PROJECT MANUAL FOR

MIDDLE SCHOOL HVAC REPLACEMENT – PHASE 2
MURPHYSBORO MIDDLE SCHOOL
MURPHYSBORO CUSD # 186
MURPHYSBORO, JACKSON CO., ILLINOIS
HR# 365-3198

Prepared for

MURPHYSBORO CUSD #186
Murphysboro, Jackson County, Illinois

DATE: January 20, 2020

Bid Package No. ___________
MIDDLE SCHOOL BUILDING RENOVATIONS – Phase 2
MURPHYSBORO CUSD # 186
MURPHYSBORO, ILLINOIS 62966
HR #365-3198

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Project: MIDDLE SCHOOL HVAC REPLACEMENT – PHASE 2
MURPHYSBORO MIDDLE SCHOOL
MURPHYSBORO CUSD # 186
MURPHYSBORO, JACKSON CO., ILLINOIS
HR# 365-3198

Owner: MURPHYSBORO CUSD #186
593 AVA ROAD
MURPHYSBORO, IL 62966

Architect/Engineer: HURST-ROSCHE, INC.
200 N. MARKET STREET
MARION, IL 62959

Date: January 20, 2020

The Owner will receive Bids until 2:00 PM local prevailing time on Wednesday the 12th day of February 2020, at the Murphysboro CUSD #186 Unit Office, located at 593 Ava Road, Murphysboro, IL 62966 for the following work:

Project Description:

Installation of new HVAC for the large gym, cafeteria, and band room. Installation of new 2x2 ceiling and lighting in cafeteria and band room, new lighting in the gymnasium as shown on the documents. Remove and install new doors as shown on the drawings. Removal and replacement of electrical panels

A MANDATORY Pre-bid Meeting will be held on Thursday, January 30, 2020, at 10:00 AM, prevailing time, at , at the Murphysboro CUSD #186 Unit Office, located at 593 Ava Road, Murphysboro, IL 62966.

Drawings and specifications may be obtained at the office of Hurst-Rosche, Inc., 200 N. Market Street, Marion, Illinois, January 20, 2020, by paying a nonrefundable amount of $100.00 ($125.00 if mailed) for each set of drawings and specifications.

Bidding Documents, Drawings and Specifications, may be examined by prospective bidders and material suppliers at the offices of Hurst-Rosche, Inc., 200 N. Market Street, Marion, Illinois 62959 and the following Plan Rooms:

McGraw-Hill Construction
www.dodgeprojects.construction.com

iSqFt Planroom
9901 Allisonville Road
Fishers, IN 46038

AGC of Western Kentucky
2201 McCracken Blvd.
Paducah, KY 42002-1059

Southern Illinois Builders Association
504 West Jackson
Marion, IL 62959

365-3198

Invitation to Bid
00 11 16 - 1
Drawings and specifications will be available for viewing on the internet at: hurst-rosche.com/contractors. The documents are being provided for reference purposes only. Bidders must obtain a signed and sealed hard copy set of the bidding documents, including bid form, from the offices of Hurst-Rosche, Inc. to submit a bid for this project.

The Owner requires the project to be substantially complete by August 1, 2020.

Bidders will be required to provide Bid security of a sum no less than 5 percent of the Bid Sum. The bid security shall be in the form of a certified check, cashier’s check, bank money order or bid bond issued by surety licensed to conduct business in the State of Illinois. Hereinafter this bid security shall be referred to as the bid bond.

Submit two copies of your Bid on the Bid Form provided. Bidders may supplement this form as appropriate.

Your Bid will be required to be submitted under a condition of irrevocability for a period of 60 days after submission.

Successful bidders shall be required to observe Illinois Public Act 77-1552 and the Illinois Department of Human Rights and Illinois Human Rights Commission Rules pertaining to Equal Employment Opportunity as provided for in paragraphs 2-101, et seq., Article II, Chapter 68, of the Illinois Revised Statutes; and comply with paragraph 271 of Chapter 48 of the Illinois Revised Statutes concerning the employment of citizens of the State of Illinois; and comply with Chapter 48, Sections 39s-1 through 39s-12, of the Illinois Revised Statutes, as amended, known as the Prevailing Wage Determination, as issued by the Illinois Department of Labor.

The Owner reserves the right to accept or reject any or all Bids or any part thereof, to waive any informalities in bidding, and to accept bids deemed most favorable to the Owner.

MURPHYSBORO CUSD #186

CHRISTOPHER GRODE, SUPERINTENDENT

END OF DOCUMENT
DOCUMENT 00 21 14 - INSTRUCTIONS TO BIDDERS - AIA

1.1 SUMMARY

A. Document Includes:
   1. Instructions to Bidders.
   2. Site examination.
   3. Prebid conference.

B. Related Documents:
   1. Document 00 11 16 - Invitation To Bid.
   2. Document 00 41 13 - Bid Form - Stipulated Price.
   3. Document 00 43 00 - Bid Form Supplements: Appendices A and B.
   4. Document 00 72 14 - General Conditions – AIA Stipulated Sum.
   5. Document 00 73 13 - Supplementary Conditions – AIA.

1.2 INSTRUCTIONS TO BIDDERS

A. These Instructions to Bidders amend or supplement AIA Document A701-1997 - Instructions to Bidders and other provisions of Bidding Documents and Contract Documents.

B. To be considered all bids must in accordance with these Instructions to Bidders.

C. Those interested parties may obtain sets of Drawings and Specifications from the Architects upon non-refundable deposit of $100.00 ($150.00 if mailed) per set.

1.3 SITE EXAMINATION

A. Bidders shall carefully examine documents and construction site to obtain first-hand knowledge of existing conditions. Contractors will not be given extra payments for conditions which can be determined by examining site and these documents.

B. Contact Mr. Darren Ripley at the following phone number to arrange date and time to visit Project site:
   1. Telephone: 618-201-4186

1.4 THE SCHEDULE FOR BIDDING THIS PROJECT IS AS FOLLOWS

A. Plans Available: January 20, 2020

B. Pre-Bid Meeting: January 30, 2020
   MANDATORY
   10:00 AM
   Murphysboro CUSD #186 Unit Office

C. Latest Time to Submit Request for Interpretation: February 6, 2020
D. Latest Time to Issue an Addendum: February 7, 2020

E. Bid Opening
   February 12, 2020
   2:00 PM
   Murphysboro CUSD #186 Unit Office

F. All requests for interpretations shall be in writing via mail or e-mail addressed to the Architect/Engineer and must be received seven (7) calendar days prior to date fixed for opening of bids in order to be given consideration. All questions must be submitted on the “Request for Interpretation Pre-Bid Question and Comment Form” included at the end of this section, and questions not submitted in accordance with this form and specified time frame will not be accepted. Any and all interpretations and supplemental instructions will be made by addendum to the Drawings and Specifications and forwarded to all bidders either by certified mail or fax transmittal. All responses by the Architect/Engineer must be in writing to be binding. Any response general in nature or affecting these Instructions to Bidders shall be sent via addendum as previously described. All bidders are required to return the signature page of the addendum signed to the Architect within 24 hours after receipt. Failure of any bidder to receive any such addendum or interpretations shall not relieve such bidder from an obligation under the bid as submitted. All addenda so issued shall become part of the Contract Documents. No addendum will be issued later than five (5) calendar days prior to bid date except one withdrawing the request for Bids or one postponing date for receiving Bids. Oral interpretations, changes or corrections will not be binding and Bidders shall not rely upon such interpretations, changes and corrections. Each Bidder shall ascertain prior to submitting Bid that all addenda issued have been received and shall acknowledge receipt in Bid.

   Questions shall be directed to:  
   E-mail: jsiefert@hurst-rosche.com

G. Materials, products and equipment described in Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by any proposed substitution. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least ten days prior to the date for receipt of Bids. Each such request shall include name of material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other work that incorporation of the substitute would require shall be included. The burden of proof of the merit of proposed substitute is upon the proposer. Architect’s decision of approval or disapproval of a proposed substitution shall be final. If the Architect approves any proposed substitution prior to receipt of Bids, such approval will be set forth in an addendum. Bidders shall not rely upon approvals made in any other manner. No substitutions will be considered after the contract award unless specifically provided in the Contract Documents.
H. Bids shall be made on unaltered Bid Forms furnished by the Architect. Fill in all blank spaces and submit two (2) copies. Bids shall be signed with name typed below signature. Where bidder is a corporation, bids must be signed with legal name of corporation followed by name of state of incorporation and legal signature of an officer authorized to bind the corporation to a contract.

