall provide all students with a student binder containing product specific training modules for the system installed. All training shall be held during normal working hours of 8:00 AM to 5:00 PM weekdays.

- B. Upon completion of the project, the Contractor shall:
1. Fine-tune and "de-bug" all software control loops, routines, programs and sequences of control associated with the control system supplied.
 2. Completely adjust and make ready for use, all transmitters, relays, damper operators, valves, etc., provided under this Section. This Contractor shall furnish copies of complete, detailed, calibrating checkout and commissionary documentation for reach controller. Documentation shall list each procedure and shall be signed by the control specialist performing the service.
 3. Furnish a complete set of system operation manual, including standard manufacturers' operating manuals, complete as-built installation diagrams, and complete software hardcopy documentation, as well as a magnetic media back-up.
 4. Provide an on-site training program for the Owner's staff in the operation and use of the control system. Training shall include three (2) segments, as follows:
 - a. Segment 1 shall include 16 hours of classroom and hands-on training. This segment shall instruct personnel in the system configuration, component characteristics, control strategy on each controlled system and all requirements for daily operation and use of the system. This segment shall give the Owner's representative a working proficiency in the day-to-day operational requirements (i.e., system monitoring, alarm acknowledgment, HVAC system troubleshooting techniques, setpoint and time schedule adjustments, manual override, etc.).
 - b. Segment 2 shall include 6 hours of on-site training. This segment will be geared for the Owner's designated prime operator. An emphasis on overall software management and manipulation shall be made, to allow the prime operator(s) to make control strategy and overall facility and system management changes as required. Attendees shall have attended Segment 1.
 - c. All training shall take place at the site and at times mutually agreed to between that ATC Contractor and the Owner. The ATC Contractor shall provide to the Owner's designated representative, at least three (3) weeks before each segment, a course syllabus outline and schedule. The ATC Contractor shall provide all training material, reference material and training aids, as required, all as part of his Contract cost.

END OF SECTION

SECTION 25 20 00

SCHEDULES

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install temperature controls.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - 1. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - 2. Division 25 - INTEGRATED AUTOMATION

1.4 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: Provide data for duct materials.
- C. Prepare and submit scaled coordination drawings.
- D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

- A. See Section 23 05 00.

PART 2 – PRODUCTS

2.1 POINT SCHEDULE

A. Note: For point software association, see sequence of operation. All points shall be able to integrate to all trends, totalizations, etc., as applicable. Additional points not specifically called for herein but required to perform the sequence as herein specified shall be provided at no additional cost to the Owner.

B. RTU Supply Air Handling Unit (EACH)

Description	AI	AO	DI	DO	Remarks	Alarm
Outside, Isolation Air Dampers and Status (via end switch)			2	2	2 Dampers	Y
Filter Differential Pressure/Alarm	1					Y
Cooling Coil Valve and Discharge Air Temp.	1	1				
Freezestat			1		Hardwire	Y
Supply Fan Start/Stop				1		
Supply Fan VSD Control and Status (a)	1	1			% Amps	
Supply Air Static Pressure (2/3 Down Duct)	1	1			Reset	
Supply Air Static High Limit			1		Hardwire	Y
Supply Air Temperature Discharge	1					Y
Smoke Detector			1			Y
Supply Air Flow (CFM)	1					Y
Temp Downstream of Heat Coil	1					

C. Exhaust Fans (EACH)

Description	AI	AO	DI	DO	Remarks	Alarm
Exhaust Fan Start/Stop and Status			1	1	%amps	Y
Exhaust Fan Air Damper Control Status (via end switch)				1	1	Y
First Speed	1			1		
Second Speed	1					Y
Space Temperature and/or Control Signal	1					Y

D. Hot Water Heating Coils (EACH)

Description	AI	AO	DI	DO	Remarks	Alarm
HW Control Valve		1				
Space Temperature	1					Y

E. Miscellaneous HVAC Points

Description	AI	AO	DI	DO	Remarks	Alarm
Outside Air Temperature (a)	4					
Outside Air Relative Humidity/Dewpoint (a)	4					

(a) Via direct link to VSD

F. Bipolar Ionization Generators Electrical Points (EACH)

Description	AI	AO	DI	DO	Remarks	Alarm
Bipolar Ionization Generators	1		1			Y

G. Supply Air Handling Unit (EACH)

Description	AI	AO	DI	DO	Remarks
Outside Air Dampers (w/End Switches)		1	1	1	1 Dampers
Filter Alarm/Differential Pressure			1		Alarm
Outside Air Temperature (in Plenum)	1				
Cooling Coil (Valve and Air Temp.)	1	1			
Freezestat			1		Hardwire
Supply Fan Start/Stop				2	Alarm
Supply Fan Status	1	1			
Supply Air Temperature Discharge	1				
Dampers	1	2			
Space Temp	2				
Start/Stop					Alarm

PART 3 – EXECUTION

- A. Provide any additional control points, DDC & Application controllers, wiring, panels, interface cards, expansion modules, I/O modules, Temp/Humid sensors, Damper/actuators, TCV/Actuators, switches, functional devices and appurtenances required for systems to operate correctly.
- B. Fully integrate all new controls with existing building BAS/BMS controls.

END OF SECTION

SECTION 25 50 00

INSTRUMENTATION TERMINAL DEVICES

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install temperature controls.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - 1. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - 2. Division 25 - INTEGRATED AUTOMATION

1.4 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: Provide data for duct materials.
- C. Prepare and submit scaled coordination drawings.
- D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

- A. See Section 23 05 00.

PART 2 – PRODUCTS

2.1 INSTRUMENTATION TERMINAL DEVICES

- A. Fan and Pump Status (Under 3 HP)

1. Water/air flow for each pump/fan shall be indicated by means of a differential pressure switch which opens an electrical contact as the differential pressure falls below a preadjusted pressure range setting. Water differential pressure switch shall be the Penn Model P-74 or similar. High pressure differential switch shall be suitable for the flow and pressure of each system.
- B. Fan and Pump Status (3 HP and Larger)
1. Verification of all air and water for all fans and pumps shall be by an analog current transformer device, which shall be furnished under the Electrical Section of these specifications. The current transformer output shall be a true analog value. Digital output devices will not be considered acceptable.
- C. Motor Start/Stop
1. Start/stop relay module shall provide either momentary or maintained switching action as appropriate for the motor being started.
 2. All relays shall be plugged in, interchangeable, mounted on a circuit board and wired to numbered terminal strips.
- D. Low Limit Alarms
1. Electric low temperature warning sensors shall be provided and shall have 20'-0" low point sensitive elements installed to cover the entire coil area. Provide a minimum of one freezestat per 30 sq.ft. of coil area. Where there are multiple coils, provide one (1) freezestat per coil. Sensors shall be wired to their respective monitoring panel (for freeze alarm) and, separately, to shut down the fan motor. Assure that the bottom 6" of each coil is protected by a freezestat.
- E. Pressure Transmitters
1. Pressure sensors and transmitters shall be selected to operate within pressure ranges of the systems as specified. Sensors and transmitters shall be mounted at the pipe tap as specified and wired to the digital system controller. Sensor shall be accurate to 0.5% across full pressure span. Sensor shall maintain integrity between 20°F and 75°F.
 2. Dirty filter shall be sensed by an electric differential pressure relay with adjustable setpoint for each filter bank. Range shall be as required to meet project requirements. These points shall be mapped back to the network manager for alarm annunciation.
- F. Valve and Damper Operators/Actuators
1. All damper operators shall be of the molded rubber diaphragm piston type and shall be fully proportioning. Operators shall be quiet in operation and shall have ample power to overcome friction of damper linkage and air pressure, to position dampers accurately and smoothly. The damper operator mounting arrangement shall be outside the airstream wherever possible, all exceptions shall be approved by the Owner's representative prior to installation. All automatic control dampers with actuators shall have (2) end switches to prove them open and closed. Initial setpoint shall be for end switch to activate at 80% (adj.) open position and 100% closed position.

2. The operators shall be capable of operating at varying rates of speed to correspond to the dictates of the controllers and variable load requirements. The operators shall be capable of operating in sequence when required by the sequence of the operation. The operators shall have external adjustable stops to limit the stroke in either direction. The operator linkage arrangement shall be such as to permit normally open or normally closed positions of the dampers as required.
3. At air handling units and all control valve actuators shall be provided with valve position feedback which shall be output to the PLC controlling said valve/unit.
4. All damper and valve operators exposed to weather shall have weatherproof enclosures and shall be electrically actuated, with industrial grade actuators. All damper and valve actuators serving all of the roof-mounted equipment shall be electric, industrial grade. All electric actuators shall be spring return with 300% of the required design calculated torque requirements, as manufactured by Belimo. Units shall be suitable for outdoor mounting under several weather and environmental conditions.
5. All multiple damper sections must have jack-shafts. For dampers larger than 20 sq.ft., provide (1) actuator motor for each 15 sq.ft. of damper area or portion thereof (i.e., a 40 sq.ft. damper requires [3] actuators).
6. Reheat/radiation valve actuators at reheat coils/radiation elements shall be electronic and shall mount on the valve body and provide complete modulating control of the valve.
 - a. The valve actuator motor shall be of the non-stall type and shall de-energize when the valve has reached either the operator or system determined position.
 - b. Actual valve position status shall be monitored from the central or remote operator's terminal and shall be displayed in percent open notation. Systems which provide only end switch feedback are not acceptable.
 - c. Changes made during setup or normal operation to the Terminal Equipment Control Unit by the portable operator's terminal or central terminal shall not be affected by loss of communication on the LAN communication bus.
 - d. It shall not be necessary to disconnect the communications bus for communication between the Portable Operator's Terminal and the Terminal Equipment Control Unit.
 - e. All valves shall be capable of manual remote adjustment via the CBAS.

G. Valves

1. All automatic control valves, other than radiation and reheat terminal device valves shall be fully proportioning. The valves shall be quiet in operation and fail-safe in in their last position. Except where noted to otherwise, heating and reheat hot water valves shall be fail "in their last position". All valves shall be capable of operating in sequence when required by the sequence of operation. All control valves shall be suitable for the pressure conditions and shall close against the differential pressure involved. Valve operators shall be of the molded synthetic type.

H. Room Type Instruments

1. Room thermostats/sensors, humidistat and transmitters shall be of the miniature type, adjustable sensitivity and calibrated dial. Thermostats shall be furnished with high impact plastic cover with tamperproof screws, with concealed adjustment without thermometer in all public and multi-occupancy areas, but with open adjustment for private offices and single occupancy type areas. Adjustment shall be open type on humidistats and transmitters. Thermostats shall be suitable for interlocking to equipment or valves as shown on the drawings and required to accomplish the sequence of operation specified herein.
2. DDC room sensors shall be linear precision resistance elements with an accuracy of $\pm 0.5\%$. Local setpoint adjustment shall be available to change setpoint $\pm 4^\circ\text{F}$. This setpoint shall be capable of being overridden by the Building Automation System. **Provide with indexing switch to allow for temporary manual override of unoccupied mode. Provide LCD with temperature display.**
3. Mechanical and electric room thermostats shall be of the heavy duty, all-metal type.

I. Smoke Detection System

1. The HVAC Contractor shall install smoke detectors furnished by the Electrical Subcontractor in all ductwork and/or equipment, as applicable. The Automatic Temperature Control Contractor shall provide all interlocking of air handling units to shut down upon activation (units and fans with capacity of 2000 cfm and larger). Alarm connection of the smoke detectors to building fire alarm system shall be by the Electrical Contractor.
2. All supply and return ventilation systems 2000 cfm and larger shall automatically stop when the in-duct smoke detectors are activated, except where return systems are utilized for smoke exhaust.
3. For supply systems 15,000 cfm and larger, the HVAC Contractor shall provide normally open smoke dampers. Automatic Temperature Control Contractor shall provide all interlocking required controlled in a way that upon fan shutdown, due to fire and/or smoke detection, the smoke dampers will automatically close. The reverse sequence shall occur where dampers are called for to be normally closed.
4. Smoke dampers (at air handling units) shall be properly controlled in a way that the system fans shall not start until dampers are open, except where coordination for fan start-up is required in the Sequences of Operation and system fans shall be shut off before smoke dampers are fully closed. All end switches, damper switches, etc., required shall be provided by the Automatic Temperature Control Contractor.

J. Dampers

1. All automatic dampers shall be furnished by the Sheetmetal Contractor. Dampers shall be single or multiple blades as required. Dampers shall be installed by the Sheet Metal Subcontractor, under the supervision of the Temperature Control Subcontractor. All blank-off plates and conversions necessary to install smaller or larger than duct size dampers shall be the responsibility of the Sheet Metal Subcontractor. All dampers shall be equal to Ruskin Models CD-60 (rectangular) or CDR-25 (round).

K. High Static Pressure Sensors (Typical All Air Handling)

1. For each fan, provide a pair of analog static pressure sensors located in each of the supply and exhaust fan's suction/discharges, which shall be hardwired to the motor starter to stop the fan(s) upon activation and, in addition, send their signals to the VFD system. One side of each switch shall sense the pressure to be measured and the other side shall reference atmospheric pressure. Should a static pressure be sensed greater than a selected high limit or 6" differential pressure (adj.), the unit shall shut down and an alarm condition shall be annunciated.

L. Temperature Sensors (Air Handling Units)

1. All air handling unit temperature sensors shall be averaging sensors which cover the entire area of airflow with multiple sensors provided as necessary to assure a maximum distance of 24" between sensor elements. Units shall be RTD type.

M. BIPOLAR IONIZATION GENERATORS. (BPI)

1. Description:

iWave-C is a self-cleaning, bi-polar ionization generator for actively treating a building's air quality that does not require replacement parts in a year or two like competing UV lights or other ionizer technologies. In addition, the iWave-C produces and maintains unparalleled ionization output and capabilities. As the air flows past the iWave-C, the device emits positive and negative ions, creating a plasma region that actively purifies the supply air, killing mold, bacteria and viruses in the coil and living space. The ionization process also reduces allergens, smoke and static electricity, as well as controlling odors (cooking, pet, VOCs) and other particles (no more sunbeams) in the air without creating ozone or any harmful byproducts.

Although suitable for residential applications, the original iWave-C is specially designed for light commercial systems up to 12 tons (4800 CFM) with no maintenance or replacement parts needed. iWave-C can be easily duct-mounted indoors or outdoors, depending on the application. iWave-C always works at peak performance, producing over 200 million ions/cc per polarity (400 million total ions/cc), making it superior to other market approaches. Special features include a programmable self-cleaning cycle, waterproof housing, digital display (for on-site visual monitoring) and integral alarm contact (for remote monitoring). In the event the ion emitters become damaged or wear out (after years of service), they can be replaced on the iWave-C model.

Three Year Limited Warranty: Nu-Calgon offers a three year limited warranty on iWave products. For a valid warranty claim within three years, proof of purchase and proof of installation by a licensed HVAC or Electrical contractor must be provided. See full warranty at iwaveair.com for complete details.

2 Directions:

This product must be used in accordance to the following directions by HVACR professionals only.

1. Turn power off to the unit.

2. Install in the duct between the prefilter and cooling coil so as to treat the coil and living space. However, the iWave-C can be installed farther down on the supply air duct. The weatherproof housing allows to be mounted indoor or outdoor. For commercial systems beyond 12 tons, multiple iWave-Cs can be used; but install a minimum of two feet apart for maximum performance.
3. When the install location is found, cut or drill a 4 inch (100 mm) round hole in duct. Insert the iWave-C into the hole and secure with four tapping screws that are provided. Note: if the iWave-C is being mounted to duct board, the included spring load wing nuts and bolts will be required.
4. Follow all electric, mechanical and building codes when installing and wiring. The iWave-C can be powered with 24VAC voltage circuit or 110-240VAC high voltage circuit. The face panel of the unit is labeled showing which terminals are 24VAC, 110-240VAC input and neutral and come prewired from the factory with six feet of liquid-tight flex conduit to reach a junction box for wiring – never connect with an extension cord.
5. Use only one voltage source at a time and never connect low and high voltage simultaneously! Whichever voltage is not used, use a wire nut to protect the unused wire. The wires are color coded as follows:
 - Black wire = 110-240VAC input
 - White = Neutral
 - Gray = 24 VAC input
 - Purple and Purple= Alarm Dry Contact

The iWave-C is provided with alarm contact for use with a building management system. When the unit is powered and there are no faults, the alarm contact will be closed, providing continuity. The contacts are rated up to 250VAC at 1A. CAUTION! Never touch brushes while operating; shock may occur. Once powered, the iWave-C initiates an internal check of all systems. After initializing, the display will blink between "ON", "GPS" and the number of days the unit has been powered. If there is a fault, the unit display will show "FALT".

6. Cleaning Cycle- The iWave-C comes with a preset cleaning cycle designed to clean the brushes every 5 days. At any time, the cleaning cycle test button on the front panel may be pushed and the unit will initiate a cleaning cycle. While the cleaning cycle is engaged, the display will change to "CLEA". To change the cycle frequency, hold the cleaning cycle button in for 5 seconds once the display shows "CLEA" and then press it until you see the number of days you want it to wait between cycles: 1 , 5, 10 or 20 days. Most applications will not need reprogramming from the factory default 5 day cleaning cycle.

For maintenance and troubleshooting, consult the instruction bulletin insert for the iWave-C (4-410) which can be obtained at www.nucalgon.com.

BID #24-05-002IFB
GRLA 2019023.01

TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All work shall be installed per manufacturer's instruction and recommendations.

END OF SECTION

SECTION 25 60 00

SEQUENCES OF OPERATION

(Part of 23 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Section 23 05 00 and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install ATC DDC temperature controls for the following:
 - 1. Monitoring & control interfacing with factory packaged controls for RTU-1, RTU-2, RTU-3 & RTU-4
 - 2. Monitoring & control interfacing with factory packaged controls for AC1/HP1 and AC2/HP2 systems.
 - 3. Monitoring & control of EF-2, EF-10 & EF-12 along with damper controls.
 - 4. Bi-Polar Ionization Generator status alarms for BPI-1A,1B, 2A 2B, 3A, 3B, 4A & 4B.
 - 5. Temperature controls for GHW RHC's 1-1, 1-2, 1-3, 2-1, 2-2, 3-1 & 4-1
 - 6. Monitoring & control for Variable Frequency Drives (VFD's)
 - 7. Full ATC DDC control integration with the existing BAS/BMS systems.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether such work is specifically mentioned in this Section.
- B. Examine Contract Documents for requirements that affect the Work of this Section. Other Specification Sections that directly relate to the Work of this Section include, but are not limited to the following:
 - a. Division 23 - HEATING, VENTILATION & AIR CONDITIONING
 - b. Division 25 - INTEGRATED AUTOMATION

1.4 SUBMITTALS

- A. See Section 23 05 00 and General Conditions for Additional Requirements.
- B. Product Data: Provide data for materials.
- C. Prepare and submit sequences and drawings.
- D. Manufacturer's Installation Instructions.

1.5 QUALITY ASSURANCE

- A. All sequences shall be made functional.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Sequences
 - 1. Air Handling Units - Recirculating Single Fan
 - 2. Air Handling Unit with Return Air
 - 3. Exhaust Air Fans
 - 4. Variable Speed Drives
 - 5. Optimized Start-Up After Power Failure
 - 6. In-Duct Zone Heating Coils (Area Heating)

2.2 AIR HANDLING UNIT - RECIRCULATING SINGLE FAN

- A. Unit shall be run continuously. When supply fan(s) are started by the DDC panel, the following sequence shall occur:
 - 1. Unit shall be equipped with outside air, return, economizer (relief), smoke dampers and isolation dampers. When dampers open and after they reach 80% open position, as determined by an end switch, the supply fan shall start at low VFD speed. After the supply fan has started, the return fan shall start through a separate output from the DDC panel at low VFD speed.
 - 2. The unit shall have separate minimum, mid and maximum outside air dampers. The minimum outside air damper shall open to minimum position and the return air and exhaust air dampers will take corresponding positions as determined by an FMS in the return duct.
 - 3. If either the supply fan or return fan stops, the other fan shall also stop.

- B. An averaging temperature sensor sensing cooling coil discharge temperature will provide a signal to the DDC panel a unit discharge air temperature shall be used to control the cooling coil 2-way modulating control valve, the outside air dampers, return air damper and economizer air damper in sequence to maintain the (adjustable) discharge air temperature. Sensor shall be installed downstream of the cooling coil. On a rise in cooling coil discharge air temperature, the outside air damper, return air dampers and economizer air damper will modulate to the 100% outside air position. On a further rise in temperature, the cooling coil control valve will be modulated open. On a drop in discharge temperature, the reverse sequence shall occur. The discharge control sequence shall maintain a constant temperature of 52°F (adj.) in the cooling mode. An outside air sensor will provide a signal to the DDC panel to modulate the outside air damper to its minimum CFM position, the return air damper to its fully open position, and the economizer damper to its minimum position whenever the outside air enthalpy is greater than the return air enthalpy. At outside air temperature of 50°F (adj.) or lower, the cooling coil valve shall be shut (refer to cooling coil freeze-protection sequence).
- C. A discharge air temperature sensor shall override the discharge control sequence and control the dampers to maintain 50°F (adj.) minimum mixed air temperature and signal an alarm condition.
- D. The discharge temperature control shall modulate the unit's modulating 2-way hot water/glycol/preheat valve in sequence to maintain 52°F (adj.) preheat coil leaving air temperature setpoint. At no time shall the heating coil and cooling coil be open at the same time. When the preheat coil valve is fully open and the leaving air temperature setpoint (52°F adj.) is not satisfied, a signal shall be sent to the steam/glycol/heat recovery system to increase the temperature of the glycol leaving the heat exchanger, in steps until the coil leaving air temperature is satisfied. Glycol/water heat recovery loop temperature shall be optimized to maximize heat recovery and minimize new energy use. Provide a preheat coil leaving air temperature sensor which shall act as a low limit selector to prohibit leaving coil temperature from dropping to below 45°F (adj.).
- E. Provide a series of low limit temperature thermostats in the leaving air section of each of the preheat coils which will stop the unit if the discharge temperature falls below 38°F (adj.). An alarm shall be announced if the temperature drops below 42°F (adj.).
- F. Smoke detectors in the supply and return plenums shall be interlocked to fans to shut down upon activation. Smoke detectors shall be furnished, installed in ductwork and wired to the fire alarm by the Electrical Subcontractor. Provide smoke dampers and end switches and interlocking to close smoke dampers in supply and return on smoke condition. Note that fans shall not be allowed to start until smoke dampers are proven open. The supply and return fans shall stop when either the supply or return air smoke detector is activated via a signal from the fire alarm system to the BAS.
- G. When the supply fan stops, the return fan will stop, the outside air and economizer air dampers will close, the cooling coil and humidifier will be de-energized and the return air damper will be open. The preheat coil control valve shall be modulated to maintain 55°F (adj.) at the preheat coil temperature sensor. If the unit is off and the air temperature inside the cooling section of the unit is below 32°F (adj.), the chilled water valve shall be opened to 30% (adj.) flow position for freeze protection and an alarm shall be sent to the BAS.
- H. Air Volumetric Control

1. This portion of the specification includes the furnishing and installing of a complete air volume DDC control system, as herein described, for achieving air volume DDC control for the air handling unit supply and return fans, and assuring minimum outside air quantities.

The air volume control shall include all sensors for air volume, velocity and pressure, as required. The supply and return air fan volumes shall be controlled by varying the speed of manually adjustable pitch vaneaxial (centrifugal) fans through their associated VFDs.

2. The air volume control system shall be furnished and controlled by the ATC Contractor, except that the airflow measuring stations shall be installed by the HVAC Contractor, but furnished by the ATC Contractor, and shall include all control stations, selector relays, etc.
3. It is the intent of this portion of the specifications for a fully synchronized control system between the supply air (VFD) volume and return air (VFD) volume. The ATC Contractor shall furnish and install a fan volume control center which shall include arithmetic and logic functions and other auxiliary devices required to maintain airflow conditions in accordance with job requirements.
4. The fan volume control components (via VFD) shall be equipped with operating features described herein and capable of performing the outlined performances. The direct digital control shall be capable of 3-mode control, proportional, plus reset, plus gain. The velocity pressure sensors shall provide a signal to the DDC panel to provide for control functions and shall be equal to Setra Model #261.
5. The fan volume control supplier shall provide all necessary factory and field labor for the complete installation and calibration and shall be responsible to provide an operating sequence to the complete satisfaction of the HVAC Engineer. In addition, the fan volume control supplier shall guarantee the proper operation of the system and shall furnish all required service and maintenance from the local office to provide for one (1) year, fully guaranteed system. Factory trained engineers and installers shall be located within a 75-mile radius of the job site so that proper service may be performed on this project.
6. Upon start-up of the supply fan and return fan, the fan volume control center shall place the supply and return fan VFD in the zero (0) speed mode. As the DDC panel receives static pressure signal, the speed of the supply fan and return fan shall increase the supply system static pressure to maintain setpoint at the duct mounted SPSS located 2/3 to 3/4 along the longest duct run. The supply air fan speed shall be controlled to maintain the desired duct static pressure. The supply fan volume (measured at the FMS in the duct provided by the ATC Contractor) shall be measured. The return fan volume shall be controlled (via speed control through the VFD) to maintain a pre-set (adj.) CFM offset between the supply and return air volume (return air volume shall be measured at the FMS, provided by the ATC Contractor, in the main return air duct). Upon startup, the return fan volume (cfm) shall match the supply fan volume until the supply fan reaches 50% of system rated cfm (adj.). On a decrease in supply air static or volume, the reverse sequence will occur. All required auxiliary devices shall be provided by the ATC Contractor. Provide DDC panel face indication to indicate supply air volume and return air volume.

- I. Automatically restart all fans after resumption of normal power following power outages and dropouts.
- J. All control sequences as listed above shall fully function in either the hand or automatic modes as selected at the VFD drive control panel. The ATC Contractor will provide all required hardware, programming, wiring, relays, coordination, etc., to provide a complete fully functional system that operates automatically with no intervention beyond switching the drive mode switch at the VFD panel.
- K. VFD bypass mode of operation, if VFD drives have bypass mode installed as an optional feature the ATC Contractor will provide "detailed" instructions as how the system, controls, VFD drives (s) etc., must be manipulated to allow system to operate in a safe manner. Instructions shall be attached to each affected VFD drive, printed and laminated for operators use.

2.3 EXHAUST AIR FANS

- A. For all exhaust fans which are not located in AHU's, furnish for installation by the HVAC Contractor, automatic supply and/or discharge air dampers and interlock with fans to "open/close" when fans are "on/off". For fan designations and areas served by each fan, see schedule on drawings.

B. Exhaust Air Fans

- 1. For all exhaust fans, the HVAC Contractor shall furnish and install the automatic supply and/or discharge air dampers. The ATC Contractor shall interlock with fans to "open/close" when fans are "on/off". For fan designations and areas served by each fan, see schedule on drawings.

2. Legend

- E = Electric
- N = None
- S = Start/Stop by DDC Panel
- T = Start/Stop by ATC Thermostat
- 24 = Continuous Operation
- SW = Remote Switch
- VSD = Variable Speed Drive
- FA = Fire Alarm
- SP = Via Static Pressure
- AFMS = Air Flow Monitor Station

3. Schedule

Fan No.	Supply Damper	Exhaust Damper	Interlock	Remarks
EF-2	N	E	S	---
EF-10	N	E	S	---
EF-12	N	E	24	---

- C. Existing equipment to be replaced with new equipment and new dampers.

2.4 VARIABLE SPEED DRIVES

- A. For each VFD, provide the following through the PLC:
1. Motor run feedback points to provide run status in both VFD and bypass mode.
 2. Provide mode feedback (VFD and bypass mode).
 3. Speed control output signal to VFD.
 4. Feedback indicating speed (Hz) and amperage.
 5. General alarm from VFD.
 6. Start/stop output to VFD.
 7. Control ramp up rate.
 8. Control ramp down rate.
 9. Adjust and set minimum speed.

2.5 OPTIMIZED START-UP AFTER POWER FAILURE

- A. The ATC Contractor shall start systems and equipment in a staggered manner after a power failure such that systems and equipment do not start all at once and overload electrical service nor create an excess negative or positive pressure in the building. Provide a 5 second (adj.) delay between start-up of each system.
- B. All equipment - any piece of equipment or system that is stopped for any reason other than loss of normal or emergency power must be alarmed and may only reset manually via the BAS. Power failure shall be as sensed by the undercurrent relays and normal/emergency power relays at the electrical automatic transfer switches.

2.6 IN-DUCT ZONE HEATING COIL (AREA HEATING)

- A. Area heating coil normally open 2-way hot water coil shall be modulated to maintain space temperature at the DDC thermostat.
- B. Valve shall be normally open.

END OF SECTION

SECTION 26 00 01
ELECTRICAL WORK

(Filed Sub-bid Required)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division 00 - PROCUREMENT AND CONTRACTING REQUIREMENTS and applicable parts of Division 01 - GENERAL REQUIREMENTS, as listed in the Table of Contents, shall be included in and made a part of this Section.

1.2 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

- B. Time, Manner and Requirements for Submitting Sub-bids:

- 1. Sub-bids for work under this Section shall be for the complete Work of this Section and shall comply with the requirements of M.G.L., c. 149, §44F. and shall be filed in a sealed envelope with the TOWN OF HOPKINTON at a time and place as stipulated in the "INVITATION FOR BIDS".

The following should appear on the upper left hand corner of the envelope:

Name of Sub-Bidder: _____

Project: TOWN OF HOPKINTON FIRE STATION HVAC UPGRADE - REBID
HOPKINTON FIRE DEPARTMENT HEADQUARTERS
73 Main Street
Hopkinton, Massachusetts 01748

Sub-Bid for Section: 26 00 01, ELECTRICAL WORK

- 2. Each sub-bid submitted for work under this Section shall be on forms furnished by the AWARDING AUTHORITY as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-bid forms are included in this Project Manual or may be obtained at the office of the Architect.
- 3. Sub-bids filed with the AWARDING AUTHORITY shall be accompanied by BID BOND or CASH or CERTIFIED CHECK or TREASURER'S CHECK or CASHIER'S CHECK issued by a responsible bank or trust company payable to the TOWN OF HOPKINTON in the amount of five percent of the sub-bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

C. Sub Sub-Bid Requirements:

1. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
2. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that subtrade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the AWARDING AUTHORITY that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings:

1. ELECTRICAL (E- Series and ED- Series) DRAWINGS and FIRE ALARM (FA- Series and FAD Series) DRAWINGS:
 - a. Drawings E0.0, ED1.1, ED1.2, ED1.3, E1.1, E1.2, E1.3, E3.0, FA0.0, FAD1.2, FAD1.3, FA1.2, FA1.3.

1.3 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the Electrical Work, including but not limited to the following:

1. Division 26 – ELECTRICAL:
 - a. Section 26 05 10 - Electrical Special Conditions
 - b. Section 26 05 20 - Basic Materials and Methods
 - c. Section 26 05 30 - Wiring Methods and Systems
 - d. Section 26 20 10 - Low Voltage Distribution
 - e. Section 28 31 10 – Fire Alarm

B. Alternates:

1. DEDUCT ALTERNATE No 1
 - a. Provide a Deduct Alternate Bid Price to remove the new HVAC RTU-2 system costs from the current scope. RTU-2 to be installed later as determined by the "Town of Hopkinton, MA". Deduct Alternate No1 to include demolition, new electrical power wiring & controls. Existing RTU-2 system & appurtenances to remain.
2. DEDUCT ALTERNATE No 2
 - a. Provide a Deduct Alternate Bid Price to remove the new HVAC RTU-3 system costs from the current scope. RTU-3 to be installed later as determined by the "Town of Hopkinton, MA". Deduct Alternate No2 to include demolition, new electrical power wiring & controls. Existing RTU-3 system & appurtenances to remain.

- C. Included in this Section is the furnishing of all labor, materials, equipment and accessories required to provide a complete installation of the Electrical work described herein and on the Drawings. Build the work of other trades into the work of this Section as required.

1.4 RELATED WORK UNDER OTHER SECTIONS

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to the following:
 - 1. Division 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC).
 - 2. Division 25 – INTEGRATED AUTOMATION

PART 2 - PRODUCTS

[Not Used]

PART 3 - EXECUTION

[Not Used]

END OF SECTION

SECTION 26 05 10

ELECTRICAL SPECIAL CONDITIONS

(Part of 26 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 01 - General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

- A. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.
- B. The work under this Contract shall include all labor, materials, tools, equipment, transportation, insurance, temporary protection, supervision and incidental items essential for proper installation and operation, even though not specifically mentioned or indicated on the drawings, but which are usually provided or are essential for proper installation and operation, of all systems as indicated on the drawings and specified herein.
- C. Coordinate work with that of all other Trades affecting or affected by the work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.
- D. The specifications and drawings describe the minimum requirements that must be met by the Electrical Subcontractor for the installation of all work as shown on the drawings and as specified here-in-under and in other Division 26 Sections. The following major items of work are included under Divisions 26:
 - 1. Cleaning, Testing and adjustment of equipment.
 - 2. Phasing of construction.
 - 3. Permit fees, etc.
 - 4. Firestopping, fire-proofing , smoke stopping and waterproofing of all electrical equipment where required.
 - 5. Hangers, supports, mechanical channels and all appurtenances required for installation of electrical equipment.
 - 6. Seismic Restraints.
 - 7. Conductors.
 - 8. Conduits, fittings and connectors, including supports.
 - 9. Pull boxes.
 - 10. Junction Boxes and Backboxes.
 - 11. Wireways.
 - 12. Electrical identification including, but not limited to panels, switchboards, transformers, conduit and conductors, etc.
 - 13. Grounding.
 - 14. Fuses.

15. Fused and Unfused Disconnect Switches.
16. Circuit Breakers.
17. Surge Protection Devices.
18. Shop Drawing Submittals.
19. Short Circuit & Coordination Study and Arc Flash Hazard Analysis.
20. Coordination Drawings.
21. Record As-Built Drawings.
22. Operation and Maintenance Manuals.
23. System Start-Up, Demonstration and Training.
24. Extension of Existing Fire System. Duct Smoke Detectors.

1.3 RELATED WORK

A. Related Work Under Division 26.

1. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the following Sections:
 - a. Section 26 00 01 – Electrical Work
 - b. Section 26 05 20 – Basic Materials and Methods
 - c. Section 26 05 30 – Wiring Methods
 - d. Section 26 20 10 – Low Voltage Distribution
 - e. Section 28 31 10 – Fire Alarm
2. Refer to the following specifications for work to be included and coordinated as part of this Section:

B. Related Work Under Other Divisions and Sections.

1. For work related to and to be coordinated with the electrical work, but not included in this Section, and required to be performed under other designated Sections or Divisions, see the following:
 - a. Division 23 – Heating, Ventilating and Air Conditioning
 - b. Division 25 – Integrated Automation

1.4 REFERENCES

- A. All materials and workmanship shall comply with all applicable Codes, Specifications, Local and State Ordinances, Industry Standards and Utility Company Regulations, latest editions.
- B. In case of difference between Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations and the Contract Documents, the Electrical Subcontractor shall promptly notify the Architect in writing of any such difference.
- C. In case of conflict between the Contract Documents and the requirements of any Code or Authorities having jurisdiction, the most stringent requirements of the aforementioned shall govern.
- D. Should the Electrical Subcontractor perform any work that does not comply with the requirements of the applicable Building Codes, State Laws, Local Ordinances, Industry Standards and Utility Company Regulations, he shall bear all costs arising in correcting the deficiencies, as approved by the Architect/Owner.

- E. Applicable Codes and Standards shall include all State Laws, Local Ordinances, Utility Company Regulations, and the applicable requirements of the latest adopted edition of the following Codes and Standards, without limiting the number, as follows:
1. NFPA 70: National Electrical Code
 2. NFPA 72: National Fire Alarm Code
 3. NFPA 101: Life Safety Code
 4. CBM: Certified Ballast Manufacturers Association
 5. IES: Illuminating Engineering Society
 6. ASTM: American Society for Testing and Materials
 7. ANSI: American National Standards Institute
 8. UL: Underwriters' Laboratories
 9. Occupational Safety and Health Standards
 10. Environmental Protection Agency
 11. National Fire Protection Association
 12. Massachusetts Building Code
 13. Massachusetts Electrical Code
 14. Office of Public Safety and Inspections
- F. In these specifications, references made to the following Industry Standards and Code Bodies are intended to indicate the latest volume or publication of the Standard. All equipment, materials and details of installation shall comply with the requirements and latest revisions of the following Bodies, as applicable:
1. ANSI: American National Standards Institute
 2. ASTM: American Society of Testing and Materials
 3. AWG: American Wire Gauge
 4. FM: Factory Mutual
 5. IEEE: Institute of Electrical and Electronics Engineers
 6. NEMA: National Electrical Manufacturers Association
 7. UL: Underwriters' Laboratories
- G. Electrical Subcontractor for the work in his scope of work shall give all necessary notices, obtain all permits, pay all governmental taxes, fees and other costs in connection with his work; file for necessary approvals with the jurisdiction under which the work is to be performed. Electrical Subcontractor shall obtain all required Certificates of Inspection for his respective work and deliver same to the Architect before request for acceptance of his portion of work is made and before final payment.

1.5 QUALITY ASSURANCE

- A. Electrical Subcontractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work under his Contract for use, occupancy and operation by the Owner.

- B. Where equipment of a substitute manufacturer differ from that specified and require different arrangement or connections from those shown, it shall be the responsibility of the Subcontractor responsible for the substitution to modify the installation of the equipment/system to operate properly and in harmony with the original intent of the drawings and specifications. When directed by the Architect, the Electrical Subcontractor shall submit drawings showing the proposed, substitute installation. If the proposed installation is accepted, the Electrical Subcontractor shall make all necessary changes in all affected related work provided under his and other Sections including location of roughing-in connections by other Trades, conduit, supports, etc. All changes shall be made at no increase in the Contract amount or additional cost to the Owner. The General Contractor shall be responsible to assure that the Subcontractor responsible for the substitution bears the cost arising to all other Trades as a result of the substitution.
- C. Unless specifically indicated otherwise, all equipment and materials required for installation under these specifications shall be new, unused and without blemish or defect. Equipment and materials shall be products which will meet with the acceptance of the Authorities having jurisdiction over the work and as specified hereinbefore. Where such acceptance is contingent upon having the products listed and/or labeled by FM or UL or another testing laboratory, the products shall be so listed and/or labeled. Where no specific indication as to the type or quality of material or equipment is indicated, a first class standard article shall be provided.

1.6 WARRANTY

- A. Refer to provisions of the General Requirements in Division 01 regarding warranties for work under this Contract.
- B. All warranties shall begin on the Date of Substantial Completion of the entire project or the Owner's acceptance of the workmanship and/or material covered by the warranty, whichever is later. The warranty coverage shall continue for the specified period. Refer to individual specification sections for warranty period. If no specific warranty period is specified, the warranty shall extend for a minimum of 365 days.
- C. Manufacturers shall provide their standard warranties for work under the Electrical Trades. However, such warranties shall be in addition to, and not in lieu of, all other liabilities which the manufacturer and Electrical Subcontractor may have by law or by other provisions of the Contract Documents.
- D. All materials, items of equipment and workmanship furnished under the Electrical Section shall carry the standard warranty against all defects in material and workmanship. Any fault due to defective or improper material, equipment, workmanship or design which may develop shall be made good, forthwith, by and at the expense of the Electrical Subcontractor for the work under his Contract, including all other damage done to areas, materials and other systems resulting from this failure.
- E. The Electrical Subcontractor shall warranty that all elements of the systems which are to be provided under his Contract, are of sufficient capacity to meet the specified performance requirements as set forth herein or as indicated.
- F. Upon receipt of notice from the Owner or Architect of failure of any part of the systems or equipment during the warranty period, the affected part or parts shall be replaced by the Electrical Subcontractor for his work or any other work affected by the failure(s).

- G. Electrical Subcontractor shall furnish, before the final payment is made, a written warranty covering the above requirements in accordance with the General Requirements.

1.7 DEFINITIONS

- A. Words in the singular shall also mean and include the plural, wherever the context so indicates, and words in the plural shall mean the singular, wherever the context so indicates.
- B. Wherever the terms "shown on drawings" are used in the specifications, they shall mean "noted", "indicated", "scheduled", "detailed", or any other diagrammatic or written reference made on the drawings.
- C. Wherever the term "provide" is used in the specifications it will mean "furnish" and "install", "connect", "apply", "erect", "construct", or similar terms, unless otherwise indicated in the specifications.
- D. Wherever the term "material" is used in the specifications it will mean any "product", "equipment", "device", "assembly", or "item" required under the Contract, as indicated by trade or brand name, manufacturer's name, standard specification reference or other description.
- E. The terms "approved", or "approval" shall mean the written approval of the Architect. Where indicated in the product section of the specifications, "Approved Equal" shall mean the proposed substitute product must be approved by the Owner, Architect and Engineer in writing prior to acceptance on the project for submission. Basis of approval of a substitute product submitted for "Approved Equal" shall be at the sole discretion of the Owner, Architect and Engineer.
- F. The term "Contract Documents" shall mean the entire set of Drawings and Specifications as listed in the Table of Contents of the General Conditions including all bound and unbound material and all items officially issued to date such as addenda, bulletins, job modifications, etc.
- G. The term "specification" shall mean all information contained in the bound or unbound volume, including all "Contract Documents" defined therein, except for the drawings.
- H. The terms "directed", "required", "permitted", "ordered", "designated", "prescribed", and similar words shall mean the direction, requirement, permission, order, designation or prescription of the Architect; the terms "approved", "acceptable", "satisfactory", and similar words shall mean approved by, acceptable or satisfactory to the Architect; and, the terms "necessary", "reasonable", "proper", "correct", and similar words shall mean necessary, reasonable, proper or correct in the judgment of the Architect.
- I. "Accessible" indicates ease of access with or without the use of ladders and without requiring extensive removal of other equipment, such as ductwork, piping, etc. to gain access. "Accessible ceiling" indicates acoustic tile type hung ceilings. Concealed spline or sheetrock ceilings with access panels shall not be considered accessible ceilings.
- J. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

- K. "Exposed" means not installed underground or "concealed" as defined above.
- L. "Electrical Subcontractor" refers to the Subcontractor responsible for furnishing and installation of all work indicated on the Electrical drawings and in the Electrical specifications.
- M. "Architect" shall refer to the Architect of Record.
- N. Engineer shall refer to the Engineer of Record
- O. "Owner" shall refer to the Owner of Record or designated representative.
- P. "Other Work Contractor" (O.W.C.) refers to the Contractor(s), or Subcontractor(s) performing work under other Sections of the Contract Documents.

1.8 THE SUBCONTRACTOR

- A. The Electrical Subcontractor shall visit the site of the proposed new facility and base his bids from his own site examinations and estimates. The Electrical Subcontractor shall not hold the Architect, Engineer, Owner or their agents or employees responsible for, or bound by, any schedule, estimate or of any plan thereof. The Electrical Subcontractor shall study the Contract Documents included under this Contract to determine exactly the extent of work provided under this Contract, as well as to ascertain the difficulty to be encountered in performing the work, in installing new equipment and systems and coordinating the work with the other Trades and existing building conditions.
- B. The Electrical Subcontractor shall faithfully execute his work according to the terms and conditions of the Contract and specifications, and shall take all responsibility for and bear all losses resulting to him in the execution of his work.
- C. The Electrical Subcontractor shall be responsible for the location and performance of work provided under his Contract as indicated on the Contract Documents. All parties employed directly or indirectly by the Electrical Subcontractor shall perform their work according to all the conditions as set forth in these specifications.
- D. The Electrical Subcontractor shall furnish all materials and do all work in accordance with these specifications, and any supplementary documents provided by the Architect. The work shall include everything shown on the drawings and/or required by the specifications as interpreted by the Architect, regardless of where such information is indicated in the Contract Documents (Architectural, HVAC, Plumbing, Fire Protection, etc.). Unless specifically indicated otherwise, all work and materials furnished and installed shall be new, unused and of the best quality and workmanship. The Electrical Subcontractor shall cooperate with the Architect so that no error or discrepancy in the Contract Documents shall cause defective materials to be used or poor workmanship to be performed.

1.9 COORDINATION OF WORK

- A. The Electrical Subcontractor shall compare his drawings and specifications with those of other Trades as well as the Architectural drawings and specifications, and report any discrepancies between them to the Architect and obtain from the Architect written instructions for changes necessary in the electrical work.

- B. Coordinate work with that of all other Trades affecting or affected by the work of this Section. Cooperate with such Trades to assure the steady progress of all work under the Contract.
- C. All work shall be installed in cooperation with other Trades installing interrelated work. Before installation, Electrical Subcontractor shall make proper provisions to avoid interferences in a manner approved by the Architect. All changes required in the work of the Electrical Subcontractor or that of any other trade caused by the Electrical Subcontractor's neglect, shall be made by him at his own expense, and to the Architect's satisfaction.
- D. The Electrical Subcontractor shall include in his bid sufficient dollar amounts to coordinate the work of this Contract. This project MAY require additional time to coordinate all Trades and allow implementation of the Owner's Standards and maintenance serviceability requirements.
- E. Locations of conduits, boxes distribution equipment, systems, etc. shall be adjusted to accommodate the work with interferences anticipated and encountered. The Electrical Subcontractor shall determine the exact routing and location of his systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings shall be completed to verify dimensions and characteristics of the various systems installations.
- F. Lines which pitch shall have the right-of-way over those which do not pitch. For example, steam piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
- G. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The Electrical Subcontractor shall provide elbows, conduit bends, "LB" fittings, offsets in busway, etc. as required for his work to effect these offsets, transitions and changes in direction.
- H. All work shall be installed in a way to permit removal (without damage to other parts) of pull and junction box covers, wiring, and all other system components provided under this Contract requiring periodic replacement or maintenance.
- I. The Contract Drawings are diagrammatic only intending to show general runs and locations of conduits, distribution equipment, systems equipment, etc. and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other Trades to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.
- J. Where discrepancies in scope of work as to what Trade provides items, such as starters, disconnects, flow switches, etc., exist, such conflicts shall be reported to the Architect during bidding and prior to signing of the Contract. If such action is not taken, the Electrical Subcontractor shall furnish such items as part of his work as necessary, for complete and operable systems and equipment, as determined by the Architect.

- K. Where drawing details, plans, specification requirements and/or scheduled equipment capacities are in conflict and where feeders, branch circuits or equipment are shown to be different between plans and/or between plans and riser diagrams, details or specifications, the most stringent requirement will be included in the Contract. Electrical systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to Architect's attention for direction as to what is to be provided.
- L. The Electrical Subcontractor shall coordinate his work with other Trades' work so that all equipment and systems can be easily, safely and properly serviced and maintained. It is imperative that service personnel can safely access all equipment.

1.10 EQUIPMENT AND MATERIALS

- A. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls shall be stored in dry, heated spaces. Equipment such as switchgear with heater elements installed shall have the heater elements energized after the equipment is received by the Electrical Subcontractor.
- B. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects that develop before acceptance of the work shall be made good at the Electrical Subcontractor's expense.
- C. The Electrical Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his respective Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.
- D. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions. Obtain the Architect's written instructions before proceeding with the work. Should Electrical Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.

1.11 USE OF PREMISES

- A. The Electrical Subcontractor shall confine all apparatus, storage of materials and construction to the limits as directed by the Architect and he shall not encumber the premises with his materials. The Electrical Subcontractor shall be held responsible for repairs, patching, or cleaning arising from any unauthorized use of premises.

- B. Notwithstanding any approvals or instructions which must be obtained by the Electrical Subcontractor from the Architect in connection with the use of the premises, the responsibility for the safe working conditions at the site shall remain that of the Electrical Subcontractor. The Architect, Engineer or Owner shall not be deemed to have any responsibility or liability in connection with safe working conditions at the site.

1.12 PROTECTION

- A. Materials, conduit, switchgear, etc., shall be properly protected during construction and all conduit openings shall be temporarily closed so as to prevent obstruction and damage. Post notice prohibiting the use of all systems provided under the Electrical Contract, prior to completion of work and acceptance of all systems by the Owner except as otherwise instructed by Architect. Take precautions to protect all materials furnished from damage and theft.
- B. The Electrical Subcontractor shall furnish, place and maintain proper safety guards for the prevention of accidents that might be caused by the workmanship, materials, equipment or electrical systems provided under his Contract.

1.13 DAMAGE TO OTHER WORK

- A. The Electrical Subcontractor shall be held responsible and shall pay for all damages caused by his work to the building structures, equipment, conduits, systems, etc., and all work and finishes installed under this Contract. Repair of such damage shall be done by the General Contractor at the expense of the Electrical Subcontractor, to the Architect's satisfaction.

1.14 CORRECTION OF WORK

- A. The Electrical Subcontractor shall promptly correct all work provided under his Contract and rejected by the Architect as defective or as failing to conform to the Contract Documents, whether observed before or after completion of work, and whether or not fabricated, installed or completed.

1.15 EXTRA WORK

- A. No claim for extra work will be allowed unless it is authorized by the Architect in writing before commencement of the extra said work.

1.16 TOUCH-UP PAINTING

- A. All equipment and systems shall be thoroughly cleaned of rust, splatters and other foreign matter of discoloration leaving every part of all systems in an acceptable prime condition. The Electrical Subcontractor, for the work under his Contract, shall refinish and restore to the original condition all equipment which have sustained damage to the manufacturer's prime and finish coats of paint and/or enamel during the course of construction, regardless of the source of damage.