I. Each bidder submitting a bid shall submit on form provided a list of any subcontractors and major suppliers he proposes to use with the bid. Failure to do so could disqualify the bid.

J. Each bidder shall designate on the attached bid form one person who shall serve as the bidder’s contact person for all matters pertaining to the bid. In absence of such designation, the person who signs the bid shall be deemed the bidder contact.

K. Each bid shall be accompanied by bid bond made payable to the Owner, in the amount of five percent (5%) of the bid sum. Security shall be either certified check, cashier's check, bank money order or bid bond issued by surety licensed to conduct business in the State of Illinois. Successful bidder's security will be retained until he has signed the contract and furnished required payment and performance bonds. Owner reserves the right to retain security of the next two (2) lowest bidders until the lowest bidder enters into contract or until thirty (30) days after bid opening, whichever is shorter. All other bid security will be returned as soon as practicable. If any bidder refuses to enter into a contract, Owner will retain bid security as liquidated damages, but not as a penalty.

L. All costs associated with the preparation and submission of a bid are the sole responsibility of the bidder. These costs shall not be chargeable to the Owner by any successful or unsuccessful bidder. All bids become the property of the Owner and shall not be returned except in the case of a late submission.

M. Simultaneously, with delivery of the executed contract, the successful bidder, at its own expense, shall furnish surety in the form of a performance bond and a labor and material payment bond in the amount of one hundred percent (100%) of the contract amount. Surety for such bonds shall be a company duly authorized and licensed in the State of Illinois and acceptable to the Owner. The Attorney-In-Fact who signs bid bonds or contract bonds must file with each bond a certified and effectively dated copy of their power of attorney.

N. All copies of the bid, bid security and any other documents required to be submitted with bid shall be enclosed in a sealed opaque envelope. Envelope shall be addressed to Murphysboro CUSD #186, 593 Ava Road, Murphysboro, Illinois 62966, and shall be identified with project name, bidder's name and address. Mailed bid envelopes shall be enclosed in a separate mailing envelope with the notation "SEALED BID ENCLOSED" on the face thereof. Oral, telephonic or telegraphic Bids are invalid and will not receive consideration. Bids shall be deposited at the location designated in the Invitation to Bid prior to time and date designated for opening, or any extension thereof made by addendum. Bidder shall assume full responsibility for timely delivery at location designated for receipt of Bids. Bids received after time and date for receipt of bids will be returned unopened.
O. A bid may not be modified, withdrawn or canceled during the thirty (30) days immediately following bid opening, and each bidder so agrees in submitting his Bid. Any bidder may withdraw, cancel or modify its bid, at any time prior to scheduled time for opening of bids, by letter or telegram actually received by Owner prior to bid time, or, with proper identification, by personally securing bid submitted; if by telegram, written confirmation over signature of bidder shall be mailed and postmarked on or before date and time of bid opening. Withdrawn bids may be resubmitted up to bid opening time provided that they are in full compliance with these Instructions to Bidders.

P. Protests
1. Any bidder who submitted a bid and believes the bid was improperly rejected or that the bid selected by the Owner is not in the best interest of the Owner may submit a written notice of intent to protest the bid to the Owner within seven (7) days. The Owner shall consider all protests before execution of a contract. Each protest must specify the reasons supporting the protest. The Owner may require that additional information be provided. Failure to supply such required information shall be cause for dismissal of the protest.

2. The Owner shall immediately investigate the allegations against the Owners actions and shall issue a written response to the protest.

3. This provision allowing for the submission of protest shall not confer any right on any bidder but is intended solely to assist the Owner in determining the best responsible bid.

Q. Any complaint or protest of the bidding procedure must be filed by the bidder to the Owner. Within 7 days of bid opening the bidder shall notify the Owner in writing of his intent to protest bidding. The bidder shall perfect this notice of intent within 7 days.

R. Owner reserves right to disqualify bids and bidders, before or after opening, upon evidence of collusion with intent to defraud or other illegal practices upon part of bidder, lack of responsibility as evidenced by poor workmanship and progress of past work, incomplete work which, in judgment of Owner, might hinder or prevent prompt completion of additional work if awarded, for being in arrears on existing contracts, in litigation with the Owner, or having defaulted on a previous contract.

S. Bidder's attention is directed to the fact that all Federal and Illinois State Laws, municipal ordinances and regulations of any and all authority having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full. Successful Bidders shall be required to comply with 775 ILCS 10 concerning equal employment opportunities; comply with 30 ILCS 570 concerning the employment of citizens of the State of Illinois; comply with 820 ILCS 265 concerning substance abuse prevention on public works projects; and comply with 820 ILCS 130 concerning prevailing wages.

T. Any successful bidder that is a corporation organized in a state other than Illinois shall furnish to the Owner, upon request, a properly certified copy of its current Certificate of Authority to do business in the State of Illinois, such certificate is to remain on file with the Owner.
U. Any successful bidder that is a corporation organized in the State of Illinois shall furnish at its own cost to the Owner, if requested, a Certificate of Good Standing issued by the Secretary of State, such certificate is to remain on file with the Owner.

V. Owner is exempt from payment of Illinois Department of Revenue's Use and Sales Tax on material entering permanently into structure.

W. Bids will be opened as announced in Advertisement for Bids.

X. Owner reserves the right to reject any or all bids or any part thereof, to waive any informalities in bidding and to accept bids deemed most favorable to the Owner.

Y. Notwithstanding any delay in preparation and execution of the formal Contract Agreement, each bidder shall be prepared, upon written notice of bid acceptance, to commence work within ten (10) days following receipt of official written Notice to Proceed, or on date stipulated in such notice.

Z. Any work in providing or preparing to provide the services specified herein that is commenced by the successful bidder prior to execution of a written contract agreement shall be at the bidder's expense.

AA. Accepted bidder shall assist and cooperate with the Owner in preparing the formal contract Agreement and, within fifteen (15) days following its presentation, shall execute same and return it to Owner.

BB. Successful bidder shall provide FULL TIME SUPERVISION ON SITE.

CC. Contract Time: Time of Substantial Completion for the project shall not be later than August 1, 2020.

END OF DOCUMENT
To: MURPHYSBORO CUSD #186
593 AVA ROAD
MURPHYSBORO, IL 62966

Project: MIDDLE SCHOOL HVAC REPLACEMENT – PHASE 2
MURPHYSBORO HIGH SCHOOL
MURPHYSBORO CUSD # 186
MURPHYSBORO, JACKSON CO., ILLINOIS
HR# 365-3198

Date: ____________________________

Submitted by: ____________________________
(full name)

(full address)
____________________________________
____________________________________

Contact Name: ____________________________

1. OFFER

Having examined the Place of The Work and all matters referred to in the Instructions to Bidders
and the Contract Documents prepared by Hurst-Rosche, Inc. for the above mentioned project, we,
the undersigned, hereby offer to enter into a Contract to perform the Work for the Sum of:

Bid #1:

$_________________________________________ dollars, in
lawful money of the United States of America.

We have included the security Bid Bond as required by the Instruction to Bidders.

All applicable federal taxes are excluded and State of Illinois taxes are excluded from the Bid
Sum.

2. REVIEW OF BID DOCUMENTS

The bidder represents that he is skilled and experienced in the use and interpretation of drawings
and specifications such as those included in the bid documents for this contract. He has carefully
reviewed the drawings, specifications and other bid documents, and has found them free of
ambiguities and sufficient for bid purposes. Further, the Bidder has carefully examined the site of
the work and, from his own observations, has satisfied himself as to the nature and location of the
work; the character, quality and quantity of materials; the difficulties likely to be encountered;
and any other items which may affect the performance of the Work. He has based his bid solely
on these documents and observations, and has not relied in any way on any explanation or
interpretation, oral or written, from any other source.
3. **CONTRACTOR’S FEE FOR CHANGES IN WORK**

Undersigned herein indicates a single percentage, not to exceed 12% for own forces and not to exceed 8% for subcontractors, for overhead and profit to be added to net extra job cost for changes in the work required to be performed by:

   a) Own Forces ___%    b) Subcontractors ___%

Undersigned herein indicates a single percentage, not less than 10% for own forces and not less than 5% for subcontractors, for overhead and profit to be added to net credit for job costs for changes in the work required to be performed by:

   a) Own Forces ___%    b) Subcontractors ___%

Percentages named above shall not include any items of insurance, bond or taxes since these are considered job cost items in contractor's quotations for changes in the work.