1.17 TRAINING AND OPERATION AND MAINTENANCE MANUALS

- A. The Electrical Subcontractor shall thoroughly instruct the Owner, to the complete satisfaction of the Architect and Engineer, in the proper operation of all systems and equipment provided by him. The Electrical Subcontractor shall make arrangements, via the Architect, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Electrical Subcontractor to the Owner's representative, then the Electrical Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this specification has been complied with.
- B. Electrical Subcontractor shall submit to the Architect for approval, a minimum of two (2) typed O & M manual sets or quantity as required in Division 1 (see General Conditions and Division 1) bound neatly in 3-ring binders. Binders shall contain all instructions for the installation, operation, emergency operation, start-up, care and maintenance of all equipment and systems (including instructions for the ordering and stocking of spare parts for all equipment installed under this Contract). The lists shall include part numbers and suggested supplier. Each set shall also include an itemized list of component parts that should be kept on hand and where such parts can be purchased.
- C. O & M manuals shall contain information indicating possible problems with equipment and suggested corrective action. The manuals shall be indexed for each type of equipment. Each section shall be clearly divided from the other sections. A sub-index for each section shall also be provided. The methodology of setting-up the manuals shall be submitted to the Architect and Owner for review prior to final submission of manuals.
- D. The O & M manuals shall contain instructions including information deemed necessary by the Architect and shall also include, but not limited to, the following:
1. Introduction
 - a. Explanation of Manual and its use.
 - b. Summary description of each Electrical system.
 - c. Purpose of each system.
 2. System
 - a. Detailed description of each system.
 - b. Illustrations, schematics, block diagrams, catalog cuts, and other exhibits.
 3. Operations
 - a. Complete detailed, walk-through, with step-by-step, sequential description of all phases of operation for all portions of the systems, including start-up, shutdown, testing and adjusting. Include all posted instruction charts.

4. Maintenance
 - a. Parts list and part numbers.
 - b. Maintenance, and replacement charts and Electrical Subcontractor's recommendations for preventive maintenance.
 - c. Troubleshooting charts for systems and components.
 - d. Instructions for testing each type of part.
 - e. Recommended list of on-hand spare parts.
 - f. General or miscellaneous maintenance notes.
 - g. Provide an estimate of manhours and material costs to perform scheduled preventative maintenance.

5. Manufacturer's Literature
 - a. Complete listing for all parts with names, addresses and telephone numbers.
 - b. Care and operation.
 - c. FINAL APPROVED SHOP DRAWINGS FOR ALL EQUIPMENT, including all and only pertinent brochures, illustrations, drawings, cuts, bulletins, technical data, certified performance charts and other literature with the model actually furnished to be clearly and conspicuously identified.
 - d. Internal wiring diagrams and engineering data sheets for all items and/or equipment to be furnished.
 - e. Guarantee and warranty data.

1.18 MANUFACTURER'S REPRESENTATIVE

- A. The Electrical Subcontractor shall provide, at the appropriate time or as directed by Architect, the on-site services of a competent factory trained Engineer of the manufacturer of specific equipment, such as the power distribution equipment, generator, automatic and manual transfer switches, variable frequency drives, motor starters, fire alarm system, lighting control systems, etc., to inspect, test, adjust and place in proper operating condition any and all items of the same manufacturer. No additional compensation will be allowed for such services. A written report shall be issued by the particular manufacturer with his findings for the Architect's record.

1.19 COORDINATION DRAWINGS

- A. Before materials are purchased, fabricated or work is begun, each Subcontractor shall prepare and obtain approval of coordination drawings, and sections for all floors/areas, including buried system/services, resulting in one (1) set of all-Trade-composite at 3/8" scale drawings, showing the size and location of all equipment, in the manner described here-in-under General Requirements. Architects review and approval of coordination drawings must be obtained prior to any fabrication or installation of any equipment or systems.

- B. The coordination drawings shall be generated from an owner approved program such as Autodesk BIM - Revit. The HVAC Subcontractor shall take the lead, supervise, and coordinate production of coordinated layout drawings, to show and coordinate all equipment. These drawings shall then be circulated to the Electrical Subcontractor so that he can indicate all his work as directed by the General Contractor and Architect and as required, to result in a fully coordinated installation.

- C. The Electrical Subcontractor shall indicate all electrical equipment and conduit provided by him or his Sub-subcontractors on the coordination drawings. This equipment and conduit shall include, but not be limited to, the following:
 - 1. All electrical distribution equipment, drawn to scale with clearance requirements. (Switchboards, busway and plug-ins, transformers, panelboards, motor control centers, fire alarm control panels and terminal cabinets, starters and VFDs, etc.)
 - 2. All switchboard and panelboard feeder conduits.
 - 3. All conduits for all systems over 2 " in diameter.
 - 4. Conduit routing and rack locations for all conduits regardless of conduit size when more than 4 conduits are grouped in a rack.
 - 5. All pull and splice boxes over 8" in size in any direction (height, width or length).
- D. All costs associated with all aspects of coordination drawings, regardless as to how long they take to produce and how many times they have to be redrawn, shall be borne by the Electrical Subcontractor.
- E. The Electrical Subcontractor may obtain the electrical drawing pdf files of the electrical contract set from the owner, if he so chooses. Such files will become only a reference to the contractor as-built drawings and it shall not be used as a replacement for as-built drawings. The Contractor shall be the sole responsible party for the file and he shall not use the file for other projects or share them with a third party or other engineering firms.
- F. The Electrical Subcontractor shall issue a of copy of contract drawings to the HVAC Subcontractor, for use in developing the required coordination drawings.
- G. The Electrical Subcontractor shall be responsible for coordinating the Electrical coordination drawings, including, but not limited to, the drawing lists, file types, producing copies of the drawings for the Architect as directed, etc.

1.20 RECORD DRAWINGS/AS-BUILT DRAWINGS

- A. The Electrical Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating hereon any variation from the Contract Drawings, in accordance with the General Conditions and Division 01. Changes, whether resulting from formal change orders or other instructions issued by the Architect, shall be recorded. Include changes in sizes, location, and dimensions of conduit, switchgear, lighting fixtures, fire alarm equipment, wiring devices, etc.
- B. The Electrical Subcontractor shall indicate progress by coloring-in various conduits, equipment and associated appurtenances exactly as they are erected. This process shall incorporate both the changes noted above and all other deviations from the original drawings whether resulting from job conditions encountered or from any other causes.

- C. The marked-up and colored-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner and they shall be corrected immediately if found either inaccurate or incomplete. This procedure is mandatory.
- D. At the completion of the job, these prints shall be submitted to the General Contractor and then to the Architect for final review and comment. The prints will be returned with appropriate comments and recommendations. These corrected prints, together with corrected prints indicating all the revisions, additions and deletions of work, shall form the basis for preparing a set of As-built Record Drawings.
- E. The Subcontractor shall be responsible for generating as-built Record Drawings utilizing program approved by the owner and electronic pdf drawings. A bound set of plans, as well as the computer files, shall be turned over to the Architect for review. After acceptance of the as-built documents by the Architect, the Electrical Subcontractor shall make any corrections necessary to the as-built documents and prepare one reproducible set of drawings as well as bound blueprint set(s) (quantity as determined by the Architect) for distribution to the Owner via the Architect.
- F. The Electrical Subcontractor may use the drawing files used for coordination drawings or request the Engineers most recently updated files. The updated drawings may not include all changes made during the course of construction and it shall be the Electrical Subcontractors responsibility to update the as-built documents to include all changes brought forth to the project resulting from bulletins, request for information (RFI's), change orders, etc. The Electrical Subcontractor may review the Engineers latest computer files for completeness prior to purchase, however the Engineer will not be responsible for updating the computer files.
- G. Included with the above shall be a complete drawing list and an owner defined standard, which shall be required to be maintained within the as-built documents.
- H. The Subcontractor shall be issued bulletins in the same manner as the original Design Documents described above.
- I. The as-built documents required shall be in addition to other requirements stated elsewhere.

1.21 SHOP DRAWING SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements herein before specified, and with the Shop Drawings, Product Data and Samples in Division 01 in the manner described therein, modified as noted hereinafter.
- B. All shop drawings shall have clearly marked the appropriate specification number of drawing designation, for identification of the submittal.
- C. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.

- D. All final approved shop drawings shall be included in the required O & M manuals.
- E. Refer to each Division 26 Section for list of required shop drawing submittals.

PART 2 – PRODUCTS

[Not Used]

PART 3 - EXECUTION

3.1 COOPERATION AND WORK PROGRESS

- A. The Electrical work shall be carried on under the usual construction conditions, in conjunction with all other work at the site. The Electrical Subcontractor shall cooperate with the Architect, General Contractor, all other Subcontractors and equipment suppliers working at the site. The Electrical Subcontractor shall coordinate the work and proceed in a manner so as not to delay the progress of the project. Provide coordination drawings for architect/engineer to review and approve.
- B. The Electrical Subcontractor shall coordinate his work with the progress of the building and other Trades so that he will complete his work as soon as conditions permit and such that interruptions of the building functions will be at a minimum. Any overtime hours worked or additional costs incurred due to lack of or improper coordination with other Trades or the Owner by the Electrical Subcontractor, shall be assumed by him without any additional cost to the Owner.
- C. The Electrical Subcontractor shall furnish information on all equipment that is furnished under this Section but installed under another Section to the installing Subcontractor as specified herein.
- D. The Electrical Subcontractor shall provide all materials, equipment and workmanship to provide for adequate protection of all electrical equipment during the course of construction of the project. This shall also include protection from moisture and all foreign matter. The Electrical Subcontractor shall also be responsible for damage which he causes to the work of other Trades, and he shall remedy such injury at his own expense.
- E. Waste materials shall be removed promptly from the premises. All material and equipment stored on the premises shall be kept in a neat and orderly fashion. Material or equipment shall not be stored where exposed to the weather. The Electrical Subcontractor shall be responsible for the security, safekeeping and damages, including acts of vandalism, of all material and equipment stored at the job site. Coordinate all storage of materials onsite with Owner and Architect - limited space is available onsite.
- F. The Electrical Subcontractor shall be responsible for unloading all electrical equipment and materials delivered to the site. This shall also include all large and heavy items or equipment which require hoisting. Consult with the General Contractor for hoisting/crane requirements. During construction of the building, the Electrical Subcontractor shall provide additional protection against moisture, dust accumulation and physical damage of the main service and distribution equipment. This shall include furnishing and installing temporary heaters within these units, as approved, to evaporate excessive moisture and ventilate it from the room, as may be required.

- G. It shall be the responsibility of the Electrical Subcontractor to coordinate the delivery of the electrical equipment to the project prior to the time installation of equipment will be required; but he shall also make sure such equipment is not delivered too far in advance of such required installation, to ensure that possible damage and deterioration of such equipment will not occur. Such equipment stored for an excessively long period of time (as determined in the opinion of the Architect) on the project site prior to installation may be subject to rejection by the Architect. Coordinate delivery with Owner and Architect prior to actual delivery. Limited space is available on site.
- H. The Electrical Subcontractor shall erect and maintain, at all times, necessary safeguards for the protection of life and property of the Owner, Workmen, Staff and the Public.
- I. Prior to installation, the Electrical Subcontractor has the responsibility to coordinate the exact mounting arrangement and location of electrical equipment to allow proper space requirements as indicated in the NEC. Particular attention shall be given in the field to group installations. If it is questionable that sufficient space, conflict with the work of other Subcontractors, architectural or structural obstructions will result in an arrangement which will prevent proper access, operation or maintenance of the indicated equipment, the Electrical Subcontractor shall immediately notify the Contractor and not proceed with this part of the Contract work until definite instructions have been given to him by the Architect.

3.2 INSTALLATION

A. General

1. Unless specifically noted or indicated otherwise, all equipment and material specified in Divisions 26 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.
2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment as to proper methods of installation.
3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
5. The Electrical Subcontractor shall coordinate the utility service installations with the local Electric Utility Co., the Owner, the Telephone Company, the City Building Department and the City Fire Department.
6. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.

3.3 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.
- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.4 CLEANING

- A. This Section of the specifications shall include the cleaning of all equipment on a day-to-day basis and final cleaning of all electrical equipment prior to turning building over to the Owner. All necessary cleaning referred to herein shall be cleaned to the satisfaction of the Architect.
- B. Electrical Distribution Equipment
 - 1. All electrical distribution equipment shall be completely cleaned and dried inside and out prior to initial energizing.
 - 2. Cleaning shall consist of vacuuming all busses, windings, enclosures (inside and out), etc. After vacuuming is complete, all equipment shall be wiped down. If equipment is wet or contains moisture, it shall be thoroughly dried and inspected by the manufacturer's representative before energizing.
- C. Raceways and Junction Boxes
 - 1. All raceways and junction boxes shall be blown out and dried prior to installation of feeder conductors and branch circuit conductors.

3.5 FINAL INSPECTION

- A. When all Electrical work on the project has been completed and is ready for final inspection, such an inspection shall be made. At this time, and in addition to all other requirements in the Contract Documents, the Electrical Subcontractor, for the work under this Contract, shall demonstrate that the requirements of these specifications have been met to the Architect's satisfaction.

3.6 SHOP DRAWING CHECKLIST

- A. The following is a checklist of job specific items that shall be submitted as Shop Drawings by the Electrical Contractor for review and approval by Engineer, Architect and Owner.
- B. The shop drawing submittals shall contain all information as stated below AND as stated in each specification section.

END OF SECTION

SECTION 26 05 20

BASIC MATERIALS AND METHODS

(Part of 26 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 01, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

- A. Refer to Section 26 05 10 – Electrical Special Conditions.

1.3 RELATED WORK

- A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 26 05 10.
- B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.4 WARRANTY

- A. Refer to provisions of the General Requirements, Supplementary General Requirements, Division 01 - Warranties and Section 26 05 10 – Electrical Special Conditions regarding guarantees and warranties for the work under this Contract.

1.5 FIRESTOPPING AND SMOKE SEALING

- A. The Electrical Subcontractor shall provide firestopping and smoke sealing of all electrical penetrations where required by Code and as determined by the Architect.
- B. The Electrical Subcontractor shall review firestop or smoke seal systems provided under Division 07 – Fire-Stopping and provide same as specified under Division 07.
- C. Where conduits are installed through sleeves, the sleeves shall be of sufficient size to provide 1/2" annular space around the conduit passing through the sleeve and all openings shall be firestopped and sealed to limit the spread of particulate air and smoke in accordance with the requirements of an appropriate UL Listed System.
- D. Where core drilling has been provided, the core shall be of sufficient size to provide 1/2" annular space around the conduit passing through the core hole and all openings shall be firestopped and sealed to limit the spread of particulate air and smoke in accordance with the requirements of an appropriate UL Listed System.

- E. Where sleeves are installed for future cable installation, all sleeves shall be firestopped and sealed to limit the spread of particulate air and smoke in accordance with the requirements of an appropriate UL Listed System using re-enterable firestop products.
- F. All cable installations that will be subject to future moves, additions, or changes shall be firestopped and sealed to limit the spread of particulate air and smoke in accordance with the requirements of an appropriate UL Listed System using fire-rated cable pathways that permit 0 to 100 percent visual cable fill and require no further action to activate the internal sealing mechanism to provide fire and leakage ratings.

1.6 WATERPROOFING AND COUNTER-FLASHING

- A. Electrical Subcontractor shall coordinate with the General Contractor the counter-flashing of all conduit and equipment provided by him, which pierce roofs, walls and other weather-barrier surfaces. Waterproofing and counter-flashing shall be provided by the General Contractor. Refer to Division 07.
- B. Any leaks developed due to Electrical Subcontractor's work shall be repaired at the Electrical Subcontractor's expense, to Architect's satisfaction.

1.7 MISCELLANEOUS IRON AND STEEL

- A. Except where specifically indicated for the General Contractor to provide supports, Electrical Subcontractor shall provide all steel supports and hangers required to support all equipment or materials provided under this Contract.
- B. All supports shall be cut, assembled, welded and finished by skilled mechanics. Welds shall be ground smooth. Stands, brackets and framework shall be properly sized and strongly constructed.
- C. Measurements shall be taken on the job and worked out to suit adjoining and connecting work. All work shall be performed by experienced metal working mechanics. Members shall be straight and true and accurately fitted.

1.8 PHASING

- A. The Electrical Subcontractor shall construct the subject project in phases as directed by the Architect and General Contractor to suit the project progress schedule, as well as the completion date of the project.
- B. For additional information related to phasing, review the General Conditions and Supplementary Conditions under Division 01 and the Architectural drawings.

1.9 SHOP DRAWING SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with the Shop Drawings, Product Data and Samples Division 01 in the manner described therein, modified as noted hereinafter.
- B. All shop drawings shall have clearly marked the appropriate specification number of drawing designation, for identification of the submittal.

- C. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.
- D. All final approved shop drawings shall be included in the required O & M manuals.
- E. Shop drawings shall include, but shall not be limited to, the following:
 - 1. Dimensions and locations of concrete housekeeping pads.
 - 2. Nameplates and circuit identification.
 - 3. Wire markers, conduit markers and cable markers.

PART 2 – PRODUCTS

2.1 ELECTRICAL IDENTIFICATION

- A. Nameplates
 - 1. Provide nameplates on switchgear, automatic transfer switches, transformers, remote mounted enclosed circuit breakers, receptacles on emergency, panelboards and special purpose motor disconnect switches, remote control stations, starters, etc., or other controls furnished or installed under Division 16. Nameplates shall designate equipment controller, function, ratings, source of power and voltage.
 - 2. The name plate on the switchgear shall have the available fault current rating as established on the short circuit and coordination study.
 - 3. Refer to details on drawings for additional requirements and information.
 - 4. Nameplates shall be laminated, black bakelite with 1/4" high, white recessed letters. Nameplates shall be securely attached to the equipment with galvanized screws or rivets. Adhesives or cements shall not be used.
 - 5. Provide a shop drawing of nameplate schedules for approval.
 - 6. Nameplates for devices and equipment on emergency power shall be "RED" in color.
- B. Panel Directories
 - 1. Panelboards shall have typed directories, listing all circuit loads, breaker sizes and phases.
 - 2. Provide copy of typed directories in O & M manuals.
- C. Wire and Cable Markers
 - 1. Feeders shall have wire markers attached indicating voltage, source, and circuit number.

2. Branch circuits shall have wire markers attached indicating source and circuit number.
3. Markers for wire and cable circuits shall be as manufactured by Brady, self-laminating vinyl or by Thomas & Betts E-Z-Code.

D. Color-Code Tape

1. Colored tape shall be polyvinyl chloride, self-adhesive not less than 3 mils thick and 1 1/2" wide, suitable for use on 90°C conductors, UL listed and shall be furnished in colors as specified herein.

2.2 HANGERS AND SUPPORTS

A. General

1. Hangers, supports, clamps, etc., shall be provided as required for all electrical equipment, including but not limited to, lighting fixtures, junction boxes, pull boxes, conduit, cable tray, busway, trapeze mounted transformers, open plenum type cabling, etc.
2. The Electrical Subcontractor shall provide all labor, materials, equipment and incidentals required for hangers and supports for all electrical equipment including concrete inserts, anchor bolts, metallic hanging and supporting devices, etc. for supporting electrical equipment.
3. Hangers and supports shall be approved standard design and shall be adequate to maintain the supported load in proper position and alignment under all operating conditions. All supports shall be designed to adequately secure the equipment against excessive dislocation due to thermal expansion and contraction and all probable external forces such as equipment, conduit and personnel contact. Installation shall meet all requirements for seismic bracing that is required by applicable Building Codes.
4. All electrical equipment shall be supported in such a manner as to prevent any strain being imposed on the equipment supported.
5. All material used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regards to tests and physical and chemical properties.
6. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.
7. Hangers and supports shall be as manufactured the following manufactures. Product numbers used herein are based on B-Line Systems , Inc.
 - a. B-Line Systems, Inc.
 - b. Caddy/Eritrust
 - c. Unistrut
 - d. Kindorf
 - e. Superstrut

B. Hangers

1. All hangers and supports shall have some form of adjustment available after installation. Hanger material shall be compatible with the conduit material.
2. Hangers for conduit 2" and smaller shall be B-Line series B3170NF, B3174 or B3198. Hangers for conduit 2 1/2" and larger shall be B-Line series B3100, B3102 or B3170.

C. Hanger Rods

1. Hanger rods shall be B-Line series ATR (All Threaded Rod) or series B3205 with threaded at ends with allowance for adjustments. Wire and strap hangers will not be permitted. All electrical equipment shall be supported by rods, hangers, etc., using bolts.
2. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.
3. Hanger rod diameters shall be based on MSS SP-69 Table 4.

D. Beam Clamps

1. All beam clamps shall be concentric loaded type clamps which engage both edges of the beam flange. The hanger shall be located directly below the web of the beam. Consult with Structural Engineer to ascertain maximum loading on hanger in each area.
2. Beam clamps shall be B-Line series B3054, B3055 or B3291 through B3297.

E. Concrete Inserts

1. Concrete inserts for hangers shall be continuous metal or spot inserts designed to be used in ceilings, walls or floors and shall be as follows:
 - a. Continuous concrete inserts shall be used where applicable for hanger rod sizes up to 3/4" diameter. Inserts may be used where supports are parallel to the main slab reinforcement and shall be B-Line series B22I, B32I or B52I.
 - b. Spot concrete inserts shall be used where applicable for hanger rod sizes up to and including 7/8" diameter. Inserts shall be B-Line series B2505 through B2508, B2500, B2501 or B3014.

F. Welded Steel Brackets

1. Wall or column supported conduits shall be supported by welded steel brackets B-Line series B3064 or B3066.

G. Stanchions

1. For floor supported equipment, such as safety switches in mechanical areas, provide either cast-in-place concrete supports or field installed supports. Each support shall be screwed or welded to the corresponding size base stand.

Supporting pipe shall be of schedule 40 steel pipe construction. Each base stand shall be secured to the concrete floor by expansion bolts. Base stands shall be B-Line series B3088 or B3088T.

H. Strut Channel

1. Strut channel trapeze hangers shall be used to support parallel conduit runs. Conduit racks or stanchions fabricated with strut channel shall be used in areas with multiple conduit runs. Strut clamps and straps shall be used to maintain proper alignment. Strut shall be a minimum of 1 5/8" wide, B-Line series B22 or heavier as required. Clamps and straps shall be B-Line series B2000 suitable for the conduit material (EMT, IMC or RGS).
2. Provide strut channel above ceilings for support of electrical equipment such as lighting fixtures where mechanical equipment and ductwork interfere with direct mounting methods. Strut shall be used to span the width of the interference and supported by rods on each end.
3. Provide all required appurtenances required to properly hang and assemble strut supports.

2.3 MECHANICAL SUSPENSION CHANNEL

- A. Mechanical suspension channel shall be furnished and installed to support electrical equipment, (panelboards, disconnect switches, starters, transfer switches, transformers, etc.) independent of walls. Where walls back up to occupied spaces, the suspension channels shall be at least 1/2" clear of the wall and shall not be directly attached to the wall.
- B. Channel shall be Unistrut, Type P3000 or approved equal. All fasteners and fittings shall be supplied to provide a complete installation as required. Channel shall be sized and mounted to allow for future conduits.
- C. All channel and fittings shall be furnished with the manufacturer's standard rust-proofed finish.
- D. Channel shall be manufactured by one of the following: Unistrut Products Co., Kindorf, or B-Line.

2.4 VIBRATION ISOLATION AND SEISMIC RESTRAINTS FOR ELECTRICAL SYSTEMS

- A. Provide a "Vibration isolation And Seismic Restraints For Electrical Systems Report" for vibration isolation analysis, seismic restraint, design plans/details and specifications report for all electrical systems to resist seismic forces as determined in accordance to Commonwealth of Massachusetts State Building Code 780CMR for the "Seismic Hazard Exposure Group " and the "Seismic Performance Category " as identified in the architectural and structural contract documents for design classifications. Restraint systems are intended to be designed to withstand the stipulated seismic accelerations applied through the component's center of gravity. The Report shall include all necessary equipment information, including but not limited to, weights, dimensions, center of gravity, mounting locations, from the submittal approved manufacturers, the appropriate calculations and installation recommendations that are stamped and certified by a licensed Professional Engineer registered in the state where the project is constructed, and with the expertise of vibration and seismic restraints for electrical systems. (Note that vibration control manufacturers usually can assist in recommendations for such services above). This Report shall be submitted and reviewed prior to installation of equipment.
- B. Seismic restraint for all electrical systems used on this project shall be provided, except where specifically allowed for exclusion in the Code.
- C. Vibration Isolation and Seismic Restraint Devices
1. All vibration isolation and seismic restraint devices described in this section shall be the product of a single manufacturer. Mason Industries is the base manufacturer of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the Base Manufacturer. The devices shall be identified by the manufacturer to be suitable for the particular seismic application(s) and also be listed with California OSHPD to ensure product seismic capability.
 2. The manufacturer of the seismic restraint devices shall certify that the devices are capable of accepting, without failure, the seismic forces. The manufacturer shall select the appropriate seismic restraint device type, quantities, locations, installation instructions, drawings and field supervision to insure proper installation and performance of systems.
 3. Corrosion protection for outdoor application shall be as follows:
 - a. Springs cadmium plated, zinc electroplated, or powder coat
 - b. Hardware cadmium plated
 - c. All other metal parts hot spray or hot dipped galvanized
 4. All seismic restraint devices
 - a. shall maintain the equipment in a captive position and not short circuit isolation devices during normal operating conditions.
 - b. shall have provisions for bolting and/or welding to the structure.
 5. Welding of springs to isolator housing, base plates, etc., is strictly prohibited.

6. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc.
7. The same manufacturer shall provide vibration isolation devices for transformers suitable to maintain minimum deflection.

D. Seismic Restraint Types

1. TYPE I: Same as TYPE B. Cast or aluminum housing, (except ductile iron) are not acceptable.
 - a. Mason Industries TYPE SLR
 - b. Avnec
 - c. Vibration Eliminator Company
2. TYPE II: Where required, each corner or side of equipment base shall incorporate a seismic restraint snubber having an all directional resilient pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing. Angle bumpers are not acceptable.
 - a. Mason Industries Type Z-1225 / Z-1011
 - b. Avnec
 - c. Vibration Eliminator Company
3. TYPE III: Restraints for suspended systems
 - a. Vibration isolated systems shall be braced with multiple 7 x 19 strand galvanized cable rope.
 - 1) Mason Industries Type SCB
 - 2) Avnec
 - 3) Vibration Eliminator Company
 - b. Non-isolated systems shall be braced with structural steel strut type with approved fastening devices to equipment and structure.
 - 1) Mason Industries Type SSB
 - 2) Avnec
 - 3) Vibration Eliminator Company
 - c. Steel angles (by contractor) shall be provided to prevent rod bending of hung equipment where indicated by the Seismic Restraint vendor's submittals. Steel angles shall be attached to the rods with a minimum of three ductile iron clamps at each restraint location. Welding of support rods to angles is not acceptable. Rod clamp assemblies shall have Anchorage Pre-approval "R" number from California OSHPD.
 - 1) Mason Ind. Model "SRC".
 - 2) Avnec
 - 3) Vibration Eliminator Company

- d. Pipe clevis cross braces are required at all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the clevis cross bolt. Clevis cross braces shall have Anchorage Pre-approval "R" number from California OSHPD.
 - 1) Mason Ind. Model "CCB".
 - 2) Avnec
 - 3) Vibration Eliminator Company
 4. TYPE IV: Double deflection neoprene isolator encased in ductile iron or steel casing.
 - a. Mountings shall have Anchorage Pre-approval "R" number from California OSHPD, certifying the horizontal and vertical seismic load ratings.
 - 1) Mason Industries Type RC or BR
 - 2) Avnec
 - 3) Vibration Eliminator Company
 5. TYPE V: Rigid attachment to structure utilizing wedge type expansion anchors for bolting and steel plates, either cast-in or anchored with wedge type expansion bolts, for welding. Powder shots are not acceptable. Concrete anchor bolt spacing shall be in accordance with manufacturer's published standards.
- E. Vibration Isolator Types
1. TYPE A: Spring Isolator - Free Standing
 - a. Spring shall have a minimum outer diameter to overall height ratio of 0.8 : 1 at rated deflection.
 - b. Reserve deflection (from published load ratings to solid height) of 50% of the rated deflection.
 - c. Ductile top cup with adjusting bolt tapped for equipment attachment locking cap screw.
 - d. Minimum 1/4" thick neoprene acoustical base pad or cup on underside, unless designated otherwise.
 - 1) Mason Industries Type SLF
 2. TYPE B: Spring Isolator - Restrained
 - a. Shall be the same as TYPE A with the following additional features.
 - 1) Integral restraining bolts with elastomeric cushions preventing metal-to-metal contact.
 - 2) Internal spring adjusting nut or bolt with leveling capability.
 - 3) Built-in all-directional limit stops with minimum 1/4" clearance under normal operation.
 - 4) Mountings shall have Anchorage Pre-approval "R" number from California OSHPD, certifying the horizontal and vertical seismic load ratings.

- a) Mason Industries Type SLR, SSLFH
3. TYPE D: Double deflection neoprene isolator encased in ductile iron or steel casing.
 - a. Mountings shall have Anchorage Pre-approval "R" number from California OSHPD, certifying the horizontal and vertical seismic load ratings.
 - 1) Mason Industries Type RC or BR
 4. TYPE E: Elastomer Hanger Isolator
 - a. Molded neoprene element with an integral bushing to insulate lower support rod from the hanger box.
 - b. Steel hanger box shall withstand three times the rated load without failure.
 - 1) Mason Industries Type HD
- F. Submittal Requirements
1. Catalog cuts or data sheets on specific seismic restraint devices restraints to be utilized detailing compliance with the specification. Reference seismic restraint types per section of this specification. An itemized list of all isolated and non-isolated equipment. Detailed schedules showing seismic restraints proposed for each piece of equipment, referencing material and seismic calculation drawing numbers. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
 2. When walls and slabs are used as seismic restraint locations, details of acceptable methods must be included.
 3. Coordinated drawings shall be marked-up with the specific locations and types of restraints shown for all electrical systems including but not limited to, conduit, cable tray. Rod bracing at various installation angles and assigned load at each restraint location shall be clearly delineated. Any and all tributary loads shall be considered for proper restraint sizing.
 4. For ceiling suspended equipment provide minimum/maximum installation angle allowed for restraint system as well as braced and unbraced rod lengths at each allowable installation condition.
- G. Related Work
1. The Electrical Subcontractor shall coordinate with the General Contractor for all concrete pads and all attachments. Coordinate with the seismic restraint manufacturer for edge distance of pads, but shall be as minimum 10 bolt diameters of clearance all around the outermost anchor bolt to allow for the use of full anchor ratings.
 2. Coordinate to ensure that the concrete pad is restrained itself to the structure to resist the seismic forces.

H. Supplementary Support Steel

1. Contractor shall supply supplementary support steel and connections for all equipment and piping as required.

I. Definitions

1. The term EQUIPMENT used throughout this specification section above includes ALL non-structural components within the facility and/or serving this facility, such as equipment located in outbuildings or outside of the main structure on grade within five feet of the foundation wall. Equipment buried underground is excluded but entry of services through the foundation walls is included. Equipment referred to below is a partial list of equipment for reference. (Equipment not listed is still included in this specification).
2. Life safety systems are defined.
 - a. All systems involved with fire alarm system.
 - b. All systems involved emergency lighting systems.
3. Positive Attachment is defined as a support location with a cast-in or wedge type expansion anchor, a double sided beam clamp, and a welded or through bolted connection to the structure.
4. Transverse Bracing is defined as restraint(s) applied to limit motion perpendicular or angular to the centerline of the conduit, cable tray or bus duct.
5. Longitudinal Bracing is defined as restraint(s) applied to limit motion along the centerline of the conduit, cable tray or bus duct.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.
2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.
3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.

4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
 5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.
- B. Hangers, Supports and Mechanical Suspension Channel
1. All horizontal runs of conduits shall be properly grouped, aligned, using substantial hangers, straps, etc. Hangers and supports shall be installed at intervals not exceeding Code requirements.
 2. Structural Support Interface
 - a. All conduit, raceways, electrical equipment and other similar system components which are supported by roof or floor joists shall be hung from the top chord or bottom chord panel point or a panel point shall be provided by applying a vertical web member. The maximum load shall not exceed 250 pounds.
 - b. All conduit, raceways, electrical equipment, etc., which are supported by roof/floor beams shall be hung from the beams with clamp attachments which engage both edges of the beam flange. The hanger shall be located directly below the web of the beam and the hanger load shall be limited to 1000 pounds in area above mechanical room and 250 pounds in remaining areas, unless otherwise approved by the Architect.
 - c. All additional supports, clamps, web members, etc., required to comply with the above requirements shall be provided by the Electrical Subcontractor, as applicable, for the work furnished and installed under this Contract.
- C. Vibration Isolation and Seismic Restraints for Electrical System
1. Refer to the Part 2 Vibration and Seismic Restraints for Electrical Systems Report for installation requirements.
 2. All floor mounted equipment shall be snubbed, anchored, bolted or welded to the structure to comply with the required seismic forces. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. All equipment must be positively restrained to the structure.
 3. All suspended equipment shall be two or four point independently braced with TYPE III restraints, installed taught for non-isolated equipment and slack with ½" cable deflection for isolated equipment. Rod bracing shall be installed as per approved submittals and shop drawings.

4. All horizontally suspended conduits shall use RESTRAINT TYPE III unless otherwise noted in the Report.
5. For all trapeze supported conduit, the individual conduits must be transversely and vertically restrained to the trapeze support at the designated restraint locations.
6. The installation shall not overstress the building structure. Bracing locations and methods shall be reviewed by the Structural Engineer and Architect prior to installation.
7. Conduit Risers and Busduct Risers
 - a. Where conduits and busduct risers pass through cored holes, core diameters to be a maximum of 2" larger than pipe O.D. Cored holes must be packed with suitable resilient fire stop material as specified in other sections of this specification and/or state and local codes.
 - b. Conduit risers and busduct risers through cored holes require a riser clamp at each floor level on top of the slab attached in a seismically approved manner for vertical restraint.
 - c. Conduit risers and busduct risers in pipe shafts require structural steel attached in a seismically approved manner at each floor level and a riser clamp at each floor level on top of, and fastened to the structural steel. The riser clamp and structural steel must be capable of withstanding all static and seismic loads.
 - d. Refer to manufacturer's seismic restraint methods for busduct.
8. Ceiling mounted lighting fixtures shall be attached to lay-in ceilings with earthquake clips or other approved means of positive attachment to T- bar structure, in addition to direct attachments to the structure.
9. All non-isolated floor or wall mounted equipment shall use RESTRAINT TYPE III or V, unless noted otherwise in the Report.
10. Where base anchoring of equipment is insufficient to resist seismic forces, provide restraint TYPE III shall be located above the units center of gravity to suitably resist "G" forces specified, unless noted otherwise in the Report.
11. A rigid conduit or cable tray system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake (e.g wall and roof; solid concrete wall and a metal deck with lightweight concrete fill, bus duct, conduit, etc. crossing a building expansion joint).

3.2 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.

- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.
- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

END OF SECTION

SECTION 26 05 30

WIRING METHODS AND SYSTEMS

(Part of 26 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 01, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

- A. Refer to Section 26 05 10 – Electrical Special Conditions.

1.3 RELATED WORK

- A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 26 05 10.
- B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.4 WARRANTY

- A. Attention is directed to provisions of the General Requirements, Supplementary General Requirements, Division 01 - Warranties and Section 26 05 10 – Electrical Special Conditions regarding guarantees and warranties for the work under this Contract.

1.5 EQUIPMENT CONNECTIONS

- A. The Electrical Subcontractor shall be responsible to provide all conduit and wiring connections to equipment provided under other Sections of the specifications and provided by the Owner.
- B. Coordinate location of all equipment with the General Contractor. Obtain installation diagrams and methods of installation of all equipment from equipment manufacturers.

1.6 SHOP DRAWING SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with the Shop Drawings, Product Data and Samples Division 01 in the manner described therein, modified as noted hereinafter.

- B. All shop drawings shall have clearly marked the appropriate specification number of drawing designation, for identification of the submittal.
- C. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.
- D. All final approved shop drawings shall be included in the required O & M manuals.
- E. Shop drawings shall include, but shall not be limited to, the following:
 - 1. Wireways.
 - 2. Boxes.
 - 3. Conductors - 600 volts.
 - 4. Conduit.
 - 5. Contractor proposed routing of all conduits 2 inches in diameter and larger.

PART 2 - PRODUCTS

2.1 WIREWAYS

- A. Furnish and install wireways as required and/or as indicated on the drawings.
- B. Wireways shall be sized as required or minimum 6" x 6" x length as required. Wireways shall be provided with hinged covers.
- C. Wireways shall be as manufactured by Cutler Hammer, General Electric, Square D, Siemens or Approved Equal.

2.2 BOXES

- A. Junction and Pull Boxes
 - 1. Boxes shall be constructed of code-gauge galvanized steel or metal with baked enamel and shall be installed at points as required whether indicated on the drawings or not. Minimum dimension shall not be less than NEC requirements.
 - 2. Provide flat plain removable covers with suitable flat head machine screws or slotted truss head bolts.
 - 3. Boxes shall be constructed with suitable barriers separating different systems where required.
 - 4. Boxes exceeding 4'-0" in any direction shall be reinforced with angle iron stiffeners and shall contain cable supports.
 - 5. PVC Schedule 40 junction boxes shall be provided in areas with corrosive atmosphere.
 - 6. Boxes shall be manufactured by one of the following: Hoffman, McKinstry or Approved Equal.

2.3 CONDUCTORS - 600 VOLTS

A. General

1. Feeders

- a. All feeder wiring shall be manufactured of copper, rated at 600 volts, single conductor. Conductors #8 AWG and larger shall be stranded.
- b. All HVAC equipment power wiring shall be copper only.

2. Branch Circuits

- a. All branch circuit, remote control, signal circuit and interlock wiring shall be manufactured of copper, rated at 600 volts, single conductor. Conductors #8 AWG and larger shall be stranded. All wiring #10 AWG and smaller shall be solid.
- b. Minimum size wire for branch circuit and power wiring shall be #12 AWG. Remote control signal circuit and interlock wiring may be #14 AWG. Fire alarm wiring shall be per the Fire Alarm System Section of these specifications.
 - 1) Refer to Part 3 for voltage drop considerations.
- c. All wiring shall be installed in conduit (power, low voltage and control wiring), unless specifically indicated otherwise.
- d. Conductors #10 and #12 AWG shall be connected with pre-insulated spring connectors encased in a steel shell (wire nuts) and rated at not less than 105°C. A minimum of 3/8" skirt shall cover the bare wires. The connector shall meet with UL approval for fixture and pressure work and shall be "B-Cap" Type B1, B2 and B4 electrical spring connectors as manufactured by the Buchanan Co., Ideal or approved equal. Pushwire connectors (as similar to WAGO Wall-Nuts) shall NOT be allowed, only wire nuts shall be allowed for connections.

B. References

1. All wiring shall conform to the National Electrical Code for construction and use.
2. Conductor type THHW shall meet or exceed the following:
 - a. ASTM B-3 or B-8
 - b. UL Standard 83
 - c. UL listed as type THHW
3. Conductor types THWN shall meet or exceed the following:
 - a. ASTM B-3 or B-8
 - b. UL Standard 83
 - c. UL listed as type THWN

4. Conductor type XHHW shall meet or exceed the following:
 - a. ASTM B-3 or B-8
 - b. ICEA S-95-658
 - c. NEMA WC-70
 - d. UL Standard 44
 - e. UL listed as type XHHW

5. Conductor type XHHW-2 shall meet or exceed the following:
 - a. ASTM B-3 or B-8
 - b. ICEA S-95-658
 - c. NEMA WC-70
 - d. UL Standard 44
 - e. UL listed as type XHHW-2

C. Insulation

1. Insulation types for all conductors shall be as follows:

Description	Location		
	Dry	Damp	Wet
Copper Branch Circuits #6 AWG and smaller	THHN/THWN	THWN	THWN
Copper Branch Circuits larger than #6 AWG	XHHW	XHHW	XHHW-2
Copper Feeders not listed below	XHHW	XHHW	XHHW-2
All Aluminum Feeders	XHHW-2	XHHW-2	XHHW-2
All Service Feeders, Exterior Feeders and Exterior Branch Circuits	XHHW-2	XHHW-2	XHHW-2
All Feeders connected to 100% rated circuit breakers	XHHW-2	XHHW-2	XHHW-2

D. Color Coding

1. Color coding shall match the Owners color coding standard. If no standard color coding system exists, use the following:

208/120 Volts			480/277 Volts		
A Phase	-	Black	A Phase	-	Brown
B Phase	-	Red	B Phase	-	Orange
C Phase	-	Blue	C Phase	-	Yellow
Neutral	-	White	Neutral	-	Grey
Ground	-	Green	Ground	-	Green with Yellow Stripe

2. Color coding shall be continuous on insulation for #6 AWG or smaller and continuous or marked with color tape at all connections and in all pull, junction and outlet boxes for conductors larger than #6 AWG.

E. Manufacturers

1. Branch circuit and feeder conductors shall be manufactured by one of the following: General Cable, Southwire, Okonite or Approved Equal.

2.4 METALLIC CONDUIT

A. General

1. Raceways for Service Feeders, including all unmetered feeders regardless if feeders are located within building, shall be Rigid Metal Conduit (RMC).
2. Raceways for feeders and branch circuits shall be rigid metal conduit (Type RMC), intermediate metal conduit (Type IMC) or electrical metallic tubing (Type EMT) subject to the restrictions of the National Electrical Code. The minimum size allowed shall be 3/4".
3. Refer to Part 3 of this specification for installation requirements.

B. Rigid Metal Conduit (RMC)

1. RMC shall be dip galvanized and it shall be permitted under all conditions subject to the restrictions of the National Electrical Code and Part 3 of this specification. Regardless of drawings or other sections in these specifications, in wet locations or locations open to exterior weather Rigid Metal Conduit shall be provided.
2. Conforms to:
 - a. UL 6
 - b. Federal Specification WW-C-581
 - c. ANSI C80.1
3. Connectors and Couplings shall be threaded.

2.5 SOLDERLESS LUGS AND CONNECTORS

- A. All lugs for 600 volt feeder conductors and connectors for branch circuit joints shall be of the solderless type suitable for copper and aluminum wire.
- B. Lugs and wire connectors shall be one of the following: Ilsco, Anderson, Burndy Corp., Thomas & Betts Co or Approved Equal.

PART 3 INSTALLATION

3.1 INSTALLATION

A. General

1. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.

2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.
3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.
5. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.

B. Core Drilling

1. Electrical subcontractor shall provide core drilling required for installation of electrical systems as follows:
 - a. Electrical subcontractor shall carry all costs for core drilling, including but not limited to, drilling of openings, time and materials to safely seal and fireproof/waterproof/smokeproof all openings, protection of structure and area of drilling, clean-up of area, etc.
 - b. Electrical subcontractor shall be responsible for any circular penetrations required for proper installation of electrical systems.
 - c. Locate required openings, prior to coring, and coordinate openings with existing utilities, trades, etc.
 - d. Do not disturb or interrupt existing systems.
 - e. Electrical subcontractor shall be responsible for damage to building and building systems from coring operation.
 - f. All holes, openings, etc. shall be sealed to the satisfaction of the Engineer, Architect and Owner.

C. Conduits

1. Conduit shall be run concealed in finished areas above suspended ceilings, in wall spaces, etc. Exposed conduit runs in finished areas require Architect's approval. All conduit runs shall be properly grouped and installed parallel to walls, ceilings, etc., and supported with proper hangers, clamps, etc. Door swings shall be checked before installing back boxes for switches and receptacles.
2. Conduit bends shall be made with conduit bending machines or by an approved hickey. Lock nuts and insulated throat bushings of the compatible material shall be used to fasten conduit to outlet boxes, cabinets, etc.

3. Raceways imbedded in slabs shall be installed in the middle third of the slab thickness where practical, and leave at least 2" concrete cover. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placing. Space raceways laterally to prevent voids in concrete. Run conduit larger than 1" trade size parallel to or at right angles to maintain reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Raceways in slab shall be RMC only, nonmetallic conduit or EMT will not be allowed.
4. Conduit ends shall be cut square, threaded and reamed to remove burrs and sharp edges. Field threads shall be of the same type and have the same effective length as factory cut threads. Excessive exposed threads will not be allowed. Turns, wherever required in exposed conduit runs, shall be made by the use of factory-made bends, or field-made bends as approved. In condulets, or in the event of a multiplicity of conduits making the same turn, a steel junction box with a removable steel cover may be used. Offsets and bends for changes in elevation of exposed conduit runs shall be made at walls or beams and not in open spaces between walls or beams. Conduits shall be routed so as not to interfere with the operation or maintenance of any equipment. The entire job shall be done in a neat and workmanlike manner, as approved by the Architect. Steel supports or racks shall be galvanized steel channel and fittings.
5. All conduit work shall be carefully cleaned and dried inside before the installation of conductors. Wire shall not be pulled into conduit system until building roof and walls are weather-tight. Plug conduit ends to exclude dust, moisture, plaster or mortar while building is under construction. No lubricants or cleaning agents which might have a deleterious effect on conductor coverings shall be used for drawing conductors into raceways.
6. Drawings, in relation to routing of conduits, are diagrammatic. Except where additional conduits may be required to avoid de-rating of branch circuits, as required elsewhere within this Section, the number and size of conduits and wire shall be furnished and installed as indicated by the drawings. Conduits shall be routed in the field so as to be coordinated with the building structure. Permanently concealed conduit shall be as short and direct as possible. Exposed conduit and conduit concealed by removable finishes such as accessible ceiling tile shall be run in straight lines parallel and perpendicular to walls, beams and columns and with right angle bends.
7. Conduits passing through floors, walls and beams shall be of such size, number and in such locations so as not to impair the strength of the construction.
8. Raceways in ceiling spaces shall be routed in such an approved manner as to eliminate or minimize the number of junction boxes required, but also shall be routed in an orderly and organized manner. Support rods and clamps shall be furnished and installed as required. Support of conduits by use of wire is strictly prohibited. Conduits shall be supported and secured by listed conduit support devices as required. Routing and installation of conduits shall be strictly coordinated with the General Contractor, other Trades and the Architect.
9. Where rigid metal conduit is threaded in the field, a standard conduit cutting die providing 3/4" taper per foot shall be employed. Threadless coupling shall

not be used on rigid metal conduit except where specifically allowed by the Architect. Running threads shall not be used on rigid metal conduit. Compression fittings shall not be used with rigid steel, intermediate metallic or aluminum conduit.

10. Conduit work shall be installed in such a manner to keep exposed threads to an absolute minimum, and in no case shall more than (3) threads be left exposed after the conduit work is made up tight.
11. Provide flexible conduits for connections to equipment furnished under HVAC, Plumbing Sections and other equipment (transformers, generators, etc.) as specified under Part 2 of this specification and where available space dictates; and where noise transmission must be eliminated or reduced. Flexible conduit shall be liquid-tight except for connections to recessed lighting fixtures.
12. Conduit and EMT runs shall be mechanically and electrically continuous from service entrance equipment to distribution equipment. Conduit shall enter and be secured to cabinet, junction box, pull box or outlet box with locknut outside and bushing inside, or with liquid-tight, threaded, self-locking, cold-weld wedge adapter. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into tapped connections. Vertical conduit runs that terminate in bottoms of wall boxes or cabinets shall be protected from entrance of foreign material before installation of conductors.
13. Size of rigid metal conduit, intermediate metal conduit, electrical metallic tubing and flexible metallic conduit shall be as shown on the drawings.
14. Check raceway sizes to determine that green equipment ground conductor fits in same raceway with phase and neutral conductors to meet NEC percentage of fill requirements. Increase duct, conduit, tubing and raceway sizes shown or specified as required to accommodate conductors.
15. Conduit secured rigidly on opposite sides of building expansion joints and long runs of exposed conduit subject to stress shall have expansion fittings. Fittings shall safely deflect and expand to twice distance of structural movement. Provide separate external copper bonding jumper secured with grounding straps on each end of fitting.
16. PVC conduit that is mounted exterior and exposed shall be installed with expansion fittings to compensate for thermal expansion and contraction where the length change, in accordance with Code (527 CMR 12:00 Article 352 – particularly, Table 352.44), is expected to be 1/8" or greater in a straight run between securely mounted items.
17. Threaded sealing fittings for rigid steel conduits shall be cadmium-coated, malleable iron. Sealing fittings for aluminum conduit shall be threaded cast aluminum. Fittings that prevent passage of water vapor shall be continuous drain. Install and seal fittings as required by manufacturer's recommendations. In concealed work, install fittings in flush steel box with blank cover plate.
 - a. Install sealing fittings at following points, and elsewhere as shown:
 - 1) Where conduits enter or leave hazardous areas equipped with explosionproof lighting fixtures, switches, receptacles and

other electrical devices.

- 2) Where conduits pass from warm to cold locations.
- 3) Where required by NEC.

b. Secure conduit system as required by NEC.

18. A minimum 3/16" diameter, twisted nylon plastic type fish cord shall be furnished and installed in all empty raceways. Provide a tag and washer sized larger than the conduit on each end of fish cord indicating the location of the other end.

D. Underground Conduits and Ductbanks,

1. All underground conduit and raceways shall be nonmetallic conduit or rigid metallic conduit.
2. All underground ductbanks shall be steel reinforced and concrete encased nonmetallic conduit or rigid metallic conduit.
3. Rigid metallic conduits installed direct buried underground shall have a factory applied plastic resin, epoxy or two (2) coats of a field applied heavy asphalt paint specifically made for this purpose. Application of heavy asphalt paint shall extend to 6" above ground level.
4. Joints/couplings in conduits and fittings shall be watertight and shall meet the requirements of the manufacturer's installation recommendations. Threaded portions of steel conduits not encased in concrete, and adjoining ends of conduits, couplings and fittings shall be coated with two (2) layers of heavy asphalt paint after installation. Connections between conduits of different types shall be made in an approved manner, using adapters and other materials and methods recommended by conduit manufacturers.
5. Slope: Pitch ducts a minimum of 4 inches/100 feet to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between 2 manholes to drain in both directions.
6. All raceways as previously described shall utilize a mandrel of sufficient size to thoroughly clear raceways of all obstructions prior to installation of any wiring.
7. Warning tape shall be provided on all duct systems to indicate route during installation.
8. All penetrations through floor slabs, foundation walls or manhole walls shall be rigid metallic conduits. Provide changeover couplings and rigid metallic conduit (RMC) as required.
9. All underground conduits with elbows and offsets greater than 30 degrees shall be rigid metallic conduit (RMC) elbows and offsets.
10. All conduits penetrating into the building shall be totally sealed with thru-wall and thru-floor fittings, and waterproofing shall be applied on the conduit from face of the building to 5'-0" beyond.