Any percentages indicated which are higher or lower than the maximum or minimum in the typewritten language herewith, shall be disregarded and typewritten figure used.

4. **CONTRACT TIME**

Undersigned agrees that, if awarded the Contract for Work bid upon herein, work will start on date designated in a written Notice to Proceed order issued by the Architect and will be completed in accordance with the contract documents, with all phases of work completed and operational and ready for acceptance by the Owner no later than as required by the Contract Agreement.

5. **ADDENDA**

The following Addenda have been received. The modifications to the Bid Documents noted below have been considered and all costs are included in the Bid Sum.

Addendum # _______ Dated _______; Addendum # _______ Dated _______
Addendum # _______ Dated _______; Addendum # _______ Dated _______

6. **APPENDICES**

The following documents are attached to and made a condition of the Bid:

   Bid Bond in form of ...........................
   Bidder's qualifications statement and supporting data.
   Document 00 43 00 – Procurement Form Supplements
   Appendix A - List of Subcontractors.
   Appendix B - List of Alternates.

7. **EQUAL EMPLOYMENT OPPORTUNITY**

During performance of this contract, Contractor agrees as follows:
a. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex or national origin. Such action shall include, but not be limited to, the following: Employment, upgrading, demotion, or transfer, recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the contracting officer setting forth the provisions of this nondiscrimination clause.

b. The contractor will in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex or national origin.

c. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract of understanding, notice advising the labor union or worker's representative of the contractor's commitments under Section 202 of Executive Order 11246 of September 24, 1965, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

d. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and by the rules, regulations, and relevant orders of the Secretary of Labor.

e. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by the rules, regulations, and order of the Secretary of Labor pursuant thereto, and will permit access to his books, records and accounts by the Department of the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.

f. In the event of the contractor's non-compliance with the nondiscrimination clauses of this contract or with any such rules, regulations or orders, this contract may be canceled, terminated or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies involved as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation or order of the Secretary of Labor, or as otherwise provided by law.

g. The contractor will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the Department may direct as a means of enforcing such provisions including sanctions for noncompliance: Provided, however, that in the event the contractor becomes involved in, or is threatened with, litigation with the subcontractor or vendor as a result of such direction by the Department, the contractor may request the United States to enter into such litigation to protect the interest of the United States.

8. NOT BARRED
The contractor by submitting its bid certifies that the Contractor is not barred from bidding on the contract as a result of a conviction for either bid-rigging or bid-rotating. 720 ILCS 5/33/E-11.

9. DRUG FREE WORKPLACE

The Contractor by submitting its bid certifies that it will provide a drug free workplace and that it is in compliance with the requirements of the Drug Free Workplace Act 30 ILCS 580.1 et. seq., and the Substance Abuse Prevention on Public Works Projects Act PA095-0635.

10. SEXUAL HARASSMENT POLICY

The Contractor by submitting its bid certifies that it has a written sexual harassment, (ii) a description of sexual harassment, utilizing examples; (iv) an internal complaint process including penalties (v) the legal resource, investigative and compliant process through the Illinois Department of Human Rights; (vi) directions on how to contact the Department and Commission; and (vii) protection against retaliation for exercising rights under the policy in accordance with 775 ILCS 5/2-105(A)(4).

11. CRIMINAL RECORDS CHECKS

The Contractor by submitting its bid certifies that it will submit to background screening those employees, including subcontract employees, which will be working on any district project. This information is to be provided in accordance with the requirements of 105 ILCS 5/10-21.9. The Contractor by submitting its bid understands that employees found to be in violation of the Illinois School Code will not be permitted to work on school grounds.

12. BID FORM SIGNATURES

The Corporate Seal of

__________________________
(Bidder - print the full name of your firm)
was hereunto affixed in the presence of:

__________________________
(Authorized signing officer Title)
(Seal)

__________________________
(Authorized signing officer Title)
(Seal)

If the Bid is a joint venture or partnership, add additional forms of execution for each member of the joint venture in the appropriate form or forms as above.

END OF DOCUMENT
To: MURPHYSBoro CUSD #186
593 AVA ROAD
MURPHYSBoro, IL 62966

Project: MIDDLE SCHOOL HVAC REPLACEMENT – PHASE 2
MURPHYSBoro MIDDLE SCHOOL
MURPHYSBoro CYSD # 186
MURPHYSBoro, JACKSON Co., ILLINOIS
HR# 365-3198

Date: __________________________

Submitted by: __________________________
(full name)
(full address)

In accordance with Document 00 21 14 - Instructions to Bidders - AIA and Document 00 41 13 - Bid Form - Stipulated Price, we include the Appendices to Bid Form Supplements listed below. The information provided shall be considered an integral part of the Bid Form.

The following Appendices are attached to this document:

Appendix A - List of Subcontractors: Include names of all Subcontractors and portions of the Work each Subcontractor will perform. Those firms listed can’t be changed without approval by the owner and the Architect. Appendix A is required to be provided within 24 hours of the bid opening.

Appendix B - List of Alternates: Include cost variation to Bid Sum applicable to the Work described in Section 01 20 00-Price and Payment Procedures. Appendix B is required to be provided at the bid opening.

BID FORM SUPPLEMENTS SIGNATURES

The Corporate Seal of __________________________

(Bidder - print the full name of your firm)

was hereunto affixed in the presence of:

__________________________________________

(Authorized signing officer Title)

(Seal)

__________________________________________

(Authorized signing officer Title)
Herewith is the list of subcontractors referenced in the bid submitted by:

(Bidder) __________________________

To (Owner) MURPHYSBORO CUSD # 186

Dated ___________ and which is an integral part of the Bid Form.

The following work will be performed (or provided) by subcontractors and coordinated by us:

<table>
<thead>
<tr>
<th>WORK SUBJECT</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>_______________</td>
<td>_______________</td>
</tr>
<tr>
<td>Electrical</td>
<td>_______________</td>
</tr>
<tr>
<td>Heating and Air</td>
<td>_______________</td>
</tr>
<tr>
<td>Architectural</td>
<td>_______________</td>
</tr>
</tbody>
</table>
APPENDIX B - LIST OF ALTERNATES

The following is the list of alternates referenced in the bid submitted by:

(Bidder)  ___________________________

To (Owner)  MURPHYSBORO CUSD # 186

Dated  ________________ and which is an integral part of the Bid Form.

The following amounts shall be added to or deducted from the Bid Sum. Refer to Section 01 20 00 - Price and Payment Procedures: Schedule of Alternates for description of alternates.

Alternate Bid #1: no Alternates

END OF DOCUMENT
1.1 SUMMARY

A. Document Includes:
   1. Contract Agreement.

B. Related Documents:
   1. Document 00 72 14 – General Conditions – AIA Stipulated Sum.
   2. Document 00 73 13 – Supplementary Conditions – AIA.

1.2 CONTRACT AGREEMENT BETWEEN OWNER AND CONTRACTOR

A. THIS AGREEMENT, made and entered into as of the ________ day of __________ in the year of Two Thousand and Nineteen by and between ___________________________ hereinafter and in the Contract Documents called "Contractor" and the MURPHYSBORO CUSD # 186, hereinafter and in the Contract Documents called "Owner."

B. WITNESSETH: That for and in consideration of the mutual covenants and agreements, hereinafter stated, Contractor and Owner covenant and agree as follows:

C. THE CONTRACT WORK:

1. Contractor covenants and agrees to furnish all labor, materials, equipment, transportation, construction plant and facilities necessary to perform all Work required by the Contract Documents, for the Project entitled:

   a. MIDDLE SCHOOL HVAC REPLACEMENT – PHASE 2
      MURPHYSBORO MIDDLE SCHOOL
      MURPHYSBORO CUSD # 186
      MURPHYSBORO, JACKSON CO., ILLINOIS
      HR# 365-3198

      as shown on Drawings and described in Specifications prepared by Hurst-Rosche Inc., 200 N. Market Street, Marion, Illinois, acting as, and in these Contract Documents referred to as Architect/Engineer and covenants and agrees to do and perform all acts and things required of Contractor by this Contract and the Contract Documents.

D. TIME OF COMPLETION:

1. Work performed under this Contract shall be commenced on date stipulated in written Notice to Proceed and, subject to authorized adjustments; Substantial Completion shall be achieved no later than August 8, 2020.

2. It is expressly understood that time is of the essence in this Contract and that a delay in the Substantial Completion of the Work beyond that provided for in Paragraph D.1 above would cause damages to the Owner, the amount of which would be difficult, if not impossible, to estimate and prove. Accordingly, if the Contractor fails to complete the Work within the period of time set forth above, subject to any time extensions permitted hereunder for excusable delays or...
Owner-requested changes, the Contractor shall pay to the Owner as liquidated damages and not as a penalty, the stipulated sum of One Thousand Dollars ($1,000.00) for each calendar day or portion thereof that Substantial Completion is so delayed.

E. CONTRACT SUM AND TERMS OF PAYMENT:

1. Contract Sum: The Owner, if Contractor shall faithfully fulfill and perform this Contract, covenants and agrees to pay Contractor in current funds, subject to additions and deductions by Change Order as provided in the Contract Documents, the sum of ___________________________ Dollars ($__________), which sum shall constitute the Contract Sum, said Contract Sum being derived from Contractor's Bid dated _______________. It is understood and agreed that should there be any increase in wage rates, or in cost of materials or equipment, or in any other of Contractor's costs or should Contractor be compelled to pay premium wages, or for overtime work, during the life of this Contract and/or prior to completion of Contractor's work thereunder, Contractor shall absorb all such increased costs, without addition to the Contract Sum except when otherwise expressly provided in Contract Documents.

2. Payments: Owner shall make payments for work performed under the Contract as provided in Article Nine of the General Conditions and in accordance with other applicable articles of the Supplementary Conditions and Contract Documents.

3. Contractor's Fees for Changes in Work: In accordance with Contractor's bid, it is agreed that the following percentages for overhead and profit shall be applied on work added to or omitted from the Contract by written Change Order approved by Architect and Owner in advance of performance of the work.

Additional Work performed by:

1. Own Forces ___%  
2. Subcontractors ___%

Omitted Work originally required by:

1. Own Forces ___%  
2. Subcontractors ___%

F. CONTRACT DOCUMENTS:

1. Contract Documents include the Contract Agreement, Contractor's Bid as accepted by Owner, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, and all Addenda issued prior to and all Modifications issued after execution of the Contract Agreement.

G. ILLINOIS LABOR:

Contractor shall comply with all Illinois statutory requirements regarding labor, including, but not limited to, the following:

1. Illinois Public Act 77-1552 and Chapter 48, Sections 39S-1 through 39S-12 of the Illinois Revised Statutes regulating wages of laborers, mechanics and other workers employed in any public works and known as the "Prevailing Wage Act," which provides in part that all laborers, mechanics and workers performing work
under the Contract shall be paid not less than the prevailing rate of wages as determined by the Illinois Department of Labor (820 ILCS 130).

2. Illinois Public Act 83-1472, Article 2 and Chapter 48, Sections 2201 through 2207, 1984 of the Illinois Revised Statutes pertaining to hiring of Illinois labor and known as the "Illinois Preference Act (30 ILCS 570)."


H. PERFORMANCE BOND AND LABOR AND MATERIAL PAYMENT BOND:

1. Within fifteen (15) days immediately following date of his receipt of this contract, Contractor shall furnish Owner the signed Contract and Performance Bond and Labor and Material Payment Bond as required by and in accordance with the terms of Contract Documents in a penal sum of one hundred percent (100%) of the Contract sum.

2. In the event Contractor fails to furnish Owner such Contract and Bonds within said period, this Contract shall thereupon become null and void at Owner's option, exercised by written registered notice and mailed to Contractor by said Owner within five (5) days thereafter. Owner may then retain and enforce as liquidated damages, bid guarantee heretofore deposited with it in connection with Contractor's proposal for this Contract or the difference between his bid and a subsequent awarded bid, whichever is lesser.

I. IN WITNESS HEREOF, the parties hereto have executed this agreement as of the day and year first written above.

OWNER:

MURPHYSBORO CUSD # 186

BY_____________________________________

TITLE____________________________________

CONTRACTOR:

Attest:

________________________________________

BY_____________________________________

Secretary

BY_____________________________________

TITLE____________________________________

END OF DOCUMENT
CONTRACTOR’S AFFIDAVIT FOR FINAL COMPLETION
(To be filed with final request for payment)

STATE OF___________________________
COUNTY OF _________________________

____________________________________, being first duly sworn upon oath deposes and says:

That he/she is _____________________________________________ of ___________

hereinafter termed "The Contractor" for all work upon the hereinafter termed "Said Project," work for the MURPHYSBORO CUSD # 186, under that certain contract between said Contractor and said Owner, bearing date of ___________________________ pertaining to said work.

Affiant further states, of his/her own knowledge, that all bills incurred by the Contractor, for services, labor and material furnished, for work done by the Contractor under said Contract, or in connection with said project have been paid and all subcontractors who have furnished services, labor or materials have no claim or demand against Owner for any services, labor and/or materials furnished and/or work done by them upon said Project.

Affiant further states that this affidavit is made on behalf of the Contractor for the purpose of obtaining payment of the sum of

___________________________________________($___________________) dollars, which affiant states, upon his/her own knowledge, constitutes the full balance due the Contractor for all services, labor and materials furnished and work done to and upon Said Project by the Contractor whether under and pursuant to provisions of said Contract and all subsequent modifications thereof and changes therein or otherwise; and that payment of the sum to the Contractor will constitute payment in full on everything due for such services, labor, materials and work, and will fully satisfy any and all claims or demands which Contractor may have or assert against said Owner, arising out of anything done or furnished by the Contractor or occurring in connection with said Project and/or Contract.

____________________________________
CONTRACTOR

Subscribed and Sworn to before me the ______ day of ________________, 20__.

____________________________________
NOTARY PUBLIC
CONTRACTOR'S RELEASE AND WAIVER OF LIEN
(To be filed with final request for payment)

TO WHOM IT MAY CONCERN:

For good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the undersigned ________________________________, hereinafter termed "Contractor," hereby waives and releases any and all liens, and any and all claims and rights to liens against the Middle School HVAC Replacement - Phase 2 at the Murphysboro Middle School, hereinafter termed "Said Project," and any and all other property owned by or the title to which is in the name of the MURPHYSBORO CUSD # 186 hereinafter termed "Owner" and upon construction and/or equipping of Said Project, any and all warrants drawn upon or issued against any such funds or monies which Contractor may have acquired or possessed or may hereafter acquire or possess, as a result or on account of, the furnishing by the Contractor of services, labor and material used in connection with the construction under and pursuant to the certain Contract between it and said Owner, bearing date of ________________ and pertaining to Said Project, or otherwise; and which said liens or claims or rights to lien may exist under and by virtue of an act of the General Assembly of the State of Illinois entitled "An Act to Revise the Law in Relation to Mechanic's Liens," approved May 18, 1903, as amended and in accordance with Chapter 82, Illinois Revised Statutes, 1976 or subsequent amendments thereto.

The undersigned further hereby acknowledges that the sum of ________________ Dollars, constitutes the entire balance due the Contractor from said Owner, for all services, labor and materials furnished and work done by it, upon or for Said Project and/or under said Contract, and that the payment in full to the undersigned for everything furnished and/or done by the Contractor in connection with Said Project, whether under the Contract or otherwise, and will satisfy in full, and will operate to fully and completely release said Owner from any and all claims or demands, of whatever nature, which the undersigned may have or assert against it, arising out of the construction and equipping of Said Project, said Contract, and any and all things done or furnished by the undersigned in connection therewith.

__________________________
CONTRACTOR

BY ____________________________

TITLE__________________________

Subscribed and Sworn to before me this _______ day of ________________, 20__.

__________________________
NOTARY PUBLIC
AFFIDAVIT OF PAYMENT TO MATERIAL SUPPLIERS AND SUBCONTRACTORS

STATE OF ________________________________

COUNTY OF ______________________________

__________________________, being first duly sworn upon oath
deposes and says, that he/she entered into a Contract with the MURPHYSBORO CUSD #186, known as
the Owner, for furnishing of labor, work services, materials, fixtures, and supplies for construction of
Middle School HVAC Replacement – Phase 2 at the Murphysboro Middle School.

That for the purpose of said Contract, the following persons, firms or corporations have been contracted
with to furnish, have furnished or prepared, or will furnish or prepare labor, services, materials, fixtures,
apparatus, machinery or supplies, or are furnishing and preparing material for said construction; that there
are due or to become due to them respectively, the amounts set opposite their names for said labor,
services, materials, fixtures, apparatus, machinery and supplies as stated; that there are no other
contractors outstanding and there is nothing due or to become due any person, firm, or corporation, for
labor, services, materials, fixtures, machinery, apparatus, or supplies, other than as stated herewith.