11. Conduit Sleeves and Thru-Wall and Thru-Floor Fittings
 - a. Where conduits pass through a concrete foundation wall of a structure below grade or through a slab floor, provide a Thruwall & Floor Seal fitting equal to OZ Gedney Type FSK fitting.
 - b. Where a waterproofing membrane is to be installed on the exterior side of the penetration, provide an OZ Gedney FSKA adaptor to clamp the membrane material around the casing penetration.
12. Prior to backfilling of underground duct system, the Electrical Subcontractor shall provide a yellow (with black lettering) marking magnetic tape, 1'-0" from finished grade, stating, "Caution, Electric Line (Telephone Line, etc.) Buried Below". Tape shall be manufactured by Panduit or Approved Equal.
13. Where nonmetallic underground conduit enters the building and continues inside to the main electric service, pull box, cabinet or other electrical apparatus, the portion of the conduit that passes through the floor or wall and the remainder of the raceway inside the building shall be steel. Provide an adapter outside the building (10'-0" beyond building wall minimum) wall to connect plastic and metal conduit.
14. Trenches shall be evenly graded so that conduits slope uniformly a minimum 4" per 100'-0", without horizontal or vertical waves. Unless specified otherwise, conduit shall slope uniformly from (1) manhole to the next or from a high point between manholes to prevent pooling of water. Conduits run from building to manhole shall slope toward manhole to avoid water draining into the building. Avoid low points between manholes or upturned elbows.
15. Run conduits straight between manholes and upturned elbows. Unavoidable bends in nonmetallic conduits shall be made by assembling couplings at a slight angle if resulting radius is at least 100'-0". For radii less than 100'-0", use 5° angle couplings or 5° factory-made bend sections. Conduit shall terminate in end bells where raceway enters manholes. All conduit bends for telecommunication ductbanks shall be 36" radius sweeps. Conduit bends for power cable conduits shall be minimum 36" radius.
16. In ductbanks, support multiple conduit runs on preformed nonmetallic conduit separators on 4'-0" centers. Separator containing metal shall have metal non-continuous and shall not form a magnetic loop. Unless otherwise shown on the drawings, spacing between exterior surfaces of conduits shall be as follows:
 - a. 2" between telephone conduits
 - b. 2" between conduits containing cables operating at 600 volts or less
 - c. 12" between telephone conduit and power conduit in the same concrete envelope
 - d. 2 1/2" between conduits containing cables operating at more than 600 volts

- e. Space conduit separators to prevent sagging of raceway and breaking of couplings and watertight seals, to maintain deformation of conduit at separators to 0.10" or less. Secure with cords where necessary. Do not use tie wires, reinforcing rods or other metallic materials.
17. Stagger conduit couplings so that couplings on adjacent conduits do not lie on the same transverse plane. Space end bells 9" center-to-center at manhole wall face for 4" conduits and space proportionately for other sizes. Transition to end bell spacing shall start 10'-0" from face of manhole wall. Conduit slope shall equal that of main bank. Make new conduit entrances into manholes and building walls consistent with grading requirements and entrances. Waterproof all conduit entrances into manholes and buildings as required by the Architect.
18. When underslab conduit extends or runs below the bottom of a slab on the ground, the slab shall be thickened in the area of the conduit so as to encase the conduit in concrete by at least 2 inches on all sides. The responsibility for and expense of this work shall be borne by the Electrical Subcontractor.
19. Concrete for conduit envelopes shall be as required or as specified under Division 03. Concrete shall extend a minimum 3" beyond exterior surface of each conduit in bank. A red color agent shall be added to the top 3 inches of the concrete used in the ductbank. Coordinate work of this Section with that of Division 03.
20. Steel reinforcing rods shall be installed in all ductbank envelopes and must extend into the wall of building, manhole or other structure it terminates at to prevent sheering of ducts. Where a connection is made to an existing conduit line the envelope shall be doweled to the existing encasement.
21. Concrete envelopes between manholes, or between manhole and building, shall be poured in a single operation. Where more than (1) pour is necessary, provide 3/4" reinforcing rod dowels extending 18" into concrete on each side of joint. Dowels shall be coated with bonded adhesive prior to the second pour. Concrete envelopes installed over extensive area of disturbed earth shall have reinforcing as required.
22. Concrete envelopes that cross other conduits or pipelines or are run under roads and driveways shall be reinforced as required. Provide reinforcement where envelopes connect to manhole and building walls. Concrete envelopes that terminate for future extension shall have dowels as specified for joints between pours. Reinforcement shall be as required.
23. Trenches shall not be backfilled until concrete envelopes have had sufficient time to set. After concrete envelopes have set, conduits shall be cleared with mandrel of the same size as the conduit.
24. Where conduits cross under existing roadways, walks or other paved areas, steel conduits may be driven instead of conduits in trenches. After installation, paved grass areas and other areas disturbed shall be restored to original condition.

25. Cap ends of spare conduits 5'-0" beyond pavement and protect them from mechanical damage. Mark the location of conduit ends with concrete monuments, 6" in diameter by 18" long, set flush in the ground with "S/C" indented in the top.
26. Arrange multiple conduits as shown on the drawings. Make minor changes in location, or cross-sectional arrangement as necessary. Where conduit runs cannot be installed as shown because of conditions not discoverable prior to digging of trenches, request the Architect's instructions before further work is done.
27. Seal active and spare conduits that enter the building with oakum or other plastic expandable compound until conductors are ready for installation.
28. Manholes shall be set on 6" layer of compacted granular backfill (sand, bank-run gravel, crushed rock). Manholes shall have a minimum of 24" of cover over the roof of the manhole.
29. No Die Cast material is allowed for this project.

E. Cutting, Patching and Conduit Sleeves

1. The Electrical Subcontractor shall be responsible for all core drilling required for his work, but in no case shall he cut into any structural elements without the written approval of the Architect.
2. All cutting, rough patching and finish patching required for electrical work shall be provided by the Electrical Subcontractor.
3. All concrete and masonry equipment bases and pads, concrete duct banks, curbs, chases, pockets and openings required for the proper installation of the work under this Contract will be provided by the General Contractor, using dimensions, templates, bolts, anchors, as required by the manufacturer's installation details of the various equipment.
4. Where conduits pass through masonry or concrete walls, foundations or floors, the Electrical Subcontractor shall set such sleeves as are necessary for passage of the conduits. Sleeves shall be of sufficient size to provide air space around the conduit passing through for fireproofing. The Electrical Subcontractor shall be responsible for the exact location of sleeves provided under his Contract.
5. Conduit passing through exterior walls and floors below grade shall be made watertight with caulking compound and pipe sleeves with wall collar located at the center of the wall extending 8" all around the conduit. Collar shall be 1/8" thick steel welded to sleeve. Coordinate material requirements with the Contractor.
6. Sleeves and inserts shall not be used in any portions of the building where their use would impair strength or construction features of the building. Elimination of sleeves must be approved by Architect.

7. Pipe sleeves shall be Schedule 40 galvanized steel and shall be set, as follows:
 - a. Set sleeves 6" above finish floor and flush on each side of walls.
 - b. Set sleeves 6" above finished floor and flush on each side of walls and electric room floors.
 - c. Sleeves in walls and partitions shall terminate flush with finished floor.
 - d. Sleeves shall be set securely in place before concrete is poured.
 - e. Sleeves shall be minimum 2" larger in diameter than the pipe passing through it.
 8. Conduits passing through fire partitions shall be provided with 10 gauge steel pipe sleeves and firestopped.
 9. All cutting and patching required by the Electrical Subcontractor in finished areas which require access shall have access panels as specified elsewhere in this specification.
 10. Fill for floor penetrations shall be fire-resistant, compatible with floor material and finished to prevent passage of water, smoke and fumes. Fill in walls shall be similar to wall material, shall be fire-resistant in fire walls, and shall prevent passage of air, smoke and fumes. Fill spaces in openings after installation of conduit or cable. All fireproofing inside sleeves shall be by the Electrical Subcontractor. Fireproofing required outside of sleeves shall be by the General Contractor.
 11. Where conduits passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling and wall finishes.
 12. Fill slots, sleeves and other openings in floors and walls if opening is not used. Identify unused sleeves and slots for future installation.
 13. Lay out conduit and openings in advance, to permit provision in work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed.
 14. Bus duct penetrations through floors shall have concrete curbs built around the floor openings, 3" minimum height.
- F. Feeder and Branch Circuit Conductors (600 Volts)
1. Install wire and cable in approved raceways as specified and as approved by Authorities that have jurisdiction. Surface metal raceways shall not be used unless explicitly specified and shown on the drawings. Do not use surface raceways on floor.

2. Wire from point of service connection to receptacles, lighting fixtures, devices, equipment, outlets for future extension, and other electrical apparatus as shown on the drawings. Provide slack wire for connections where required. Wire nut ends of wires and provide blank covers for outlet boxes designed for future use.
3. Conductors #10 and smaller in branch circuit panelboards, signal cabinets, signal control boards in switchboards and motor control centers shall be bundled.
4. The branch circuit wiring has been designed for dedicated neutral conductors for each circuit and shall be installed as indicated on the drawings. All home runs shall have dedicated neutrals, sharing of neutrals shall NOT be allowed. No more than (3) 1-pole branch circuits (or 6 current carrying conductors) shall be installed in any conduit run.
5. Follow homerun circuit numbers shown on the drawings to connect circuits to panelboards. Where homerun circuit numbers are not shown on the drawings, divide similar types of connected loads among phase busses so that currents in each phase are within 10% of each other during normal usage.
6. All feeder, branch circuit or auxiliary system wiring passing through pull boxes and/or being made up in panelboards shall be properly grouped, bound and tied together in a neat and orderly manner in keeping with the highest standards of the Trade, with plastic cable ties. Loose ends of the cable ties shall be properly trimmed after making up same. Cable ties shall be Ty-Raps, as manufactured by Thomas & Betts, Holub Industries, Inc., Quick-Wrap, Burndy Unirap or approved equal.
7. Branch circuits and auxiliary system wiring shall be peeled out of the wiring gutters at the terminal cabinet and panels at 90° to circuit breakers and terminal lugs for connecting to same.
8. For large size conductors available only in black, use colored plastic tape at all ends, where connections and splices are made and in all pull boxes for the specified color code identification. Tape shall be wrapped around the conductor (3) complete turns.
9. Joints and splices shall be made in an approved manner and shall be equivalent, electrically and mechanically, to the conductor insulation. All conductors shall be connected by use of solderless crimp (compression) type connectors; these joints and splices shall be taped with (1) wrap of varnish cambric tape and then a minimum of (3) wraps of No. 88 Scotchbrand (3M Company) all-weather vinyl plastic electrical tape, or equal Permacel or Plymouth Co. Each wrap of tape shall be half-lapped. Conductors of size #4 AWG or larger shall have (2) coats of insulating varnish applied over the tape for joints in manholes, handholes or exposed-to-weather conditions.
10. Provide nonferrous identifying tags or pressure-sensitive labels for cables, feeders, and power circuits in pull boxes, manholes and switchboard rooms, at cable termination and in other locations.

11. Tags or labels shall be stamped or printed to correspond with markings on the drawings or marked so that feeder or cable may be identified readily. If suspended tags are provided, attach with 1/32" diameter, nylon, 55 pound test monofilament line or slip-free plastic cable lacing unit.
12. The number and size of conductors in each run of conduit is indicated on the drawings. Where there is a conflict between the number of wires indicated and the actual number required, the actual number and size required shall be installed.
13. All branch circuits shall be connected to breakers at Electrical Subcontractor's discretion. The balancing of all loads between phases shall be the Electrical Subcontractor's responsibility.
14. Splices, taps and lugs shall be electrically and mechanically secure and solderless lugs, and crimp connectors shall be used. Lugs shall be used for conductor sizes #8 AWG and larger. All lugs shall be of the proper size, and in no case shall strands be cut from a conductor in order to fit the conductor into a lug. Provide lug/cable adapters for breakers where oversized cables are indicated. All lug connections to buses in switchboards, unit substations, motor control centers, etc., shall be 2-bolt/nut connections.
15. Provide 1/4" polyethylene ropes for pulling wire. Provide wire pulling lubricants that meet applicable UL requirements as necessary.
16. Provide cable supports for vertical feeders as required by NEC. Vertical feeders shall be supported at every other floor level.
17. Provide split wedge cable supports with clamps for cable without metallic sheath in pull boxes. Supports shall be as manufactured by O.Z./Gedney or approved equal.
18. All wiring shall be installed and supported in accordance with the requirements of the NEC.

3.2 GROUNDING ELECTRODE SYSTEM

- A. Provide separate green insulated equipment grounding conductor for each single- or 3-phase feeder and each branch circuit. Install grounding conductor in common conduit with related phase and neutral conductors. Parallel feeders installed in more than (1) raceway shall have individual full size green insulated equipment ground conductors in each.
- B. Determine numbers and sizes of screw terminals for equipment grounding bars in panelboards and other electrical equipment. Provide screw terminals for active circuits, spares and spaces.
- C. Provide green, insulated equipment ground conductor in same raceway with associated phase conductors, as follows:
 1. From panelboard grounding bus to green ground terminals of receptacles to green 10-32 washer-in-head outlet box machine screw. (Receptacles with special cast boxes and factory designed and approved ground path do not require separate ground jumper.)

2. From panelboard ground bus to green 10-32 washer-in-head machine screw in ceiling outlet box or junction box, through flexible metallic conduit to ground terminal on lighting fixture and from green 10-32 washer-in-head machine screw in ceiling outlet box or junction box through flexible metallic conduit to green 10-32 washer-in-head machine screw in switch outlet box.
 3. From panelboard ground bus to green 10-32 washer-in-head machine screw in junction box or disconnect switch through flexible metallic conduit to starter unit, disconnect switch and to ground terminal in connection box mounted on motor.
 4. From equipment ground bus in motor control center through conduit and flexible metallic conduit to ground terminal in connection box mounted on 3-phase motors.
 5. From dry type transformer neutrals to the building steel (or the ground grid system) by means of copper wire, as scheduled and detailed on the drawings.
- D. Provide green insulated grounding conductor in all non-metallic conduits.
- E. All empty conduit runs shall be provided with insulated and grounding bushing and grounded by a #12 AWG green ground conductor to the nearest panel ground bus.

3.3 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.
- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.4 EQUIPMENT CONNECTIONS

- A. Furnish and install all power wiring and conduit including connections as required for equipment provided by HVAC, Automatic Temperature Control Trades and for equipment provided by the Owner. All interface and control wiring and conduit shall be provided by the respective Trade.

- B. Electrical Subcontractor shall review HVAC, Automatic Temperature Control and Architectural drawings for quantity and location of all equipment requiring power connection.
- C. All electrical connections to vibration isolated equipment shall be by flexible conduit of length at least 24" in length, installed with visible slack, or in a loop configuration, to allow free movement of the equipment and prevent transmission of noise and vibration.
- D. Equipment grounding integrity of all equipment and non-current-carrying metal parts must be ensured.
- E. All equipment requiring electrical connections which is furnished under other Sections and by others shall be connected under this Section.
- F. Before connecting any piece of equipment, check the nameplate rating against the information shown on the drawings and call to the attention of the Architect any discrepancies.
- G. The Electrical Subcontractor shall carefully study all equipment manufacturer's wiring diagrams and make corrections accordingly.
- H. The Electrical Subcontractor shall be held responsible for any damage done to motors or equipment driven by motors, due to incorrect direction of rotation, caused by faulty electrical connections, and incorrectly sized motor circuit protection, furnished under this Contract.
- I. Drawings and specifications of other Subcontractors and equipment suppliers furnishing motors shall be consulted for verification of size, speed and operation.
- J. On multi-speed motors, the isolating switches at the motor location shall be so interlocked or shall be of such a type that operation of (1) switch shall simultaneously open all conductors to the motor.

END OF SECTION

SECTION 26 20 10

LOW VOLTAGE DISTRIBUTION

(Part of 26 00 01, Filed Sub-bid)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 01, General Requirements, shall be included in, and made part of, this Section.

1.2 DESCRIPTION OF WORK

- A. Refer to Section 26 05 10 – Electrical Special Conditions.

1.3 RELATED WORK

- A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 26 05 10.
- B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.4 QUALITY ASSURANCE

- A. The manufacturers listed within this specification have been pre-selected for use on this project. No submittal will be accepted from a manufacturer other than specified.
- B. To ensure system compatibility, all low voltage distribution equipment shall be the products of the same manufacturer.

1.5 WARRANTY

- A. Attention is directed to provisions of the General Requirements, Supplementary General Requirements, Division 01 - Warranties and Section 26 05 10 – Electrical Special Conditions regarding guarantees and warranties for the work under this Contract.

1.6 QUALIFICATIONS

- A. The manufacturer of the low voltage distribution equipment shall be the manufacturer of the major components within the equipment.
- B. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001 or 9002 certified.

- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. The low voltage distribution equipment shall be suitable for and certified to meet all applicable seismic requirements of the latest accepted edition of the Massachusetts State Building Code for seismic zone 2 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, with a peak acceleration and ZPA as required per the Code. The tests shall fully envelope the response spectrum for all equipment natural frequencies up to at least 35 Hz.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation. Promptly notify the Architect in writing of any conflict between any requirements of the Contract Documents and the manufacturer's directions. Obtain the Architect's written instructions before proceeding with the work. Should Electrical Subcontractor perform any work that does not comply with the manufacturer's directions or written instructions from the Architect, he shall bear all costs arising in correcting any deficiencies that should arise.
- B. Equipment and materials shall be delivered to the site and stored in original sealed containers, suitably sheltered from the elements, but readily accessible for inspection by the Architect until installed. All items subject to moisture damage such as controls shall be stored in dry, heated spaces. Equipment such as switchgear with heater elements installed shall have the heater elements energized after the equipment is received by the Electrical Subcontractor.
- C. The Electrical Subcontractor shall be responsible to fully inspect all shipments for damage and report damage to the manufacturer and the Architect.
- D. Equipment shall be tightly covered and protected against dirt, water, and chemical or mechanical injury and theft. At the completion of the work, equipment and materials shall be cleaned and polished thoroughly and turned over to the Owner in a condition satisfactory to the Architect. Damage or defects that develop before acceptance of the work shall be made good at the Electrical Subcontractor's expense.
- E. The Electrical Subcontractor shall make necessary field measurements to ascertain space requirements, for equipment and connections to be provided under his respective Trade and shall furnish and install such sizes and shapes of equipment to allow for the final installation to conform to the drawings and specifications.
- F. The low voltage distribution equipment shall be split into shipping groups for handling as directed by the Electrical Subcontractor or as the manufacturer's limitations dictate. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be packaged and shipped separately. Each

switchgear shipping group shall be equipped with lifting eyes for handling solely by crane.

- G. The low voltage distribution equipment being stored prior to installation shall be stored so as to maintain the equipment in a clean and dry condition. If stored outdoors, indoor gear shall be covered and heated, and outdoor gear shall be heated.

1.8 ACCEPTABLE MANUFACTURERS

- A. Siemens
- B. Square D
- C. General Electric
- D. Eaton

1.9 SHOP DRAWING SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with the Shop Drawings, Product Data and Samples Division 01 in the manner described therein, modified as noted hereinafter.
- B. All shop drawings shall have clearly marked the appropriate specification number of drawing designation, for identification of the submittal.
- C. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.
- D. All final approved shop drawings shall be included in the required O & M manuals.
- E. Shop drawings shall include, but shall not be limited to, the following:
 - 1. Enclosed circuit breakers.
 - 2. Fuses
 - 3. Load centers.
 - 4. Motor controllers - magnetic starters.
 - 5. Motor disconnect devices.
 - 6. Panelboards - branch circuit and distribution. (100A-1200A)
 - 7. Power system studies and trip settings.
 - 8. Safety switches.
 - 9. A copy of short circuit, coordination, motor starting, voltage drop and Arc Flash Studies indicating the submitted equipment satisfy the study's results shall be included. Such studies shall be submitted and approved prior to equipment shop drawing submittals, otherwise the electrical contractor shall make appropriate correction to the equipment to address any comment indicated on the studies shop drawings review sheet. Any delay to the project due to the shop drawings proper resubmission would be the contractor's responsibility.
- F. The following equipment rooms, drawn at $\frac{1}{4}''=1'-0''$ scale, with all the electrical equipment laid out including dimensions, Code clearances, etc., shall be submitted

with the equipment shop drawings. Acceptance of these shop drawings shall be obtained prior to installation of feeder conduits:

1. All satellite normal and emergency electrical rooms and closets.

Notes:

Equipment shop drawings will not be reviewed without the room/equipment layouts.

The Architect/Engineer reserve the right to rearrange equipment in electrical equipment rooms or spaces once final equipment dimensional information is known and prior to installation of the equipment. Install equipment in the final location selected by the Architect/Engineer at no additional cost to the Owner.

2. Test reports.

The following product information shall be submitted:

- a. Descriptive bulletins.
- b. Product sheets.

1.10 CLOSEOUT SUBMITTALS AND O & M MANUALS

- A. The following information shall be submitted for record purposes, in a binder, prior to final payment:

1. Final as-built drawings and information for items listed above.
2. Operation and maintenance manuals with the following information:
 - a. Instruction books and/or instruction leaflets
 - b. Recommended renewal parts
3. Wiring diagrams.
4. Certified production test reports.
5. Installation information.
6. A copy of latest short circuit, coordination and Arc Flash Studies including a copy of all Arc Flash labels.
7. Seismic certification and equipment anchorage details.

PART 2 – PRODUCTS

2.1 ENCLOSED CIRCUIT BREAKERS

- A. Molded Case Circuit Breakers

1. Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics. Ground fault

protection shall be provided as required by NEC for any feeder, service or circuit with voltage more than 150 volts to ground and rated 1000 amperes and more.

2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
3. All enclosed circuit breakers shall be UL listed and labeled. Enclosed circuit breakers shall have rating not less than the power systems studies short circuit study ratings available from the power sources, with a minimum of 100KAIC .
4. Enclosed circuit breakers shall be fully rated for short circuit ratings match to the source of power equipment. Series ratings of Panelboards will not be acceptable.
5. Circuit breakers 250 ampere frame and below for normal power distribution shall be of the thermal-magnetic type with inverse time-current characteristics or shall be of the solid state type. The circuit breaker unit shall be provided with field interchangeable unit.
6. All feeder circuit breakers associated with the emergency generator system shall be microprocessor-based with true RMS sensing trip units, regardless of frame size.
7. Circuit breakers over 250 ampere frame, Emergency branch feeder and Legally Required branch feeders shall be microprocessor-based with true RMS sensing trip units. The circuit breaker unit shall be provided with field interchangeable unit.
 - a. Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a microprocessor, and a flux-transfer shunt trip. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
 - b. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

- c. The microprocessor-based trip system shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.
 - d. Molded Case Circuit Breaker Trip Units
 - 1) System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
 - a) Adjustable long time pick-up and delay
 - b) Adjustable short time pick-up and delay, with selective curve shaping
 - c) Adjustable instantaneous pick-up
 - d) Adjustable ground fault pick-up and delay, with selective curve shaping
8. Provide circuit breakers UL listed for application at 100% of their continuous ampere rating in their intended enclosure.

B. Accessories

- 1. Provide padlockable handle locks, shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings or specified in the specifications.

C. Enclosures

- 1. All enclosed circuit breakers shall have NEMA 1 general purpose enclosures unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below.
 - a. NEMA 1 surface or flush-mounted general purpose enclosures primarily intended for indoor use.
 - b. NEMA 3R rain-tight enclosures intended for outdoor use primarily to provide protection against rain, sleet, and damage from external ice formation.
- 2. All enclosed circuit breakers shall have metal nameplates, front cover mounted, that contain a permanent record of catalog number and maximum rating. Provide handle mechanisms that are padlockable in the "OFF" position.

2.2 FUSES

- A. All fuses shall be rated for proper voltage in which they are applied. Interrupting ratings shall be greater than the short circuit current available at the terminals of the switch.
- B. Fuse Types
 - 1. Fuses for motor branch circuits shall be dual element time delay Type RK5.