<table>
<thead>
<tr>
<th>MATERIAL SUPPLIER AND/OR SUBCONTRACTOR</th>
<th>CONTRACT ITEM</th>
<th>CONTRACT AMOUNT</th>
<th>AMOUNT PAID</th>
<th>AMOUNT TO DATE</th>
<th>AMOUNT DUE OR TO BECOME DUE</th>
</tr>
</thead>
</table>

__________________________

CONTRACTOR

Subscribed and sworn to before me, a Notary Public, this ________ day of ______________; A.D. 20__

__________________________

NOTARY PUBLIC
CONSENT OF SURETY COMPANY TO FINAL PAYMENT
(To be filed with final request for payment)

PROJECT: Middle School HVAC Replacement - Phase 2
(Name, address) Murphysboro Middle School
Murphysboro CUSD #186

TO (Owner): Murphysboro CUSD #186
(Name, address) 593 Ava Road,
Murphysboro, IL 62966

CONTRACTOR:
(Name, address)

CONTRACT DATE: BOND NO.: 

In accordance with the provisions between Owner and Contractor indicated above, ________________
_________________________________________ SURETY COMPANY, hereby
approves of final payment to Contractor, and agrees that final payment to Contractor shall not relieve
Surety Company of any of its obligations to Owner, as set forth in Surety Company's bond.

IN WITNESS WHEREOF, Surety Company has hereunto set its hand this _____ day of
______________________________, 20__.

_________________________________________ Surety Company
Attest:
(Seal):
_________________________________________ Signature of Authorized Representative

Title

365-3198 Consent Of Surety Company To Final Payment
00 65 50 - 1
1.1 SUMMARY
A. Document Includes:
   1. General Conditions.
B. Related Documents:
   2. Document 007313 – Supplementary Conditions - AIA.

1.2 GENERAL CONDITIONS

1.3 SUPPLEMENTARY CONDITIONS
A. Refer to Document 007313 for modifications to General Conditions.

END OF DOCUMENT
1.1 SUMMARY

A. Document Includes:
   1. General Conditions.
   2. Supplementary Conditions.

B. Related Documents:
   1. Document 00 41 13 – Bid Form – Stipulated Sum
   2. Document 00 52 14 – Agreement Form - AIA

1.2 GENERAL CONDITIONS

A. The General Conditions of the Contract for Construction, AIA Document A201, Sixteenth Edition, 2007, Articles 1 through 15, is a part of this Contract and is incorporated herein as fully as if here set forth. Copies of the General Conditions are on file and may be reviewed at the offices of the Architect, or may be obtained from the American Institute of Architects, St. Louis Chapter, 911 Washington St., #225, St. Louis, Missouri 63101-1203.

1.3 SUPPLEMENTARY CONDITIONS

A. The following supplements modify, change, delete from or add to the "General Conditions of the Contract for Construction," AIA Document A201, Sixteenth Edition, 2007. Where any Article of the General Conditions is modified or changed or any Paragraph, Subparagraph or Clause thereof is modified, changed or deleted by these supplements, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

1.4 REFERENCE TO DIVISION 01

A. Where provisions of General Conditions relate to project administrative or work-related requirements of the Contract, and those provisions differ from those specified in Division 01, provisions outlined in Division 01 shall prevail.

1.5 ARTICLE 1: GENERAL PROVISIONS

A. 1.5.1 In the second line following the word “Specifications” insert the words "and Project Manual,“.

B. 1.6 TRANSMISSION OF DATA IN DIGITAL FORM: Add new subparagraph

   1.6.1 Electronic drawings provided by the Owner or Architect are for informational purposes only and are not intended for any other use. The paper copies provided are a true representation of the completed design and if discrepancies should exist
between the paper copy and the electronic copy, the paper copy shall govern.

C. Delete Subparagraph 1.1.8 its entirety and substitute the following:

1.1.8 INITIAL DECISION MAKER

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2 and certify termination of the Agreement under Section 14.2.2. If the Initial Decision Maker is not specifically identified in the Agreement, the responsibilities of the Initial Decision Maker shall default to the Architect.

D. DEFINITIONS: Add Paragraph 1.1.9

1.1.9 PROJECT MANUAL

The Project Manual is the collection of documents which includes the bidding requirements, sample forms and, certain Contract Documents such as the Conditions of the Contract and the Specifications.

1.6 ARTICLE 2: OWNER

A. Delete Section 2.2.1 in its entirety.

B. 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER:

C. Delete Subparagraphs 2.2.3 and 2.2.5 in their entireties and substitute the following:

2.2.3 The Owner shall, at the request of the Contractor, furnish to Contractor any survey or other similar descriptive information of project site that Owner has in his possession. Upon demonstration of need by Contractor for specific additional survey information, Owner shall obtain and furnish such information to Contractor.

2.2.5 Contractor will be furnished, free of charge, 1 copy of Drawings, Specifications, and Project Manual as set forth in Division 1 of the Specifications. Additional copies will be furnished to Contractor at cost of reproduction, postage and handling.

1.7 ARTICLE 3: CONTRACTOR

A. 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR: Add Subparagraphs 3.2.5 and 3.2.6:

3.2.5 The Contractor by executing the Contract represents that he has carefully examined the Site of the Work at each location and that he has full knowledge of and fully understands the facilities, site conditions, difficulties and restrictions attending performance of the Work. Contractor further represents that he has taken all required measurements and carefully inspected existing constructions, irregularities and interferences which may affect the Work. No additional
compensation will be allowed for conditions increasing Contractor’s cost which were not known to or appreciated by him prior to executing the Contract if they could have been discovered by him following the foregoing procedures and thoroughly informing himself of all existing conditions affecting the Work.

3.2.6 Contractor will not, however, be required to excavate, penetrate or demolish any constructions or other work and conditions prior to executing the Contract in order to uncover and/or expose concealed conditions that affect the Work. If, during course of construction, Contractor uncovers conditions that affect the work that could not have been known and understood by the above described careful examination of conditions affecting the Work, he shall promptly notify the Architect, in writing, who will determine if claims for additional costs or extensions of time are justified. If such claims are found to be justified, Contract will be modified in accordance with Article 7 of the General Conditions.

B. 3.4. LABOR AND MATERIALS: Delete Paragraph 3.4, in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.4 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.

C. 3.6. TAXES: Delete Paragraph 3.6, in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.6 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.

D. 3.7 PERMITS, FEES AND NOTICES: Delete Paragraph 3.7, in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.7 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.

E. 3.8 ALLOWANCES: Delete Paragraph 3.8, in its entirety.

F. 3.11 DOCUMENTS AND SAMPLES AT THE SITE: Delete Paragraph 3.11, in its entirety.

G. 3.13 USE OF SITE: Delete Paragraph 3.13, in its entirety. Refer to Specification Section 01 10 00, Summary, for provisions on this subject. References to Paragraph 3.13 elsewhere in the Contract Documents shall read as referring to Section 01 10 00 of the Specifications.

H. 3.15 CLEANING UP: Delete Paragraph 3.15, in its entirety. Refer to Specification Section 01 70 00, Execution and Closeout Requirements, for provisions on this subject. References to Paragraph 3.15 elsewhere in the Contract Documents shall read as referring to Section 01 70 00 of the Specifications.

I. 3.18.1 INDEMNIFICATION: Insert the word “defend” between the word “indemnify” and phrase “and hold harmless” in the first sentence. Also insert the phrase “or
intentional misconduct” between the phrase “negligent acts or omissions” and the words “of the Contractor”, in the middle of this section.

1.8 ARTICLE 4: ARCHITECT

A. 4.1 GENERAL: Delete Subparagraph 4.1.1 in its entirety and substitute the following:

4.1.1 The Owner shall retain an architect or engineer lawfully licensed to practice architecture or engineering or an entity lawfully practicing architecture or engineering in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

1.9 ARTICLE 5: SUBCONTRACTORS

A. 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK: Add new Subparagraph 5.2.1.1:

5.2.1.1. Within ten (10) days of notification of acceptance of his proposal, Contractor shall submit the names of those to whom he intends to award a Subcontract.

1.10 ARTICLE 6: CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

A. 6.1 OWNER’S RIGHT TO PERFORM CONSTRUCTION AND TO AWARD SEPARATE CONTRACTS: Delete Subparagraph 6.1.3 in its entirety and substitute the following:

6.1.3 General Contractor shall have responsibility of coordinating efforts of all contractors and to maintain overall direction of job progress. Each Contractor shall coordinate operational methods with other contractors and encourage communications among all trades. All Contractors shall make other contractors aware of any problems, delays in materials shipments or lack of work force, and assist other contractors in maintaining job momentum and direction of overall project.

1.11 ARTICLE 8: TIME

A. Add new paragraph 8.3.2 as follows:

8.3.2 Notwithstanding the foregoing or any other provision to the contrary in the Contract, in the event of any delay to the Work caused by weather-related matters or any other event of force majeure or otherwise outside the reasonable control of Owner and Contractor, an extension of the Contract Time shall be the Contractor’s sole remedy (which extension shall be subject to the terms of Article 15 below) and the Contract Sum shall not be increased.
1.12 ARTICLE 9: PAYMENTS AND COMPLETION

A. 9.2 SCHEDULE OF VALUES: Add new Paragraph 9.2:

9.2 SCHEDULE OF VALUES: Delete Paragraph 9.2 in its entirety. Refer to Specification Section 01 20 00, Price and Payment Procedures, for provisions on this subject. References to Paragraph 9.2 elsewhere in the Contract Documents shall read as referring to Section 01 20 00 of the Specifications.

B. 9.3 APPLICATIONS FOR PAYMENT: Add new Subparagraph 9.3.1.3

9.3.1.3: Until Substantial Completion, the Owner will pay 90 percent of the amount due Contractor on account of approved progress payments.

1.13 ARTICLE 11: INSURANCE AND BONDS

A. 11.1.1 In the first line following the word "maintain," insert the words "in a company or companies licensed to do business in the state in which the project is located and rated ‘A’ or better by A.M. Best Co.,". The school district shall be named additional insured for Liability and Automobile Insurance.

B. Add new Subparagraph 11.1.1.9:

11.1.1.9 General Liability Insurance shall be comprehensive, on occurrence, and shall include:

- Premises and Operations.
- Independent Contractors.
- Products and Completed Operations.
- Broad Form Property Damage.
- Personal Injury.
- Explosion, Collapse and Underground damage where the hazard exists.
- Contractual liability.

C. Add the following Sub-Subparagraphs to Subparagraph 11.1.2:

11.1.2.1 The insurance required by Subparagraph 11.1.1 shall be on a project specific basis and written for not less than the following, or greater if required by law:

1. Worker's Compensation:
   a. State: Statutory
   b. Applicable Federal: Statutory
   c. Employer's Liability: $500,000

2. Comprehensive General Liability:
a. Bodily Injury:
   $1,000,000       Combined Single Limit

b. Property Damage:
   $1,000,000       Combined Single Limit

Limit Coverage for bodily injury and property damage per occurrence and in the same aggregate limit will be accepted in lieu of the separate limits specified above.

3. Personal Injury:
   $1,000,000       Combined single limit including owned non-owned, and hired motor vehicle.

4. Comprehensive Automobile Liability:
   a. Bodily Injury:
      $1,000,000       Combined single limit including owned, non-owned, and hired motor vehicle.
   b. Property Damage:
      $1,000,000       Combined single limit including owned, non-owned, and hired motor vehicle
   c. $1,000,000       Combined Single

Limit coverage for bodily injury and property damage per occurrence and in the same aggregate limit will be accepted in lieu of the separate limits specified above.

11.1.2.2 Umbrella Form Liability Coverage:

An Umbrella Form Liability coverage to not less than $2,000,000 for any one occurrence and subject to the same aggregate over the Employer's Liability, Comprehensive General Liability, and Comprehensive Automobile Liability coverage is required.

D. Add the following Subparagraph 11.1.3.1:

11.1.3.1 Contractor shall furnish one copy each of Certificates of Insurance herein required for each copy of the Agreement which shall specifically set forth evidence of all coverage required by Paragraph 11.1. The Certificate of Insurance is to be
accompanied by AIA Document G715TM-1997 (Supplemental Attachment for ACORD Certificate of Insurance 25-S). Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits. The Contractor shall furnish to the Owner notice of any policy cancellation at least 30 days (10 days for non payment of premiums) prior to the effective date of cancellation. The Contractor shall submit copies of subcontractor’s Certificates of Insurance prior to the beginning of work.

E. Add the following Subparagraph 11.1.4.1:

11.1.4.1 The Owner, Architect, Contractors and Sub-Contractors shall be named as additional insureds on ISO form 20331001 by endorsement for the purpose of coverage only with no liability for premium payments. All policies and coverages shall include a waiver of subrogation in favor of the Owner.

F. 11.3. PROPERTY INSURANCE: Delete Subparagraph 11.3.1 in its entirety and substitute the following:

11.3.1: The General Contractor shall be responsible to maintain property (builder’s risk) insurance upon the completed value of all work at the site under this contract to the full insurable value thereof. This insurance shall include the interests of the Owner, the General Contractor, Subcontractors, and Sub-subcontractors in the work and as their interests may appear in the work, and shall be an all-risk type policy, including theft, subject to the exclusions generally accepted in the insurance industry. This coverage is not intended to, and shall not, provide coverage for tools, equipment, scaffolding, forms, or other devices used by the Contractors or Subcontractors in performing work under this contract.

11.3.1.2 Delete this Paragraph in its entirety.

G. Delete Subparagraphs 11.3.1.3 in its entirety and substitute the following:

11.3.1.3 If the property insurance requires deductibles, the Contractor shall pay costs not covered because of such deductibles.

1.14 ARTICLE 12: UNCOVERING AND CORRECTION OF WORK

A. Add new paragraph 12.2.6 as follows:

12.2.6 As part of its Work, the Contractor shall perform a one-year warranty inspection with the Architect and Owner within one year of Substantial Completion to ascertain any defects or failures in Contractor’s Work.

If any defects, deficiencies, or failures or noted the Contractor shall promptly remedy such defect, deficiency or failure. All obligations are in addition to any other warranties to be provided as part of its Work.
ARTICLE 13: MISCELLANEOUS PROVISIONS

A. Revise ARTICLE 13.1 to read: the contract shall be governed by Illinois law.

B. Add new paragraph 13.8 as follows:

13.8 REFERENCED STANDARDS

13.8.1 No provision of any referenced standard specification, manual or code; whether or not specifically incorporated by reference in the Contract Documents; shall be effective to change the duties and responsibilities of Owner, Contractor or Architect, or any of their consultants, agents or employees from those set forth in the Contract Documents, nor shall it be effective to assign to Architect, or any of Architect's consultants, agents or employees, any duty or authority to supervise or direct the furnishing or performance of the Work or any duty or authority to undertake responsibility contrary to the provisions of Articles 1 through 15.

C. Delete Section 13.6 INTEREST.

D. Delete Section 13.7 TIME LIMITS ON CLAIMS

E. Add New Section which reads:

In the event the Owner files a court proceeding to enforce the terms or provisions of this Agreement or to recover damages from the Contractor and/or its Surety for breach of the Agreement, the Owner shall be entitled to recover its reasonable attorneys’ fees and/or legal expenses in the event the Owner is the prevailing party. In any court proceeding brought by one party hereto against the other to enforce or interpret the terms of the Agreement or to resolve any dispute concerning any party of the services or Work, the action shall be filed in the Circuit Court of Jackson County, Illinois.

ARTICLE 15: CLAIMS AND DISPUTES

A. Add at the end of Section 15.1.4 CLAIMS FOR ADDITIONAL COSTS.

“It is understood and agreed that Contractor has fully and adequately investigated market prices for labor and supplies and will be taking the risk for increases in costs of materials and labor price increases and that the general conditions included in the Contract Sum have taken this into account. There shall be no increase in the Contract Sum due to an increase in either cost nor shall there be any increase in general conditions nor Contract Sum due to an increase in Contract Time due to weather related delays, although there may be an agreement as to an increase in Contract Time as set forth in Section 15.1.5 below”

B. Add at the end of Section 15.1.5.2

“Contractor shall not be entitled to an increase in the Contract Sum for any reason related to or arising out of adverse weather conditions. In addition, Contractor shall
not be entitled to an extension of time based on adverse weather conditions unless Contractor establishes to the reasonable satisfaction of the Initial Decision Maker that such adverse weather was abnormal for the period in which the Work was performed, based upon NOAA data of the location of the Work.”