2. Fuses for equipment other than motor loads shall be general purpose 1-time Class K1.
 3. Control power transformers for motor controller circuits shall be as recommended by motor starter and motor control center manufacturer.
- C. Spare Fuses
1. Provide spare fuses in the amount of 20% (not less than three (3) nor more than nine (9) of all sizes and types).
 2. Spare fuses shall include general purpose fuses, motor fuses, and control fuses used in motor control centers, starters, etc.
 3. A complete list and quantity of spare fuses shall be submitted with record drawings for review.
- D. Spare Fuse Cabinet
1. Furnish and install a heavy duty steel cabinet 2'-0" wide by 3'-0" high by 1'-0" deep with shelves.
 2. Cabinet shall be provided with hinged lockage cabinet door.
 3. Coordinate with Owner for desired mounting location for the fuse cabinet. If no directions is given, install in the Main Electric room Level 1
- E. Manufacturers
1. Gould Shawmut
 2. Bussman
 3. Eaton
 4. Cooper
 5. GE
- F. Molded Case Circuit Breakers
1. Feeder breakers rated for 250A and below shall be molded case circuit breakers and shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics.
 2. Feeder circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

3. Feeder circuit breakers shall have a minimum symmetrical interrupting capacity of 100,000 amperes.
4. Feeder circuit breakers 250 ampere frame and below shall be of the thermal-magnetic type with inverse time-current characteristics or shall be of the solid state type.
5. Feeder circuit breakers over 250 ampere frame, Emergency branch feeder, Legally Required and branch feeders shall be microprocessor-based with true RMS sensing trip units.
 - a. Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a microprocessor, and a flux-transfer shunt trip. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
 - b. Field Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.
 - c. The microprocessor-based trip system shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.
 - d. Molded Case Circuit Breaker Trip Units
 - 1) System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
 - a) Adjustable long time pick-up and delay
 - b) Adjustable short time pick-up and delay, with selective curve shaping
 - c) Adjustable instantaneous pick-up
6. The breakers shall be UL listed for application at 100% of their continuous ampere rating in their intended enclosure.
7. The breakers that can be adjusted to 1200 Ampere or higher shall include an Arc Energy-reducing maintenance switching with local status indicator feature to comply with 527 CMR 12:00 Article 240.87.
7. The Emergency and Legally required system shall be coordinated per Code. The gear/switchboard manufacturer shall provide adequate frame size to allow selective coordination of trip sizes noted on drawings. The manufacturer shall prove selective coordination of the Emergency, Legally Required, and Elevator system downstream circuit breakers.

2.3 MOTOR CONTROLLERS

A. General

1. The manufacturer shall submit wiring diagram(s) for each type of motor starter. Prior to submission for approval by the Engineer, the Electrical Subcontractor shall submit these drawings to the HVAC/Automatic Temperature Control (ATC) Subcontractors to determine suitability in their system(s). Following this review, the Electrical Subcontractor may submit the drawings to the Engineer for review. The submittal shall clearly indicate that the HVAC/ATC Subcontractors have reviewed the wiring diagrams and have accepted them for use with their systems.
2. All magnetic motor starters shall be sized by the equipment manufacturer based on the motor horsepower size indicated on the accepted mechanical equipment shop drawings (also refer to nameplate rating of motors).

B. Magnetic Motor Starters

1. All 480 volt starters minimum sizes shall be as follows:
 - a. Less than 1/2 HP: NEMA Size 0
 - b. 1/2 to 10 HP: NEMA Size 1
 - c. 15 to 25 HP: NEMA Size 2
 - d. 30 to 50 HP: NEMA Size 3
 - e. 60 to 100 HP: NEMA Size 4 - Reduced Voltage
 - f. 125 to 200 HP: NEMA Size 5 - Reduced Voltage
2. All 208 volt starters minimum sizes shall be as follows:
 - a. Less than 1/2 HP: NEMA Size 0
 - b. 1/2 to 7½ HP: NEMA Size 1
 - c. 10 HP: NEMA Size 2
 - d. 15 to 25 HP: NEMA Size 3
 - e. 30 to 40 HP: NEMA Size 4 - Reduced Voltage
 - f. 50 to 75 HP: NEMA Size 5 - Reduced Voltage
 - g. 100 HP: NEMA Size 6 - Reduced Voltage
3. Magnetic starters shall be electrically operated, electrically held, three pole assemblies with arc extinguishing characteristics and shall be equipped with double-break silver alloy contacts. The starter shall have straight-through wiring. Each starter shall have provisions for a total of five normally open or five normally closed auxiliary contacts wired to a terminal block with two (2) normally open and two (2) normally closed unused spare auxiliary contacts.
4. Coils shall be of molded construction, color-coded and permanently marked with voltage, frequency and part number.
5. The overload shall be of the solid-state type. The overload relay shall provide high accuracy through the use of state-of-the-art microelectronic packaging technology. The relay shall be suitable for application with NEMA size 1 through Size 7 motor starters. The overload relay shall be of modular in design, be an integral part of a family of relays to provide a choice of levels of protection, be designed to directly replace existing electromechanical overload

relays, and be listed under UL Standard 508. The overload shall have the following features:

- a. Be self-powered.
 - b. Class 10 or 20 tripping characteristics.
 - c. Manual or automatic reset.
 - d. Phase loss protection. The relay shall trip in 2 seconds or less under phase loss condition when applied to a fully loaded motor.
 - e. Visible trip indication.
 - f. (1) NO and (1) NC isolated auxiliary contact.
 - g. Test button that operates the normally closed contact.
 - h. Test rip function that trips both the NO and NC contacts.
 - i. A current adjustment range of 3.2:1 or greater.
 - j. Ambient temperature compensated.
 - k. Ground fault protection. Relay shall trip at 50% of full load ampere setting.
 - l. Jam/Stall protection. Relay shall trip at 400% of full load ampere setting, after inrush.
6. Each starter shall be equipped with the following:
- a. A primary and secondary fused control power transformer sized 50 VA above the minimum rating.
 - b. Two LED indicating lights, "RED" for run; "GREEN" for stop.
 - c. A mechanical H-O-A selector switch. Electronic or touch pad type H-O-A switches will not be acceptable.
 - d. Device panel with space to accommodate five (5) oil-tight, pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters.
7. Time delay relays shall be provided as follows:
- a. All motors 15 HP and above to delay starting of motor upon energization.
 - b. All two-speed motors for delay between "high" and "low" speeds to allow coast down of motor.
 - c. All reversing starters between forward and reverse and between reverse and forward to allow motor to stop.
 - d. All timers shall be adjustable between 1 and 60 seconds continuous. Final adjustment shall be made by the Electrical Subcontractor to coordinate with system conditions. List of settings shall be provided to the Owner and Electrical Engineer for review.
- C. Manual Starters (Thermal Overload Switch)
1. The manual starter (thermal overload switch) shall be 600VAC rated toggle-operated and shall be rated for the horsepower of the load served, with a minimum of 1HP equal to Eaton Cutler-Hammer Type MS.

2. Manual starters shall be provided with thermal overload protection. Motor overload protection shall be provided by means of a bimetallic type thermal relay in combination with interchangeable heaters. Starter shall have quick-break operating mechanism, silver contacts, and pressure type terminal contacts. The operating handle shall indicate whether unit is "ON", "OFF" or "TRIPPED". Heaters shall be installed without removing the starter from the housing or disturbing the wiring. All heaters shall be sized per the horsepower of the motor code letter. Coordinate with HVAC and Plumbing Trades.
3. The enclosure shall be general purpose NEMA 1 or other as identified on the drawings.

D. ENCLOSED COMBINATION SOFT-START CONTROLLERS

1. These specification requirements are for solid state reduced voltage motor controllers herein referred to as soft starters. The soft starter shall be designed to operate a NEMA design B motor to reduce the current in-rush as well as mechanical shocks that can result from starting or stopping a motor across the line and UL 508 - Industrial Control Equipment Listed.
2. The soft starter shall be provided by the manufacturer factory mounted in an enclosure rated as NEMA Type 1. Enclosure shall include a door mounted digital keypad for adjusting the soft starter parameters and viewing process values and viewing the motor and soft starter status without opening the enclosure door. Provisions shall be available for padlocking the enclosure door.
3. The enclosed product shall be provided complete with overcurrent protective device molded case disconnect switch and in-line fuse block for Class J power fuses from 10 to 600A or Class L power fuses from 601 to 1600A for Type 1 short circuit protection:
 4. The motor must be automatically protected from solid state component failure by isolation contactor that opens when the motor is stopped or when the controller detects a fault condition including a shorted SCR. The soft starter shall utilize an SCR bridge consisting of at least two SCRs per phase to control the starting and stopping of industry standard motors. The soft start shall provide torque control for linear acceleration independent of motor load or application type without external feedback. The gating of the SCRs will be controlled in such a manner to ensure stable and linear acceleration ramp. The soft starter shall be controlled by a microprocessor that continuously monitors the current and controls the phasing of the SCRs. Analog control algorithms shall not be allowed.
 5. All soft starter power ratings will utilize the same control board/module.
 6. A shorting contactor shall be standard on soft starters in all enclosure configurations. Protective features and deceleration control options integral to

the soft starter shall be available even when the shorting contactor is engaged.

7. The equipment shall be equal to the features of Altistart 48 Enclosed Soft Start Starter by Square D / Schneider Electric . The equipment shall be the same manufacturer as the electrical distribution equipment.
8. Digital indication shall provide, as a minimum, the following conditions:
9. Soft starter status - ready, starting/stopping, run.
10. Motor status - current, torque, thermal state, power factor, operating time, power in kW.
11. Fault status - Motor thermal overload, soft starter thermal fault, loss of line or motor phase, line frequency fault, low line voltage fault, locked rotor fault, motor underload, maximum start time exceeded, external fault, serial communication fault, line phase reversal fault, motor overcurrent fault.
12. The soft starter must be preset to the following for adjustment-free operation in most applications:
 - a. Linear (torque-controlled) acceleration ramp of 15 seconds.
 - b. Current limitation to 400% of the motor full load current rating.
 - c. Class 10 overload protection.
 - d. Motor current preset per NEC / NFPA 70 table 430.150 for standard hp motors.
 - e. A digital keypad shall be utilized configure the following operating parameters as required:
 - f. Motor full load amps adjustable from 40 to 130% of the soft starter's rating.
 - g. Current limitation on starting adjustable from 150 to 700% of the motor current rating, not to exceed 500% of the soft starter rating.
 - h. Linear (torque-controlled) acceleration ramp adjustable from 1 to 60 seconds.
 - i. Initial torque adjustable from 10 to 100% of nominal motor torque.
 - j. Torque limit adjustable from 10 to 200% of nominal motor torque.
 - k. Maximum start time adjustable from 10 to 999 seconds.
 - l. Voltage boost adjustable from 50 to 100% of the nominal supply voltage.
 - m. Selection of freewheel, soft stop or braking.

- n. Linear (torque-controlled) deceleration ramp time adjustable from 1 to 60 seconds.
 - o. Threshold to change to freewheel from a controlled deceleration ramp to freewheel stop: adjustable from 0 to 100% of the nominal motor torque.
 - p. Braking torque level adjustable from 0 to 100% effectiveness.
 - q. Selection of Class 2, 10, 10A, 15, 20, 25 or 30 motor thermal overload protection.
 - r. A digital keypad shall be utilized configure the controller parameters as required:
 - s. Output relays shall provide the following status indications:
 - 1) One Form A (N.O.) minimum for indication of fault.
 - 2) One Form A (N.O.) for indication that acceleration ramp is complete and current is below 130% motor FLA (end of start).
 - 3) One Form A (N.O.) for indication when HOA switch is in the OFF mode.
 - 4) One Form A (N.O.) for indication when HOA switch is in the HAND manual mode.
13. Additional inputs and outputs shall be available to provide the following status indications:
- a. Two assignable control inputs for the following functions: force to freewheel stop, external fault input, disable serial link control, external motor overload reset or general fault reset.
 - b. Two assignable logic-level signal outputs for the following functions: motor thermal overload alarm, "motor powered" signal, motor overcurrent alarm, or motor underload alarm.
 - c. One analog output shall be available for 4 to 20 or 4 to 20 milliamp indication of motor current, motor torque, motor power, motor thermal state, or power factor.
 - d. When HOA Switch is put into the 'HAND' manual mode, the controller shall bypass the factory setting for manual activation and initiate the Form A output relay to have the fire alarm system initiate damper open and start fan.
 - e. Relay and I/O functions listed above must be isolated with respect to common.
 - f. A microprocessor-based thermal protection system shall be included which continuously calculates the temperature-rise of the motor and soft starter and provides:

- g. A motor overload pre-alarm that indicates by relay contact or logic output that the motor windings have exceeded 130% of its rated temperature rise. This function shall be for alarm only.
 - h. A motor overload fault will stop the motor if the windings have exceeded 140% of temperature-rise.
 - i. An electronic circuit with a time-constant adjustable to the motor's thermal cooling time-constant ensuring the memorization of the thermal state even if power is removed from the soft starter.
 - j. The soft starter shall provide line and motor phase loss, phase reversal, underload, stall, and jam protection.
 - k. The integral protective features shall be active even when the shorting contactor is used to bypass the SCRs during steady state operation.
 - l. The soft starter control circuit shall be fed from the line supply and be completely independent of the power circuit and separate from the control logic.
 - m. The peripheral soft starter control circuitry shall be operated at 120 Vac 60 Hz from a control power transformer included within the enclosure.
14. Operator devices shall be door mounted and shall be:
- a. Three position H-O-A switch which provides for manual (HAND) start or remote signal (AUTO) start from user-supplied relay contacts.
 - b. GREEN RUN pilot light illuminated whenever the soft starter is provided a run command and no fault condition is present.
 - c. RED OFF pilot light illuminated whenever the soft starter is supplied with control power and no run command is present.
15. All operator devices shall be remote-mounted using supplied 120 Vac control logic. Clearly labeled terminals shall be provided for field installation.
16. A microprocessor shall control the operation of the shorting contactor via an output relay. The shorting contactor shall close, shorting the SCRs after the acceleration ramp is complete and motor current is below 130% of motor FLA, and open on a stop command to allow a deceleration ramp.
17. Overload protection integral to the soft starter shall continue to protect the motor when shorting is engaged.
18. A full voltage bypass starter with overload protection shall be included to provide motor operation in the case of soft starter failure.
19. A "NORM/BYPASS" selector switch shall be mounted on the enclosure door.

2.4 PANELBOARDS - BRANCH CIRCUIT AND DISTRIBUTION (100A - 1,200A)

A. General

1. All panelboards shall be UL listed and labeled. Panelboards shall have rating not less than the short circuit ratings available from the power sources, assume a minimum of 100KAIC for bid purposes.
2. Panelboards shall be fully rated for short circuit ratings indicated above. Series ratings of Panelboards will not be acceptable.

B. Construction

1. Interiors shall be completely factory assembled with bolt-on devices. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
2. All spaces indicated in distribution panels shall be provide with connector kits to allow installation of future circuit breakers. Where no spaces are indicated on the drawings, provided spaces for remaining poles.
3. Trims for distribution, lighting and appliance panelboards shall be supplied with a door-in-door trim. The inner door shall be a hinged door over all circuit breaker handles. The outer door shall be the entire trim with a piano hinge to expose wiring gutters. Inner door in panelboard trim shall not uncover any live parts. Inner doors shall have a semiflush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners. Switching device handles in distribution panelboards shall be accessible.
4. Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.
5. Where double tub panels are indicated on the drawings, each tub shall contain the same number of breakers and spaces. Box and trim sizes shall be identical.
6. Where auxiliary gutters are indicated for feed through lugs, a separate gutter shall be attached to the panelboard, sized as required based on conductor size, with an individual cover.
7. A directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
8. All locks shall be keyed alike.

C. Bus

1. Main bus bars shall be plated aluminum sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.
2. A bolted ground bus shall be included in all panels.
3. In addition to the bolted ground bus, an isolated ground bus shall be included in panels as indicated on the drawings.

4. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices.
 5. Neutral Bus
 - a. Full-size insulated neutral bars shall be included for panelboards shown with neutral.
 - b. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection.
- D. Power Distribution Panelboards, Circuit Breaker Type
1. Molded case circuit breakers shall provide circuit overcurrent protection with inverse time and instantaneous tripping characteristics. Ground fault protection shall be provided on each breaker.
 2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy, and arc extinction shall be accomplished by means of DE-ION arc chutes.
 3. Circuit breakers 250 ampere frame and below shall be of the thermal-magnetic type with inverse time-current characteristics or shall be of the solid state type.
 4. Circuit breakers over 250 ampere frame shall be microprocessor-based with true RMS sensing trip units.
 - a. Each molded case circuit breaker microprocessor-based tripping system shall consist of three current sensors, a microprocessor, and a flux-transfer shunt trip. True RMS sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time delay settings are reached.
 - b. Interchangeable rating plugs shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.
 - c. The microprocessor-based trip system shall have thermal memory capabilities to prevent the breaker from being reset following an overload condition until after a preset time delay.
 - d. Molded Case Circuit Breaker Trip Units
 - 1) System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments:
 - a) Adjustable long time pick-up and delay

- b) Adjustable short time pick-up and delay, with selective curve shaping
- c) Adjustable instantaneous pick-up

E. Branch Circuit Panelboards

1. Bolt-in type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
2. Circuit breakers shall be thermal magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100 ampere frame and through 100 ampere trip sizes shall take up the same pole spacing. 20 ampere, single pole circuit breakers shall be UL listed as type SWD for lighting circuits.
3. All branch circuit breakers serving devices (receptacles, light fixtures, smoke detectors, etc.) within the sleeping areas of a dwelling unit shall be "Arc Fault Circuit Interrupter" type conforming to UL Standard 1699.
4. Where appliances such refrigerators and disposals are not readily accessible provide combination ground fault circuit interrupter /arc fault circuit interrupter GFCI/AFCI breaker to protect the equipment. The electrical contractor shall review the drawings prior to bid and allow such an allowance for the appliances with inaccessible or out of reach outlet.
5. The circuit breakers feeding the listed loads below shall be provided with padlockable handle locks. The padlockable handles shall be capable of being locked in the "ON" and "OFF" positions and shall be secured with a screw. The loads are as follows:
 - a. Fire Alarm
 - b. Exit Signs
 - c. Emergency Lights
 - d. Energy Management systems
 - e. Lighting Control Systems
6. Provide spare circuit breakers matching the circuit breakers in the panel for minimum of 15% of the total number of poles in each panel (i.e. 42 Pole panel with 25 - 20A/1P active connected circuit breakers shall be provided with minimum 6-20A/1P spare circuit breakers).

F. Enclosure

1. Enclosures shall be at least 20 inches wide and 5 3/4 inches deep made from galvanized steel. Provide minimum gutter space in accordance with the National Electric Code. Where feeder cables supplying the mains of a panel are

carried through its box to supply other electrical equipment, an auxiliary gutter shall be provided, sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.

2. Enclosures shall be provided with removable blank ends.
3. Panelboards shall have NEMA 1 general purpose enclosures unless otherwise noted.
 - a. Enclosure types:
 - 1) NEMA 1 surface or flush-mounted general purpose enclosures primarily intended for indoor use.
 - 2) NEMA 3R raintight enclosures intended for outdoor use primarily to provide protection against rain, sleet, and damage from external ice formation.

G. Nameplates

1. Each panel shall have an engraved nameplate for each section. Engraved nameplate shall include panel designation, voltage, phase, ampere rating of upstream feeder breaker or main circuit breaker, and designation of upstream panel or other device similar to:

PANEL L42
100 AMPERE, 480/277 VOLT, 3 PHASE, 4 WIRE
FED FROM PANEL D42

2. Where panel is fed directly from an upstream transformer, nameplate shall be similar to:

PANEL D22
800 AMPERE, 208/120 VOLT, 3 PHASE, 4 WIRE,
FED FROM PANEL D42 VIA 225 kVA TRANSFORMER

3. Nameplates shall be laminated plastic, black characters on white background, and secured with screws. Characters shall be 3/16 inch high, minimum.
4. Panelboards shall be provided with typewritten directories with plastic protector indicating circuit numbers, equipment served and room number of the area served. All room numbers used for directory cards shall be the room numbers assigned by the Owner and not necessarily room numbers indicated on the drawings. Coordinate all room numbers with Architect prior to final printing of directory cards. Directory cards shall be edited and maintained during the course of construction to keep an accurate, up to date record of each feeder or branch circuit.

H. Finish

1. Surfaces of the trim assembly shall be properly cleaned, primed, and a finish coat of gray ANSI 49 or 61 paint applied.

2.5 SAFETY SWITCHES

- A. All safety switches shall be Heavy Duty type. General Duty type switches shall NOT be allowed.
- B. Provide disconnect switches as shown on drawings, with the following ratings:
 - 1. 30 to 1,200 Amperes.
 - 2. 250 Volts AC, DC; 600 Volts AC.
 - 3. 2-poles and 3-poles plus S/N.
 - 4. Fusible and Non-Fusible.
 - 5. Mechanical lugs suitable for aluminum or copper conductors.
- C. Construction
 - 1. Switch blades and jaws shall be visible and plated copper.
 - 2. Switches shall have a red handle that is easily padlockable with three 3/8" shank locks in the "OFF" position.
 - 3. Switches shall have defeatable door interlocks that prevent the door from opening when the handle is in the "ON" position. Defeater mechanism shall be front accessible.
 - 4. Switch assembly and operating handle shall be an integral part of the enclosure base.
 - 5. Switches rated 30 amps to 600 amps shall have reinforced fuse clips.
 - 6. Switch blades shall be readily visible in the "OFF" and "ON" position.
 - 7. Switch mechanism shall be non-teasable, positive quick-make/quick-break type. Bail type mechanisms are not acceptable.
 - 8. Fusible switches shall be suitable for service entrance.
 - 9. Switches shall have line side shields.
 - 10. Suitable for systems capable or 200kA at 480V with Class J, L, R, or T fusing as applicable.
 - 11. Embossed or engraved ON-OFF shall be provided.
 - 12. Double-make/double-break switch blade feature shall be provided.
 - 13. Renewal parts shall be shown on the inside of the door.
- D. Enclosures

1. Types
 - a. NEMA 1 General Purpose.
 - b. NEMA 3R Raintight.
 - c. NEMA 4 Watertight Stainless Steel.
 - d. NEMA 12 Dust-tight and Oil-tight Special Industry.
 2. All interior safety switches shall have NEMA 1 general purpose enclosures. All exterior safety switches shall have NEMA 3R rainproof enclosures unless otherwise noted.
 3. Paint color shall be ANSI 61 gray.
- E. All switches shall be UL-98 listed and meet NEMA Specifications KS-1.
- F. All switches shall have defeatable door interlocks that prevent the door from opening when the operating handle is in the "ON" position.
- G. Switches shall have line terminal shields.
- H. Where safety switches are installed between variable speed drives and their associated motor, an interlock switch shall be provided on the safety switches and 2#14-1/2"C. shall run from the interlock switch to the associated variable speed drive to turn off the drive while the safety switches is in the off position.
- I. All two speed motors shall be provided with 6-pole motor safety switches.
- J. All motors/pumps/air handling units shall be provided with proper size/rating disconnect switch whether indicated on drawings or not to comply with NEC. Install and connect disconnect switches furnished by other Trades.
- K. Where the safety switches are serving emergency loads (article 700 and 701 loads) they shall be provided with status auxiliary contacts.

2.6 VIBRATION ISOLATION

- A. Vibration control devices, materials and related items. Perform all work as indicated on the Drawings and as specified herein to provide complete vibration isolation systems in proper working order.
- B. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate dimensions and size of housekeeping pads.
- C. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified requirements.
- D. Provide any incidental materials needed to meet the requirements stated herein, even if not expressly specified or indicated on the Drawings.

- E. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.
- F. Should any equipment cause excessive noise or vibration, provide remedial work to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.
- G. Upon completion of the work, the Architect shall inspect the installation and shall inform of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.
- H. The shop drawing submittal for isolated electrical equipment shall include submittal information for the isolation mounts. Information supplied shall be as follows:
 - 1. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
 - 2. Detailed selection data for each vibration isolator supporting equipment, including:
 - a. The equipment identification mark.
 - b. The isolator type.
 - c. The actual load.
 - d. The static deflection expected under the actual load.
 - e. The additional deflection-to-solid under load.
 - f. The ratio of spring height under load to spring diameter.
- I. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. Provide for all costs associated with submission of samples.
- J. Vibration Isolation Type DNP (Double Neoprene Pad)
 - 1. Neoprene pad isolators shall be formed by two layers of 1/4" (6.4mm) to 5/16" (8mm) thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
 - 2. Manufacturers
 - a. Amber/Booth - Type NR.
 - b. Korfund Dynamics - Type Korpad.
 - c. Mason Industries - Type WSW.