C. Delete Section 15.1.6 CLAIMS FOR CONSEQUENTIAL DAMAGES

D. Delete Sections 15.2.6, 15.2.6.1, and 15.2.8.

E. Delete Section 15.3 MEDIATION in its entirety.

F. Delete Section 15.4 ARBITRATION in its entirety.

G. Delete Section 15.4.4. CONSOLIDATION OR JOINDER in its entirety.

END OF SECTION
## Jackson County Prevailing Wage Rates posted on 12/16/2019

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| PAINTER OVER 30 FT. | ALL | BLD | 31.86 | 33.36 | 1.5 | 1.5 | 2.0 | 2.0 | 6.25 | 10.93 | 0.00 | 0.55 |
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| PILEDRI

### Legend

**Rg** Region  
**Type** Trade Type - All, Highway, Building, Floating, Oil & Chip, Rivers  
**C** Class
Base Base Wage Rate

**OT M-F** Unless otherwise noted, OT pay is required for any hour greater than 8 worked each day, Mon through Fri. The number listed is the multiple of the base wage.

**OT Sa** Overtime pay required for every hour worked on Saturdays

**OT Su** Overtime pay required for every hour worked on Sundays

**OT Hol** Overtime pay required for every hour worked on Holidays

**H/W** Health/Welfare benefit

**Vac** Vacation

**Trng** Training

**Other Ins** Employer hourly cost for any other type(s) of insurance provided for benefit of worker.

Explanations JACKSON COUNTY

The following list is considered as those days for which holiday rates of wages for work performed apply: New Years Day, Memorial Day, Fourth of July, Labor Day, Thanksgiving Day, Christmas Day and Veterans Day in some classifications/counties. Generally, any of these holidays which fall on a Sunday is celebrated on the following Monday. This then makes work performed on that Monday payable at the appropriate overtime rate for holiday pay. Common practice in a given local may alter certain days of celebration. If in doubt, please check with IDOL.

Oil and chip resealing (O&C) means the application of road oils and liquid asphalt to coat an existing road surface, followed by application of aggregate chips or gravel to coated surface, and subsequent rolling of material to seal the surface.

**EXPLANATION OF CLASSES**

**ASBESTOS - GENERAL** - removal of asbestos material/mold and hazardous materials from any place in a building, including mechanical systems where those mechanical systems are to be removed. This includes the removal of asbestos materials/mold and hazardous materials from ductwork or pipes in a building when the building is to be demolished at the time or at some close future date.

**ASBESTOS - MECHANICAL** - removal of asbestos material from mechanical systems, such as pipes, ducts, and boilers, where the mechanical systems are to remain.

**LABORER - OIL AND CHIP RESEALING**

Hook and unhook chip box from aggregate truck; distribute material within chip box; perform flagging work related to oil and chip resealing; hand spray oil fluids; handle traffic control, including setting-up and maintaining barricades, drums, cones, delineators, signs and other such items, as well as laying-out and applying or removing temporary roadway markings used to control traffic in job site related to oil and chip resealing; and perform clean-up related to oil and chip resealing.

**CERAMIC TILE FINISHER, MARBLE FINISHER, TERRAZZO FINISHER**

Assisting, helping or supporting the tile, marble and terrazzo mechanic by performing their historic and traditional work assignments required to complete the proper installation of the work covered by said crafts. The term “Ceramic” is used for naming the classification only, and is in no a limitation of the product handled. Ceramic takes into consideration most hard tiles.

**ELECTRIC POWER LINEMAN**

Construction, maintenance and dismantling of overhead and underground electric power lines, including high voltage pipe type cable work, and associated structures and equipment.
ELECTRIC POWER EQUIPMENT OPERATOR - CLASS 1
Operation of all crawler type equipment D-4 and larger from the ground to assist the Electric Power Linemen in performing their duties.

ELECTRIC POWER EQUIPMENT OPERATORS - CLASS 2
Operation of all other equipment from the ground to assist the Electric Power Linemen in performing their duties.

ELECTRIC POWER GROUND MAN
Applies to workers who assist the Electric Power Lineman from the ground.

ELECTRONIC SYSTEMS TECHNICIAN
Installation, service and maintenance of low-voltage systems which utilizes the transmission and/or transference of voice, sound, vision, or digital for commercial, education, security and entertainment purposes for the following: TV monitoring and surveillance, background/foreground music, intercom and telephone interconnect, field programming, inventory control systems, microwave transmission, multi-media, multiplex, radio page, school, intercom and sound burglar alarms and low voltage master clock systems.

Excluded from this classification are energy management systems, life safety systems, supervisory controls and data acquisition systems not intrinsic with the above listed systems, fire alarm systems, nurse call systems and raceways exceeding fifteen feet in length.

TRUCK DRIVER - BUILDING, HEAVY AND HIGHWAY CONSTRUCTION Class 1. Drivers on 2 axle trucks hauling less than 9 ton. Air compressor and welding machines and brooms, including those pulled by separate units, truck driver helpers, warehouse employees, mechanic helpers, greasers and tiremen, pickup trucks when hauling materials, tools, or workers to and from on-the-job site, and fork lifts up to 6,000 lb. capacity.

Class 2. Two or three axle trucks hauling more than 9 ton but hauling less than 16 ton. A-frame winch trucks, hydrolift trucks, vactor trucks or similar equipment when used for transportation purposes. Fork lifts over 6,000 lb. capacity, winch trucks, four axle combination units, and ticket writers.

Class 3. Two, three or four axle trucks hauling 16 ton or more. Drivers on water pulls, articulated dump trucks, mechanics and working forepersons, and dispatchers. Five axle or more combination units.

Class 4. Low Boy and Oil Distributors.

Class 5. Drivers who require special protective clothing while employed on hazardous waste work.

TRUCK DRIVER - O & C (Oil and Chip Resealing ONLY)
It involves driving of contractor or subcontractor owned, leased, or hired pickup, dump, service, or oil distributor trucks. Includes transporting materials and equipment (including, but not limited to oils, aggregate supplies, parts, machinery and tools) to or from the job site; distributing oil or liquid asphalt and aggregate; stock piling material; and maintaining trucks at job site related to oil and chip resealing.

Class 1. Distributors, liquid asphalt hauling and hauling of asphalt rubber-tired rollers.

Class 2. Stockpiling.

Class 3. Tandem hauling to job site.
OPERATING ENGINEERS - BUILDING, HEAVY AND HIGHWAY CONSTRUCTION

Class 1. Boom or Winch Type Truck; Back-End man on Bituminous Surfacing Machine; APSCO or Equal Spreading Machine, Backhoe, Backfiller, Boom or Winch Cat, Bituminous Mixplane Machine, Blacksmith, Bituminous Surfacing Machine, Bull-Dozer, Crane, Shovel, Dragline, Truck Crane, Pile Driver, Concrete Breaker, Concrete or PumpCrete Pumps, Dinky or Standard Locomotives, Well or Caisson Drills, Elevating Grader, Fork Lifts, Flexplane, Gradeall, Hi-Lift Hoists, Guy-Derricks, Hysters, Mechanic Motor Patrol, Mixers - 21 cu. ft. or over, Push Cats, Pulls and Scrapers, Two Well Point Pumps, Pulverizer or Tiller, PugMill, Rubber-Tired Farm Type Tractor with Bulldozer/Blade/Auger or hi-lift over 1/2 yd., Jersey Spreader, Tract-Air used with Drill or Hi-Lift, Trenching or Ditching Machines, Wood Chipper w/Tractor, Self-Propelled Roller w/Blade, Equipment Greaser, Self-Propelled Bump Grinder on Concrete pavement, Boat Operator, Skid-Loaders, Tuggers, Lazer Screed, and Self-Propelled Chip Spreader (when others run conveyors).

Class 2. Any type tractor pulling any type roller or disc, Two Air Compressors (220 cu. ft. capacity or over), Two AirTract Drills, AirTrack Drill w/Compressor, Automatic Bins or Scales w/Compressor or Generator, Pipeline Boring Machine, Bulk Cement Plant w/Separate Compressor, Power Operated Bull Float, Hydra-Lift w/Single Motor, Straw Mulcher Blower w/Spout, Self-Propelled Roller/Compactor, oiler on milling machine, Self-Propelled Air-Track Drill (one), Air Compressor w/Valve driving piling, Two Conveyors, Self-Propelled Concrete Saw, Form Grader, Truck Crane Oiler, Self-Propelled Vibrator, Rubber Tired Farm Type Tractor w/Blade/Bulldozer/Auger/hi-lift - 1/2 yd. or less, Elevator Operator, Man Lift (scissor lift) when lifting materials.