- d. Kinetics Noise Control - Type NPS.
 - e. Vibration Mounting and Control - Series Shear Flex.
 - f. Substitution: under provisions indicated.
- K. Vibration Isolation Type HN (Hanger Neoprene)
- 1. Vibration isolation hangers shall consist of neoprene-in-shear or glass fiber element contained in steel housing. Neoprene neck bushing (or other element) shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30 degree arc before contacting the hanger housing.
 - 2. Type HN isolators shall be one of the following products or approved equal:
 - a. Amber/Booth - Type BRD-A.
 - b. Korfund Dynamics - Type H.
 - c. Mason Industries - Type HD.
 - d. Kinetics Noise Control - Type RH or FH.
 - e. Vibration Mountings and Control - Type RHD or RFD.
 - f. Substitutions: under provisions indicated.
- L. Vibration Isolation Type FSNTL (Floor Spring and Neoprene Travel Limited)
- 1. Spring isolators shall be free-standing and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring shall have a minimum additional travel-to-solid equal to 50 percent of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one. All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of 1/4" (6.4mm) shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
 - 2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel, or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.

3. Manufacturers
 - a. Amber/Booth - Type CT.
 - b. Korfund Dynamics - Type WSCL.
 - c. Mason Industries - Type SLR.
 - d. Kinetics Noise Control, Inc. - Type FLS.
 - e. Vibration Mounting and Controls, Inc. - Series AWR.
 - f. Substitutions - under provisions indicated.

- M. Vibration Isolation Type NP (Neoprene Pad)
 1. Neoprene pad isolators shall be one layer of 1/4" (6.4mm) or 3/8" (9.5mm) thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
 2. Manufacturers
 - a. Amber/Booth - Type NR.
 - b. Korfund Dynamics - Type Korpad.
 - c. Mason Industries - Type W.
 - d. Kinetics Noise Control, Inc. - Type NPS.
 - e. Vibration Mounting and Controls, Inc. - Series Shear Flex.
 - f. Substitutions must be equal under the provisions indicated.

- N. Flexible Electrical Connections
 1. Type A
 - a. Flexible Electrical Connection Type A shall be an expansion/deflection prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
 - b. Manufacturers
 - 1) Crouse-Hinds (Syracuse, NY) - "XD".
 - 2) Spring City Electrical Mfg. Co. (Spring City, PA) - Type DF.
 - 3) O.Z. Gedney.
 - 4) Substitutions must be equal under provisions indicated.

2. Type B
 - a. Flexible Electrical Connection Type B shall be field fabricated using a minimum 3' (914mm) length of liquid-tight flexible conduit or cable.
- O. Grommets
 1. Grommets shall be custom made by combining a neoprene washer and sleeve. Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specifically formed to prevent bolts from directly contacting the isolator base plate.
 2. Manufacturers
 - a. MBIS, Inc. (Bedford Heights, Ohio) – Isogrommets.
 - b. Barry Controls (Watertown, MA) - Series W.
 - c. Substitutes must be equal under the provisions indicated.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General
 1. Unless specifically noted or indicated otherwise, all equipment and material specified in Part 2 of this specification or indicated on the drawings shall be installed under this Contract whether or not specifically itemized herein. This Section covers particular installation methods and requirements peculiar to certain items and classes or material and equipment.
 2. The Electrical Subcontractor shall obtain detailed information from manufacturers of equipment provided under Part 2 of this specification as to proper methods of installation.
 3. The Electrical Subcontractor shall obtain final roughing dimensions and other information as needed for complete installation of items furnished under other Sections or furnished by the Owner.
 4. The Electrical Subcontractor shall keep fully informed of size, shape and position of openings required for material and equipment provided under this and other Sections. Ensure that openings required for work of this Section are coordinated with work of other Sections. Provide cutting and patching as necessary.

5. The Electrical Subcontractor shall coordinate the electric service installation with the local Electric Utility Co.
 6. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be of a galvanized or cadmium plated finish or of another approved rust-inhibiting coating.
- B. Concrete Housekeeping Pads
1. Concrete pads shall be installed for all freestanding low voltage distribution equipment and transformers sized 112.5 kVA and larger. All transformers located at basement level shall be installed on concrete pads, regardless of transformer size.
 2. The General Contractor shall provide the concrete work. Electrical Subcontractor shall supervise and coordinate concrete work to ensure that proper grounding cable, rods, conduit, etc., are located as detailed and as required. The electrical Subcontractor shall also ensure that the concrete is level to within manufacturers published tolerances.
 3. All concrete housekeeping pads shall extend a minimum of 6" on each side from the equipment mounted on it. Mounting height of each overcurrent/disconnect device in the above equipment shall not exceed 6'-6" above finished floor. If overcurrent devices exceed 6'-6" above finished floor as a result of the housekeeping pad, the pad shall extend in front of the gear a minimum of 4'-0".
- C. Electrical Distribution Equipment
1. The Electrical Subcontractor shall install the low voltage distribution equipment per the manufacturers recommendations and the Contract Drawings.
 2. The installation of all equipment, including working space requirements, shall conform to all NEC and local codes.
 3. All necessary hardware to secure the assembly in place shall be provided by the Electrical Subcontractor.
 4. The Electrical Subcontractor shall ensure that no piping, ductwork or other equipment foreign to the electrical trade passes through the area extending from the floor to the structural ceiling with the width and depth equal to that of the electrical distribution equipment plus 6" on either side of panel.
 5. Floor mounted assemblies shall be installed on concrete housekeeping pads and shall be provided with adequate lifting means. Floor mounted assemblies shall be capable of being moved into installation position and bolted directly to the floor without the use of floor sill.
 6. Equipment mounted on sheetrock and studded walls shall not be attached directly to the sheetrock wall. Provide 1/2" plywood attached to wall studs or provide metal channel attached to wall studs for mounting of equipment.

7. All electrical equipment shall be installed such that the handle of the highest circuit breaker does not exceed 6'-6" above finished floor.
8. The location of all electrical distribution equipment installed in mechanical or plumbing equipment rooms shall be coordinated with the respective Subcontractor.
9. The equipment shall be installed and checked in accordance with the manufacturer's recommendations prior to first energization. This shall include but not limited to:
 - a. Checking to ensure that the pad location is level to within .125 inches.
 - b. Checking to ensure that all bus bars are torqued to the manufacturer's recommendations.
 - c. Assemble all shipping sections, remove all shipping braces and connect all shipping split mechanical and electrical connections.
 - d. Secure assemblies to foundation or floor channels.
 - e. Measure and record megger readings phase-to-phase, phase-to-ground, and neutral-to-ground (four-wire systems only).
 - f. Inspect and install all circuit breakers, components, etc. in their proper compartments.
10. Identification shall be provided for all electrical distribution equipment. The electrical system identification shall clearly describe the equipment connected. Method of identification shall be by laminated nameplate made of bakelite or similar material with engraved letters at least 1/4" high and securely attached to the equipment with galvanized screws. Adhesives or cements shall not be used. A list of nameplates shall be submitted to the Architect for approval prior to fabrication.
11. Control wiring shall be provided as required. Interface all local and remote control wiring and operational systems for each load.
12. Recessed and surface mounted equipment shall be mounted on walls with studs and cross-bracing, as required to assure sufficient strength so as to restrict any movement of the equipment.

3.2 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NEMA, UL, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.

- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.3 PHYSICAL SEPARATION OF NORMAL AND EMERGENCY SYSTEMS

- A. All feeders of the emergency system shall be UL listed 2-hour fire rated MI cable.

3.4 SHORT CIRCUIT & COORDINATION STUDY AND ARC FLASH HAZARD ANALYSIS

- A. General

1. Provide a Short Circuit & Coordination Study and Arc Flash Hazard Analysis Study. These studies shall be performed by the distribution equipment manufacturer or a firm engaged by the distribution equipment manufacturer and the Arc Flash Analysis shall be per NFPA 70E, Article 130.3, Annex D. Include motor starting study for the system including only the major motor loads. Include a voltage drop study for the longest run at each system and voltage. Add conductors sizes where required to meet NEC voltage drop limits (total of 5%).
2. The studies shall be submitted to the Architect prior to receiving final approval of the distribution equipment shop drawings and prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval from the Architect may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.
3. The studies shall include all portions of the electrical distribution system from the normal power incoming primary source or sources, the emergency standby source or sources, down to and including all panels and distribution equipment in the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear where applicable.

4. The firm should be currently involved in high and low voltage power system evaluation. The study shall be performed, stamped and signed by a registered professional engineer in the State of Massachusetts. Credentials of the individual(s) performing the study and background of the firm shall be submitted to the Engineer for approval prior to start of the work. A minimum of five (5) years' experience in power system analysis is required for the individual in charge of the project.
5. The firm performing the study shall demonstrate capability and experience to provide assistance during start up as required.
6. The power system studies are required to confirm the adequacy of the ratings of all electrical system components and proper coordination settings of all circuit breakers to the satisfaction of the Electrical Engineer. These studies shall not be used as a basis to compromise the electrical system and do not imply that short circuit ratings of distribution equipment and devices may be lower than those indicated on the drawings or specified herein.
7. The switchgear equipment manufacturer shall carry in his bid to the Electrical Subcontractor, a sufficient allowance to provide modifications of two frame sizes up or down to allow for coordination of the equipment, if necessary, based on the results of the studies identified herein. The emergency, legally required and elevator systems shall be selectively coordinated down to 0.01.

B. Study Report

1. The results of the Short Circuit & Coordination Study and Arc Flash Hazard Analysis Study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted to the Architect.
2. The report shall include the following sections:
 - a. Descriptions, purpose, basis and scope of the study.
 - b. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
 - c. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.
 - d. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.
 - e. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA &

voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designations.

- f. Incident energy and flash protection boundary calculations.
 - g. Comments and recommendations for system improvements, where needed.
 - h. Executive Summary including source of information and assumptions made.
3. Arc Flash labels shall be provided in hard copy. The labels shall be 3/5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- a. Labels shall include, at minimum, the location designation, nominal voltage, flash protection boundary, hazard risk category, incident energy, working distance, and report number and issue date.
- C. Data Collection for the Study
1. The Electrical Subcontractor shall provide the required data for preparation of the studies. The Engineer performing the short circuit & coordination and arc flash hazard analysis studies shall furnish the Electrical Subcontractor with a listing of the required data immediately after award of the contract.
 2. The Electrical Subcontractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and prior to release of the equipment for manufacture.
- D. Short Circuit and Coordination Study
1. The short circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.
 2. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, branch circuit panelboards, and all other distribution equipment throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

3. In the coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
4. Include on the curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices. Include all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.
5. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400, or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
6. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults. Separate medium-voltage relay characteristic curves from curves for other devices by at least a 0.4-second time margin.
7. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on Drawing one-lines.
8. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Submit a draft of the study to the Architect for review prior to delivery of the study to the Owner. Make all additions or changes as required by the reviewer.
9. Include fault contribution of all motors in the study. Notify the Architect, in writing, of circuit protective devices not properly rated for fault conditions.

10. Provide settings for the motor starters or obtain from the Mechanical Subcontractor, include in the study package, and comment.
11. When an emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.
12. Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
13. For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current and time to ensure protective devices will not trip during major or group start operation.
14. The Emergency and Legally required system shall be coordinated down to .01 seconds.

E. Arc Flash Analysis Study

1. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.
2. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented in the proposal.
3. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
4. The Arc-Flash Hazard Analysis shall include all MV, 575v, & 480v locations and significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA.
5. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
6. The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

7. Arc flash computation shall include both line and load side of main breaker calculations, where necessary.
8. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

F. Power Company Approval

1. Where required, copies of the final report shall be submitted to the power company for their review and approval. Approved copies of the report shall be submitted to the Architect.

3.5 MOTOR STARTING AND VOLTAGE DROP STUDY

- A. Submit a starting study stamped by a Registered Professional Engineer for each significant low voltage or medium voltage motor or motor group which requires conformity with the specified power company inrush limitations.
1. The study shall consist of written calculations and an equivalent impedance diagram to ensure that selected motors and controller equipment restrict the starting current to within the specific power company inrush requirements and to within the voltage drop limitations for the motors and the principal incandescent lamp manufacturers.
 2. Percentage voltage drop shall be determined from a consideration of the above factors, the frequency of starts, borderline of irritation, borderline of flicker visibility, etc.
 3. Calculations and impedance diagram shall be complete and clearly define the base quantities selected, source, system, motor and starting equivalent impedances, etc., conclusions, and recommendations.
 4. Motor starting study may be incorporated with the short circuit and protection coordination study.
 5. Motor starting study shall be prepared by the power circuit breaker or equipment manufacturer who furnishes the switchgear or equipment for the incoming service to the contract site.
- B. Note that Drawings and Specifications indicate the general requirements for the motors, motor starting equipment, medium voltage and low voltage equipment, etc., but additional specific characteristics of equipment furnished shall be determined in accordance with the results of the motor starting study.
1. Equipment design discrepancies and proposed corrective modifications if required shall be submitted with the motor starting study, with any variations clearly noted on the subsequent shop drawings.
 2. Necessary field settings, adjustments and minor modifications for conformance with the approved motor starting study shall be accomplished without additional expense to the Owner.

3. Equipment shop drawings shall not be submitted until the motor starting study has been approved.
- C. A voltage drop study shall also be included to verify if the system distribution meets ASHREA and NEC maximum allowed voltage drop for feeders (2%) and branches (3%). As a result of voltage drop calculations, proper size adjustments to the conductors shall be made to satisfy the requirements.

3.6 FIELD SETTINGS

- A. The Electrical Subcontractor shall perform field adjustments of the circuit breakers as required to place the equipment in final operating condition. The settings shall be in accordance with the approved protective device coordination study or as directed by the Engineer.
- B. For transformers, adjust taps to deliver appropriate voltage and measure primary and secondary voltage to confirm proper setting.
- C. Field Adjustments for Motor Starters
 1. Follow the manufacturer's instructions and the contract documents concerning any short circuit device settings, heater selection, timing relays, or startup of components.
 2. Heater installation and overload relay adjustment shall be the responsibility of the Electrical Subcontractor after field installation of the motor control center and verification of all motor full load amperes.

3.7 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Electrical Subcontractor in installation and start-up of the equipment specified under this section for a period of 2 working days. The manufacturer's representative shall provide technical direction and assistance to the Electrical Subcontractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The Electrical Subcontractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

3.8 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.
- B. The Electrical Subcontractor shall provide three (3) copies of the manufacturer's representative's certification before final payment is made.
- C. A certified test report of all standard production tests shall be available to the Engineer upon request.

3.9 TRAINING

- A. The Electrical Subcontractor shall provide a training session for up to 2 Owner's representative for 2 normal workdays at a jobsite location determined by the owner.
- B. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.
- C. The training program shall include the following:
 - 1. Review of the project one-line drawings and schedules.
 - 2. Review of the factory record shop drawings.
 - 3. Review of all equipment in the electrical distribution system.
 - 4. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program.
 - 5. Provide three ring binders to participants complete with copies of drawings and other course material covered.

END OF SECTION

SECTION 28 31 10

FIRE ALARM SYSTEM

(Part of 26 00 01, Filed Sub-bid)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, as listed on the Table of Contents and including General and Supplementary Conditions and Division 1, General Requirements, shall be included in, and made part of, this Section.
- B. The fire protection/alarm system narrative for the project shall be included in and made part of this section.

1.2 RELATED WORK

- A. For work to be included as part of this Section, to be furnished and installed by the Electrical Subcontractor, refer to the Related Work section of Specification Section 26 05 10.
- B. Carefully examine all of the Contract Documents, criteria sheets and all other Sections of the specifications for requirements that affect work under this Section, whether or not such work is specifically mentioned in this Section.
- C. Refer to all other trades including mechanical drawings and carry fire alarm devices such as smoke damper connections, control modules, monitor modules, remote test/indicators and duct smoke detectors for a complete code compliant operational system.
- D. The Electrical Subcontractor bidding the project shall carry all costs to obtain and provide all related equipment, wiring methods and devices required for a complete installation from the Building Fire Alarm Maintenance Contractor. This work shall be part of the bid. If additional equipment or work is required by the Building Fire Alarm Maintenance Contractor that was not part of the original bid, the Engineer shall be notified immediately upon awarding of the bid.

1.3 DESCRIPTION OF WORK (MODIFICATIONS TO AN EXISTING FIRE ALARM SYSTEM)

- A. Manufacturers: Subject to compliance with requirements, provide products that match and are compatible with the existing devices and equipment.
- B. Provide the changes as indicated on the documents to the existing addressable or hardwired fire detection, Duct smoke detection and alarm and control system with audible/strobe devices in compliance with all applicable codes and authorities having jurisdiction.

1. All new equipment shall be UL Listed for its intended purpose and cross-listed for use on the existing system.
2. The installer and manufacturer's warranty shall be for a minimum of one year from the date of final acceptance testing.
3. Provide all connections, programming and testing as required for final acceptance by AHJ.

1.4 CIRCUITING CRITERIA

A. Signaling Line Circuit

1. Addressable SLC loop wiring shall be extended to connect new devices.
2. Separate addressable signaling line circuit(s) (SLC) for each floor shall terminate on separate communication card in the fire alarm control panel. The system shall be designed with a maximum of 80% of the devices each communication card is capable of supporting.

1.5 SYSTEM SUPERVISION

- A. The fire alarm system shall remain in function as presently programmed. Provide re-programming and supervision of system as required for new devices.
- B. Duct Smoke detection Devices shall be electronically supervised for:
 1. Failed or missing electronic components/circuit cards
 2. Failure of power supplies
 3. Failure of battery charger and/or batteries
 4. Loss of signal from alarm initiating device
 5. Missing initiating device
 6. Failed initiating device
 7. Open circuit wiring
 8. Short circuit wiring
 9. Short to ground wiring

1.6 AUTOMATIC SYSTEM OPERATION

- A. The fire alarm system shall remain in function as presently programmed. Provide re-programming and supervision of system as required for new duct smoke detection devices.
- B. Supervisory Condition
 1. Existing Supervisory Condition Operation
 - a. The supervisory condition shall send a signal to the approved central station via the digital dialer, coded transmitter, or master box.

- b. The supervisory condition shall be uniquely identified on the alpha-numeric display at the control panel, fire command center (where FCC applicable) and remote annunciator. In addition, a corresponding yellow LED shall flash.
- c. The system supervisory audible signal shall be activated at the control panel, fire command center (where FCC applicable) and remote annunciator
- d. Differentiation between a supervisory condition and a trouble condition shall be provided.

1.7 MANUAL SYSTEM OPERATION

- A. The fire alarm system shall remain in function as presently programmed. Provide re-programming and supervision of system as required for new devices.

1.8 SYSTEM PROGRAMMING

- A. The fire alarm system shall remain in function as presently programmed. Provide re-programming and supervision of system as required for new devices.

1.9 MANUFACTURER'S REPRESENTATIVE

- A. The Electrical Subcontractor shall provide, at the appropriate time or as directed by Architect, the on-site services of a competent factory trained Engineer of the manufacturer of the fire alarm equipment to inspect, test, adjust and place in proper operating condition any and all items of the same manufacturer. No additional compensation will be allowed for such services. A written report shall be issued by the particular manufacturer with his findings for the Architect's record.
- B. All final connections, testing and adjusting of the system shall be done under the direct supervision of the system supplier. After completion of the installation, a trained technician employed by the system supplier shall demonstrate the system to the satisfaction of the Owner's representative and shall make all additional adjustment to the system operation as required by the Owner's representative as a result of this demonstration.

1.10 SHOP DRAWING SUBMITTALS

- A. Prepare and submit shop drawings in accordance with the requirements hereinbefore specified, and with the Shop Drawings, Product Data and Samples Division 1 in the manner described therein, modified as noted hereinafter.
- B. Project specifications require that the installing contractor prepare complete Tier-2 Two Documents as required by codes and regulations. The electrical contractor shall submit the complete tier 2 shop drawings to the engineer for review and obtain approval prior to submission to the Fire Department. Any deficiency or inadequate information in the tier-2 shop drawings will result rejection of the shop drawings, the contractor will be responsible to revise and resubmit entire package to the engineer. The engineer shall review the submittals and upon satisfactory imprint approved stamp on the submission. Refer to project fire protection/fire alarm narrative for additional information, such information shall be carried as a part of this project scope.

- C. Project specifications require that the installing contractor provide the building owner with a complete Tier-3 documents including record drawings, specifications, system sequence of operation, equipment/device operations and maintenance manuals for the new fire alarm system devices to be added under this contract. Refer to project fire protection/fire alarm narrative for additional information, such information shall be carried as a part of this project scope.
- D. All shop drawings shall have clearly marked the appropriate specification number of drawing designation, for identification of the submittal.
- E. Disposition of shop drawings shall not relieve the Electrical Subcontractor from the responsibility for deviations from drawing or specifications, unless he has submitted in writing a letter itemizing or calling attention to such deviations at time of submission and secured written approval from the Engineer, nor shall such disposition of shop drawings relieve the Electrical Subcontractor from responsibility for errors in shop drawings or schedules.
- F. Fire alarm system shop drawings shall contain the following information. Shop drawings that are missing any information described below will not be reviewed:
 - 1. A detailed list of each piece of equipment with model numbers and UL listings for each system component.
 - 2. Manufacturer's specification sheets for each item listed above.
 - 3. A description of how the specified system functions. Provide a sequence of operation document indicating 'alarm', 'trouble' and 'supervisory' conditions.
 - 4. Confirmation that the manufacturer's representative will provide jobsite supervision during the installation of the system, will perform the final testing of the system, and instruct the operating personnel on the operation of the system.
 - 5. Stand-by battery calculations.
 - 6. Power supply calculations.
 - 7. Detailed one-line diagrams of the specified system showing all devices and the interconnection wiring, including:
 - a. Conductor sizes and types with cut sheets and information indicating where each type and size is used.
 - b. Conduit sizes and types.
 - c. Addresses.
 - 8. Floor plans
 - a. Floor plans which indicate the intended use and number of each room.

- b. Location of all alarm, supervisory and trouble initiating devices, including but not limited to pull stations, smoke detectors, monitor and control relay modules, etc. Each device shall include the respective address.
9. Classification of central station.
 10. Shop drawings shall include name(s), license number(s) and expiration date of the license of the Electrical Contractor(s) installing the system.
 11. The shop drawings shall be given to the Owner for review and comment, after they have been reviewed by the Engineer. If the address numbers do not appeal to the Owner's requirements, then the Owner shall provide an accurate indication of the numbering system of each device on the shop drawings. The Owner shall also clearly indicate the visual and initiating zones for the building.
 12. After the review and comment of the Owner, the shop drawings shall be returned to the manufacturer to be revised and reissued. The manufacturer shall provide a new set of shop drawings reflecting the changes made by the Owner at the initial review. The revised shop drawing shall be used to program the installed fire alarm system.

1.11 CLOSEOUT SUBMITTALS AND O & M MANUALS

- A. The following information shall be submitted for record purposes, in a binder, prior to final payment:
 1. Final as-built drawings and information for items listed above.
 2. Operation and maintenance manuals with the following information:
 - a. Instruction books and/or instruction leaflets
 - b. Recommended renewal parts
 - c. A list of addresses of all peripheral devices connected to the system
 3. Wiring diagrams.
 4. Certified test reports.

1.12 REFERENCES

- A. The following list of Reference Standards shall be used in system design, installation, operation and maintenance. The Reference Standards used shall be the latest applicable edition of said Reference Standards unless otherwise approved (NFPA - National Fire Protection Association):
 1. Massachusetts Building Code
 2. Building Officials Code Association (BOCA)
 3. Uniform Building Code (UBC)
 4. International Building Code (IBC)
 5. Massachusetts Electrical Code
 6. Massachusetts State Fire Marshall

7. NFPA 70 – National Electrical Code
8. NFPA 72 - National Fire Alarm Code
9. NFPA 101 – Life Safety Code
10. Underwriters Laboratories (UL)
11. Hopkinton Fire Department
12. International Municipal Signal Association Cable Specifications
13. Approved List of Materials and Methods of Construction for Municipal Fire Alarm
14. Americans with Disability Act

B. Each item of the fire alarm system shall be listed as a product of a single fire alarm manufacturer under the appropriate UL category and shall bear the UL label.

C. All control equipment shall be listed under UL UOJZ

1.13 QUALITY ASSURANCE

A. To ensure system compatibility, all components of the fire alarm system including control panels, alarm initiating devices, alarm indicating devices, etc. shall be the products of the existing Fire alarm System manufacturer.

1.14 WARRANTY

A. Attention is directed to provisions of the General Requirements, Supplementary General Requirements, Division 1 - Warranties and Section 26 05 10 – Electrical Special Conditions regarding guarantees and warranties for the work under this Contract.

1.15 ACCEPTABLE MANUFACTURERS

A. New C) Detectors and Duct Smoke Detectors shall be compatible with the existing Fire Alarm System.

PART 2 – PRODUCTS

2.1 POWER SUPPLIES

A. Fire Alarm System Power Supplies

1. Power supplies for the fire alarm system shall consist of full wave, rectified 24 volts DC. Multiple power supplies shall be provided as required to provide 24 volt DC power to all New fire alarm system equipment and peripheral equipment connected to the system.
2. The power supply shall receive 120 volt AC power from the Existing to remain building emergency power system and the secondary output of the power supply shall be fused.

B. Additional Power supplies shall be of the dead front construction and housed in a steel enclosure integral to the fire alarm system control panels and may be externally mounted power supplies.

2.2 BATTERIES/BATTERY CHARGER

A. Batteries

1. Rechargeable, sealed lead-acid batteries shall be provided with reliable and repeatable discharge and recharge characteristics for use in fire alarm systems.
 2. Batteries shall be of identical voltage, model number, appearance and approximately the same date of manufacture to allow connections in series to produce a system voltage of 24 volts DC. And shall be sized to accommodate the New Smoke Detection devices as required.
- B. The Existing system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of sixty (60) hours with fifteen (15) minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon normal power failure. All battery charging and recharging operations shall be automatic.
- C. Power cable size from the batteries to the control panel and/or fire command center shall be determined by the manufacturer based on power demand and acceptable voltage drop calculations.
- D. All external circuits requiring system operating power shall be individually fused at the control panel.

2.3 SYSTEM INTERFACE MODULES

A. General

1. System interface modules shall communicate over the same lines as the other addressable devices and shall receive their operating power from a separate source within the fire alarm control panel.

B. Communicating Device Module

1. All alarm initiating devices indicated on the electrical drawings shall be addressable. These devices shall report to a communicating device module in the control panel. Each module will communicate with the microprocessor to continually poll the remote devices for normal, abnormal, shorted, and open line conditions.
2. The communicating device module shall continuously interrogate each of the addressable devices on its communications channel for status changes and/or trouble conditions.
3. The system shall communicate with each initiation device individually and each device shall be individually annunciated at the control panel, fire command center (where FCC applicable) and remote annunciator.
4. Each device shall have the capability of being disabled or enabled, individually.

C. Monitor Module

1. Monitor modules shall supervise and monitor the status of non-addressable, normally open, direct contact devices such as sprinkler water flow switches and valve tamper (supervisory) switches. These monitor modules shall communicate the equipment status (normal, alarm, trouble) to the control panel.
2. Monitor modules shall also be used to indicate status of equipment such as, emergency generator, fire pump controllers, and other systems as indicated on the drawings.

D. Control Module

1. Control modules shall supervise and control the operation of auxiliary devices. Control modules shall also operate functions such as building fans and dampers, elevator recall, release door hold back devices, as well as any other system control functions indicated here in or on other trades drawings and specifications. Regardless of fire alarm drawings, number and location of devices such as smoke dampers shall be obtained from mechanical (HVAC) drawings/details or their related trade.
2. Control modules shall provide 2-pole, 2-throw, supervised relay switching that may be used to connect through easily replaceable 2A fuses.
3. Control modules shall communicate the supervised wiring status (normal, trouble) to the fire alarm control panel and will receive a command to transfer the relay from the fire alarm control panel.

E. Multi-Voltage Relay

1. The control relay shall be a multi-voltage relay. The voltage of the control coil shall be a selectable input for 120VAC or 24VDC or 12VAC.
2. The output contacts shall be SPDT form C dry contacts rated for 10 amps.
3. The relay shall be a PAM as manufactured by Space Age or Engineer approved equal.

2.4 SMOKE DETECTORS

A. Photoelectric Smoke Detector

1. Photoelectric smoke detectors shall be analog addressable and shall utilize a light emitting device and a light sensing device mounted within a smoke chamber. The smoke chamber shall be designed to effectively manage light dissipation and extraneous reflections from dust particles, insects or other airborne contaminants in such a way as to maintain stable, consistent detector operation.
2. The control panel shall be capable of continually analyzing the analog signal from each smoke detector for calibration, sensitivity and address identification. The values from each detector shall be displayed at the control panel upon command.

3. Each smoke detector shall have a unique address. Systems that utilize detector bases, separate from the detectors, shall ensure the bases are interchangeable with other addressable devices.
4. Each smoke detector shall include an LED that shall flash once every 30 – 60 seconds to indicate that it is operating properly. If the detector goes into alarm, and the alarm is confirmed by the control panel, the LED shall flash continuously until the system is reset at the control panel.
5. Each detectors sensitivity shall be individually adjustable from the control panel. Should a detectors signal reach a predetermined level, and remain there for a predetermined duration, a discrete detector trouble signal shall be annunciated at the control panel, fire command center (where FCC applicable) and remote annunciator.
6. Should a detectors signal reach an alarm level, the alarm sequence of events shall be initiated.
7. Smoke detectors shall be capable of operating one remote alarm indicator, an auxiliary relay or an audible base. These devices shall be capable of being activated by the associated detector or any other detector as programmed at the control panel.
8. Detectors shall operate properly from +32 to 100 degrees Fahrenheit and from 0 to 93% relative humidity, non-condensing.

B. Duct Smoke Detectors

1. Duct mounted smoke detectors shall be addressable and shall be comprised of a photoelectric smoke detector as specified above mounted within an air duct housing designed for detection of smoke in heating, air conditioning and ventilation (HVAC) ducts in accordance with NFPA 90A.
2. The duct smoke detector housing shall include sampling tubes that extend into and across the duct of the HVAC system. When fans are operating, a continuous cross sectional sampling of air from the duct shall flow through the smoke detector in the housing, after which, the air shall be returned to the duct. Regardless of fire alarm drawings, number and location of duct smoke detectors shall be obtained from mechanical (HVAC) drawings and details.
3. Upon alarm actuation of the smoke detector [a signal shall be sent to the ATC system to shut down the respective fan] [a supervised relay, incorporated into the duct smoke detector shall directly shut down the respective fan].
4. The duct smoke detector shall obtain its operating power from the fire alarm control panel. If the duct smoke detector requires power from an external source, the manufacturer shall inform the Electrical Subcontractor of this requirement and the Electrical Subcontractor shall provide this power from the emergency distribution system at no additional cost to the Owner.
5. Each duct smoke detector shall be furnished with a supervised auxiliary relay for use by the ATC system manufacturer for fan shutdown.

6. Each duct smoke detector shall include a remote alarm indicator (LED) with a key test switch. This device shall be mounted within proximity of the duct detector and labeled to clearly show which detector it is associated with. The device shall be a key activated device that, when manually operated, will functionally test the detector, and force the associated detector into alarm. The system will then activate all functions programmed to follow the detector. The LED shall illuminate when the detector is in alarm.
7. Any conventional duct smoke detector provided with the mechanical equipment shall be monitored by an addressable monitor module. This duct smoke detector/module shall include a remote alarm indicator (LED) with a key test switch. This device shall be mounted within proximity of the duct detector and labeled to clearly show which detector it is associated with. The device shall be a key activated device that, when manually operated, will functionally test the detector, and force the associated detector into alarm. The system will then activate all functions programmed to follow the detector. The LED shall illuminate when the detector is in alarm. The conventional duct smoke detector shall be furnished with a supervised auxiliary relay for use by the ATC system manufacturer for fan shutdown, otherwise a fire alarm system connected control module shall be included to shut down the fan.

2.5 WIRING AND RACEWAYS

A. Wiring

1. Refer to Part 3 of these specifications for acceptable wiring methods.
2. All fire alarm system wiring shall be new and shall meet the requirements of the NEC Article 760 (ANSI/NFPA 70) and as recommended by the fire alarm system manufacturer.
3. The following cable types shall be utilized:
 - a. Type FPL – Power Limited General Purpose.
 - 1) Conductor type FPL shall meet or exceed the following:
 - a) Conductor: Fully annealed solid bare copper per ASTM B3.
 - b) Insulation: Premium grade color coded, polypropylene.
 - c) Jacket: Red PVC
 - d) Shield (if required): 100% aluminum/polyester, 25% overlap; Stranded tinned copper drain wire.
 - e) NEC Article 760.
 - f) UL type FPL.
 - g) UL 1424.
 - h) UL 1685 Vertical Tray Flame Test.
 - b. Type FPLR – Power Limited Suitable for floor to floor.
 - 1) Conductor type FPLR shall meet or exceed the following:

- a) Conductor: Fully annealed solid bare copper per ASTM B3.
 - b) Insulation: Premium grade color coded, S-R PVC.
 - c) Jacket: Red PVC.
 - d) Shield (if required): Overall polyester supported aluminum foil; Stranded tinned-copper drain wire.
 - e) NEC Article 760.
 - f) UL type FPLR.
 - g) UL 1424.
 - h) UL 1666 Flame Test.
- c. Type FPLP – Power Limited Suitable for use in ducts, plenums and other spaces.
- 1) Conductor type FPLP shall meet or exceed the following:
 - a) Conductor: Fully annealed solid bare copper per ASTM B3.
 - b) Insulation: Premium grade color coded, plenum.
 - c) Jacket: Red Fluoropolymer.
 - d) Shield (if required): Overall polyester supported aluminum foil; Stranded tinned-copper drain wire.
 - e) NEC Article 760.
 - f) UL type FPLP.
 - g) UL 1424.
 - h) ANSI/NFPA 262.
- d. Type NPLF – Non-Power Limited General Purpose.
- 1) Conductor type NPLF shall meet or exceed the following:
 - a) Conductor: Fully annealed solid bare copper per ASTM B3.
 - b) Insulation: Premium grade color coded, polypropylene.
 - c) Jacket: Red PVC
 - d) Shield (if required): 100% aluminum/polyester, 25% overlap; Stranded tinned copper drain wire.
 - e) NEC Article 760.
 - f) UL type NPLF.
 - g) UL 1425.
 - h) UL 1685 Vertical Tray Flame Test.
- e. Type NPLFR – Non-Power Limited Suitable for floor to floor.
- 1) Conductor type NPLFR shall meet or exceed the following:
 - a) Conductor: Fully annealed solid bare copper per ASTM B3.
 - b) Insulation: Premium grade color coded, S-R PVC.
 - c) Jacket: Red PVC.
 - d) Shield (if required): Overall polyester supported aluminum foil; Stranded tinned-copper drain wire.

- e) NEC Article 760.
 - f) UL type NPLFR.
 - g) UL 1425.
 - h) UL 1666 Flame Test.
- f. Type NPLFP – Non-Power Limited Suitable for use in ducts, plenums and other spaces.
- 1) Conductor type NPLFP shall meet or exceed the following:
 - a) Conductor: Fully annealed solid bare copper per ASTM B3.
 - b) Insulation: Premium grade color coded, plenum.
 - c) Jacket: Red Fluoropolymer.
 - d) Shield (if required): Overall polyester supported aluminum foil; Stranded tinned-copper drain wire.
 - e) NEC Article 760.
 - f) UL type NPLFP.
 - g) UL 1425.
 - h) ANSI/NFPA 262.
- g. Type MC-FPLP Fire Alarm Metal Clad Cable – Metal Clad Power Limited Suitable for use in ducts, plenums and other spaces
- 1) Fire Alarm Metal Clad Type MC-FPLP cable may be used in concealed areas if allowed by the Authority Having Jurisdiction. All installations shall comply with Code.
 - 2) Provide all necessary fittings, hangers, and accessories as required. The Fire Alarm Metal Clad Type MC-FPLP shall be prefabricated at the factory and shipped to the site on cable reels.
 - 3) Reference Standards
 - a) MC cable shall be in compliance with the latest applicable edition of the following industry standards:
 - (1) National Electrical Code (NEC)
 - (a) NEC 330
 - (2) Federal Specification A-A-59544
 - (3) Underwriters Laboratory (UL)
 - (a) UL 1569
 - (b) UL 1479
 - (c) UL 66
 - (d) UL 83
 - (e) UL1424
 - (f) UL 1581
 - (4) 1,2 and 3 hour Through Penetration Fire Wall Rated
 - (5) NFPA 262

- 4) Construction
 - a) Conductors
 - (1) Conductors shall be solid copper, soft drawn 98% conductive copper with TFN/THHN, 600 volt MC and 300volt FPLP fully plenum rated insulation.
 - b) Exterior armor
 - (1) The exterior sheath shall be manufactured of galvanized interlocking steel strip with distinct red striping.
- 5) Manufacturer
 - a) MC cable shall be as manufactured by AFC Series Fire Alarm Type MC-FPLP Fully Plenum Rated, or equivalent approved equal.
- 6) Fittings
 - a) Fittings for MC cable shall be suitable for use with the appropriate cable assembly.
 - b) Fitting shall be as manufactured by AFC or Approved Equal.
- h. Type CI Fire Alarm Cable - where UL 2-hour fire rated wiring system is required.
 - 1) Type CI cable shall be 2-hour fire-rated polymer insulated cables.
 - 2) All Fire Alarm Type CI cable shall be installed in conduit to provide 2-hour survivability to provide an Electrical Circuit Protective System as defined in the UL Fire Resistive Directory.
 - 3) The "CI" cable shall be listed in the UL General Information Directory under Power-Limited Fire Alarm Cable (HNIR) and Non-Power Limited Fire Alarm Cable (HNHT).
 - 4) Reference Standards
 - a) Type CI cable shall be in compliance with the latest applicable edition of the following industry standards:
 - (1) National Electrical Code (NEC)
 - (a) NEC 760

- (2) Underwriters Laboratory (UL)
 - (a) UL 2196
 - (b) UL 1424
 - (c) UL 1425
 - (d) UL Fire Resistive Directory

- 5) Construction
 - a) Conductors: Solid or stranded high conductivity copper designed to ensure tensile strength under fire conditions.
 - b) Cable Temperature Rating: 90 degrees Celsius
 - c) Insulation Material: Silicone rubber.
 - d) Insulation Voltage Rating: 600 volts.
 - e) Outer Jacket: Low smoke zero halogen polyolefin.
 - f) Shielded Construction: Copper/polyester foil tape.
 - g) Unshielded Construction: Polyester separator tape.
 - h) Minimum Voltage Rating to Ground: 72 volts.

- 6) Manufacturer
 - a) CI cable shall be as manufactured by Raychem, or equivalent approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Furnish and install the complete fire alarm system in accordance to the drawings, these specifications and all applicable Codes and Ordinances and in accordance with the manufacturer's recommendations.
2. The Electrical Subcontractor shall furnish and install, in accordance with manufacturer's instructions, all wiring, conduit and outlet boxes required for the erection of a complete system as described herein and as indicated on the drawings.
3. Final connections between the control equipment and wiring system shall be made under direct supervision of a representative of the manufacturer.

4. The Electrical Subcontractor shall be responsible for the proper placement of all heat and smoke detectors to ensure proper spacing. Smoke detectors shall be spaced a maximum of 30'-0" on center and no greater than 15'-0" from end walls, doors, etc.
 5. Installation of equipment and devices that pertain to other work in the Contract shall be closely coordinated with the appropriate Contractors. The Electrical Subcontractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
 6. Cover all smoke detection devices with plastic bags immediately after installation to maintain cleanliness. If detectors are contaminated with dirt or dust during the construction period, it shall be the responsibility of the Electrical Subcontractor, at his cost, to clean or replace each device as directed by the Owners representative or the Authority having jurisdiction.
 7. All miscellaneous hardware and support accessories, including support rods, nuts, bolts, screws and other such items, shall be furnished as required for proper installation of the system and shall be of a galvanized or cadmium plated finish, or of other approved rust-inhibiting coating.
 8. The Electrical Subcontractor shall ensure that all concealed equipment that may require maintenance or access for any reason are made easily accessible.
- B. Devices installed in unheated spaces shall be non-addressable type with addressable monitor module to allow connection to addressable fire alarm system, signaling line circuit, whether indicated or not on drawings.
1. Provide non-addressable pull stations and provide an addressable monitor module for the pull stations. The addressable monitor module shall be installed in a heated space.
 2. Provide non-addressable heat detectors instead of smoke detectors and provide an addressable monitor module for the heat detector. The addressable monitor module shall be installed in a heated space.
- C. Wiring
1. Wiring Methods
 - a. All wiring between Control Panels, Transponder Cabinets, Terminal Cabinets and Annunciators shall be installed in Conduit.
 - b. All wiring between fire alarm transponder panels and terminal cabinets shall be two (2) hour fire rated conductors, such as Raychem CI, to provide survivability.
 - c. All wiring between fire alarm transponder panels and remote annunciators shall be two (2) hour fire rated conductors, such as Raychem CI, to provide survivability.
 1. Wiring types and sizes shall be as recommended by the Fire Alarm Equipment manufacturer. Minimum #16 AWG.

2. All wiring shall be UL listed for fire protective signaling systems and meet the requirements of NEC Article 760.
3. Color code shall be used throughout. All wires shall be tagged at all junction points and shall test free from grounds or crosses between the conductors.
4. Where Class A wiring is specified, wiring shall be routed to maintain 1'-0" separation between vertical runs and 4'-0" separation between horizontal runs per NFPA 72.
5. Maximum wiring distances shall be within manufacturer's specifications.
6. T-tapping of signal device conductors to signal circuit conductors shall NOT be accepted.
7. No splice is allowed for fire alarm system wiring.

B. Backboxes

1. All surface mounted fire alarm devices shall be mounted on backboxes specifically made for the purpose and shall be red in color. Provide all components (i.e. 'skirts', etc.) as required for a complete installation.
2. Surface devices mounted on standard 4" square metal backboxes shall not be allowed.
3. Provide backboxes for all devices and equipment as per manufacturer's recommendation. A backbox shall be provided for all devices.

C. Raceways

1. All fire alarm system wiring shall meet the requirements of NEC Article 760 and all National, State and Local Electrical Codes. Conduit sizes shall be determined by the fire alarm equipment manufacturer to support the quantities and types of wiring to be installed. Minimum 1/2" conduit.
2. All pull and junction boxes shall be sprayed red and labeled "Fire Alarm". A red stripe, 4" wide, shall be painted on all conduit for fire alarm system wiring and/or all junction boxes and conduit fittings shall be painted red. Wiring color code shall be maintained throughout the installation.

3.2 MATERIALS AND WORKMANSHIP

- A. All materials and equipment shall be new and unused and shall meet requirements of the latest Standards of NFPA, UL, NEMA, IPCEA, ANSI and IEEE. Equipment shall have components required or recommended by OSHA, applicable NFPA documents and shall be UL listed and labeled.
- B. Despite references in the specifications or on the drawings to materials or pieces of equipment by name, make or catalog number, such references shall be interpreted as establishing standards of quality for materials and performance.

- C. Finish of materials, components and equipment shall not be less than Industry good practice. When material or equipment is visible or subject to corrosive or atmospheric conditions, the finish shall be as approved by the Architect.
- D. Provide proper access to material or equipment that requires inspection, replacement, repair or service. If proper access cannot be provided, confer with the Architect as to the best method of approach to minimize effects of reduced access.
- E. All work shall be installed in a neat and workmanlike manner and shall be done in accordance with all Local and State Codes.
- F. The Owner will not be responsible for material, equipment or the installation of same before testing and acceptance.

3.3 COORDINATION OF MAINTENANCE AND PRE-TESTING

- A. It shall be the responsibility of the representative of the equipment manufacturer to provide the Owner's representatives with maintenance contract proposals of qualified companies who specialize in the maintenance, testing and central station monitoring of fire alarm systems.
- B. Pre-Testing of Fire Alarm System - Provide the services of an authorized technical representative of the manufacturer of the equipment to supervise the installation, adjustment and all pre-testing of the system required to assure a complete and fully operative facility in accordance with this specification and all local Fire Department Regulations. A signed pre-test report substantiating this shall be submitted by the manufacturer.
- C. It shall be the responsibility of the Electrical Subcontractor, where equipment or systems added under this Contract are found to be defective or not in accordance with the manufacturer's published data, the specification and/or Contract Drawings, to correct all discrepancies. It shall further be the responsibility of the Electrical Subcontractor to perform all retests and indicate to the Owner, the Fire Department and the Engineer that all systems perform as required by the Contract Drawings and specifications. Retests shall be performed in accordance with the Owner's requirements and at a time which is acceptable to the Owner, and all costs for retesting and operational retesting shall be borne by the Electrical Subcontractor. The Electrical Subcontractor shall notify the Owner and Engineer (7) days in advance of the date when the system will be ready for retesting.

3.4 MANUFACTURER'S CERTIFICATION

- A. The qualified, factory trained authorized representative of the manufacturer shall provide on-site supervision of the fire alarm system installation. The representative shall certify, in writing, that the system and equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.
- B. The Electrical Subcontractor shall provide three (3) copies of the manufacturer's representative's certification before final payment is made.

3.5 FINAL ACCEPTANCE TESTS

- A. The Owner shall NOT be responsible for fire alarm system material or equipment prior to final testing and acceptance.
- B. Before final approval and acceptance by the Owner, fire protection and life safety systems shall be subjected to tests specified in any applicable NFPA Codes and Standards. Tests shall be witnessed by the representative of the Fire Department and by the representatives of the Owner, Owner's Insurance Underwriter and Security Department (if applicable). Conduit, wiring and accessory devices in any portion of new system shall not be covered up or concealed permanently until they have been tested and approved. At least 7 days notice shall be given to aforementioned representatives before test.
- C. Test shall comprise activating and verifying the operations of each and every device (input and output) and auxiliary functions. No exceptions to this requirement will be accepted. A written test log of this complete test shall be submitted prior to acceptance of the system by the Owner.
- D. Manual and Automatic Fire Alarm Systems
 - 1. Upon completion of system or part as determined by the Owner, satisfactory acceptance test of entire installation shall be made. Test shall include central control station, (i.e. the proprietary protective signaling system), and manual and automatic fire alarm systems. Test(s) shall include but shall not be limited to the following: Manual pull stations, evacuation signals/lights, thermal and/or smoke detectors, automatic door release devices, waterflow and supervisory alarm devices, and elevator capture and recall.
- E. Test shall meet requirements of the following:
 - 1. NFPA 72, Chapters 10 and 14: Fire Alarm Systems
 - 2. NFPA 25: Sprinkler Systems
- F. To assure that wire size, power supply, number of devices on a circuit, etc., are suitable to support 100 percent of devices being in alarm or operated simultaneously, this test shall include the following:
 - 1. Place all sensors and monitor modules in alarm. Each shall display its address and alarm condition. At least the first ten (10) devices on each circuit shall also have their alarm LED's lighted.
 - 2. Operate all control modules for the alarm or operated condition. Each module shall display its address and condition.
 - 3. Reset all alarmed and operated devices. The panel shall display the address of any off-normal devices.
- G. Test each sensor for alarm verification by momentarily testing for alarm. The sensor shall not initiate an alarm. Then, test by placing the sensor in alarm such that it remains in alarm for the selected verification time. The sensor shall initiate an alarm.

- H. Test each sensor for trouble by removing the sensor from its base. The address and trouble condition for each shall be displayed. Insert a different type of sensor into the base. The address and trouble condition shall be displayed. The sensor will return to normal only when the proper sensor type is reinserted in the base.
- I. Print out the English language descriptor and status of each module in the system. The printout shall also include the date and time.
- J. Audible sound level measurements shall be conducted throughout the entire building,
- K. The equipment manufacturer shall have a local branch office staffed with trained, full-time employees who are capable of performing testing, inspection, repair, and maintenance services for the life of the system.

3.6 MAINTENANCE CONTRACT

- A. The Subcontractor shall provide in writing to the Owner a proposal for an approved Service and Testing Inspection and Maintenance Contract.
- B. The Maintenance Contract as a minimum shall include:
 - 1. Transmitters shall be tested at least twice yearly. During bi-annual test of each system, at least one alarm initiating circuit shall be tested in each alarm circuit. Submit report of each month's test.
 - 2. Detectors associated with interior fire alarm system shall be tested once every 12 months, with 1/12 (one-twelfth) the number being tested in each monthly test.
 - 3. Self-restoring detectors shall be exposed either to heat or smoke to test ability to initiate alarm.
 - 4. Fusible link detectors shall be unscrewed from holders to test ability to initiate alarm. Every six months, one fusible link shall be exposed to heat to test ability of fusible link to respond to heat.
 - 5. Quarterly test reports shall include the following information:
 - a. Date of test.
 - b. Name and location being tested.
 - c. Number of interior alarm circuits.
 - d. Number of devices tested and type.
 - e. Condition of emergency stand-by power supply.
 - f. Name of company conducting test.
 - g. Name and signature of person conducting test.
- C. Testing agreement shall not cover:
 - 1. Damage resulting from accidents, fire, storm, water, negligence, misuse, vandalism, nor defective or improper wiring.
 - 2. Testing of waterflow switches on sprinkler system (waterflow switches to be tested by sprinkler company personnel).

3. Testing or repairs of door release mechanisms covered in another section of hardware contract.
 4. Testing or repairs of dampers, smoke hatches, elevator controls, and other peripheral equipment not supplied by fire alarm manufacturer.
- D. The tester shall be responsible for coordination between the sprinkler and smoke control testers so that water flow, valve tamper, door, damper and fan controls are all tested in a comprehensive manner at the same time.

3.7 TRAINING

- A. A training session shall be provided by a fully qualified, trained representative of the equipment manufacturer who is thoroughly knowledgeable of the specific installation of the fire alarm system. It should be given to personnel responsible for operating the system and representatives of the local Fire Department.
- B. Provide a minimum of 8 hours of training. The approved final version of the operation and maintenance manual shall be used during the training.
- C. Schedule training with Owner with at least 7 days advance notice.

END OF SECTION