Class 3. Belt Drag Machine, Power Broom, Mechanical Plasterer Applicator, Trac-Air, Air Compressor (220 cu. Ft. or over) One, Air Compressor (under 220 cu. Ft) four, Automatic Bin, Bulk Cement Plant w/Built-in Compressor running off same motor or electric motor, Fireman or Switchman, Self-Propelled Form Tamper, Light Plants (4), Welding Machines (4), Pumps (4), or Combination of four (4) Pumps, Light Plants, Welding Machines, Air-Compressors (under 200 cu. Ft.), Mudjacks or Wood Chipper, Mixers – less than 21 cu. Ft. Mortar Mixer w/ Skip or Pump, Pipeline Tract Jack. One Operating Engineer may operate and maintain any combination of the following pieces of equipment, not to exceed four (4) which shall be within a reasonable distance, such combination may include any equipment in this classification: (Compressors, Light Plants, Welding Machines, Pumps or Conveyors), One Well – Point Pump, Two Motor Driven Heaters, One Air Compressor (under 220 cu. Ft.), One Engine-Drive Conveyor, One Motor Driven Heater, One Light Plant, One Pump, One Welding Machine, One Ulmac or Equal Spreader, Oilers, and one Generator 10 kw or greater.

OPERATING ENGINEER - O & C (Oil and Chip Resealing ONLY). Includes the operation of all motorized heavy equipment used in oil and chip resealing, including but not limited to operating self-propelled chip spreaders, and all types of rollers (both hard and rubber tired); and other duties pertaining to the operation or maintenance of heavy equipment related to oil and chip resealing.

Class 1. See Class 1 above for types of equipment operated.

Class 2. See Class 2 above for types of equipment operated.

Class 3. See Class 3 above for types of equipment operated.

OPERATING ENGINEER RIVER WORK 1 - operate the following machines when working on River Work and Levee Work on the Mississippi and Ohio Rivers, Lakes and Tributaries: Crane, Shovel, Dragline, Scrapers, Dredge, Derrick, Pile-Driven, Push Boat, all power boat operators, Mechanic, Engineman on Dredge, Leverman on Dredge, All Bituminous Spreader machines, Backhoe, Backfiller, Boom, or Winch Cat, Bituminous Mixplane Machine, Blacksmith, Bituminous Surfacing Machine, Bulldozer, Truck Cranes, Hydraulic Truck Mounted Boom/Crane, Concrete Finishing Machine, or Spreader Machine, Concrete Breaker, Concrete or Pumpcrete Machines, Concrete Plant Operator, All Off Road Material Hauling Equipment, Dinky or Standard Locomotives, Well Drill, Elevating Grader, Fork-Lifts, Flexplane, Gradeall, Hi-Lift, Power Handblade Tugger type Hoist, Hoist Two Drum (or over one), Guyderrick, Hyster, Motor Patrol, Mixers - 21 Cu. Ft. or over, Push Cat, Pulls, & Scrapers, Pumps—Two Well Points, Equipment Greaser, P & H Pulverizer or Pulverizer equal to Pugmill, Pugmill, Rubber-Tired farm type tractor w/Bulldozer/Blade/Auger or Hi-Lift over 1/2 yard, Skimmer Scoops, Seaman Tiller, Jersey Spreader, Tract-Air used with Drill or Hi-Lift, Trenching or Ditching
Machine, Wood Chipper w/Tractor, self-propelled roller w/Blade, Concrete Pumps and Small Equipment Operators.

OPERATING ENGINEER RIVER 2 - when working on River Work and Levee Work on the Mississippi and Ohio Rivers, Lakes and Tributaries shall be employed as the Oiler or Fireman on Crane, Dragline, Shovel, Dredge, Truck Crane, Pile Driver, Gradeall, Dinky or Standard Locomotive, Guy Derrick, Trenching Machine or Ditching Machine 80 H.P. and over, All Terrain (cherry-picker) with over 40 ton Lifting Capacity, Deck Oiler, and Deckhands on the Ohio River.

Other Classifications of Work:

For definitions of classifications not otherwise set out, the Department generally has on file such definitions which are available. If a task to be performed is not subject to one of the classifications of pay set out, the Department will upon being contacted state which neighboring county has such a classification and provide such rate, such rate being deemed to exist by reference in this document. If no neighboring county rate applies to the task, the Department shall undertake a special determination, such special determination being then deemed to have existed under this determination. If a project requires these, or any classification not listed, please contact IDOL at 217-782-1710 for wage rates or clarifications.

LANDSCAPING

Landscaping work falls under the existing classifications for laborer, operating engineer and truck driver. The work performed by landscape plantsman and landscape laborer is covered by the existing classification of laborer. The work performed by landscape operators (regardless of equipment used or its size) is covered by the classifications of operating engineer. The work performed by landscape truck drivers (regardless of size of truck driven) is covered by the classifications of truck driver.

ARTICLE 25: PREVAILING RATE OF WAGES

25.1 Pursuant to Illinois Compiled Statutes 820 ILCS 130/0.01 et seq., these specifications list on the following pages, the Illinois Department of Labor prevailing rate of wages for the county where the contract is being performed and for each craft or type of worker needed to execute the contract.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Contract description.
B. Contractor's use of site and premises.
C. Owner occupancy.
D. Specification Conventions.
E. Contractor’s Duties.

1.2 CONTRACT DESCRIPTION

A. Work of the Project includes:
   Bid #1: Installation of new HVAC for the large gym, cafeteria, and band room.
   Installation of new 2x2 ceiling and lighting in cafeteria and band room, new lighting in
   the gymnasium as shown on the documents. Remove and install new doors as shown on
   the drawings. Remove and replacement associated electrical panels as shown.

B. Perform Work of the Contract under fixed cost contract with Owner in accordance with
   Conditions of Contract.

1.3 CONTRACTOR’S USE OF SITE AND PREMISES

A. Limit use of site and premises to allow:
   1. Owner occupancy.
   2. Work by Owner.
   3. Use of site and premises by the public.

1.4 OWNER OCCUPANCY

A. The Owner will occupy the premises during construction for the conduct of normal
   operations.

B. Cooperate with Owner to minimize conflict, and to facilitate Owner's operations.

C. Schedule the Work to accommodate Owner occupancy.

1.5 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This
   imperative language is directed to the Contractor, unless specifically noted otherwise.
   The words “shall be” are included by inference where a colon (:) is used within sentences
   or phrases.
1.6 CONTRACTOR’S DUTIES

A. Except as specifically noted, Contractor shall provide and pay for:
   1. All labor, materials, and equipment used for construction of and/or incorporated into the project.
   2. All tools, construction equipment and machinery.
   3. Required building permits, and all inspection fees by governmental authorities.
   4. Other facilities and services necessary for proper execution and complete of work.

B. Owner is exempt from sales tax on product permanently incorporated in work.
   1. Obtain sales tax exemption certificate number from Owner.
   2. Place exemption certificate number on invoices for materials incorporated in work.
   3. Upon completion of work, file with Owner a notarized statement that all purchases made under exemption certificate were entitled to be exempt and furnish copies of invoice to Owner.
   4. Pay legally assessed penalties for improper use of exemption certificate number.

C. Comply with codes, ordinances, rules, regulations, orders, and other legal requirements of public authorities which bear on performance of work.

D. Promptly submit written notice to Architect/Engineer of observed variance of contract documents from legal requirements.
   1. It is not the Contractor’s responsibility to make certain that drawings and specifications comply with codes and regulations.
      a. Appropriate modifications to contract documents will account for/reflect necessary changes.
      b. Assume responsibility for work known to be contrary to such requirements if written notice is not provided by the Contractor to the Architect.

E. Enforce strict discipline and good order among employees.

F. Do not unreasonably encumber site with materials or equipment.

G. Do not load structure with weight that will endanger structure.

H. Assume full responsibility for protection and safe-keeping of products stored on premises.

I. Move any stored products which interfere with operations of Owner or other Contractors.

J. Obtain and pay for use of additional storage or work areas needed for operations.

K. The School Board shall prohibit the use of tobacco on school property when the property is being used for any school purposes. Tobacco shall mean cigarette, cigar, pipe or tobacco in any other form including smokeless tobacco which is any loose, cut, shredded, ground, powdered, compressed or leaf tobacco that is intended to be placed in the mouth without being smoked. All members of work crews must
remain fully clothed and refrain from using obscene or profane language during these same time parameters. School purposes include, but are not limited to, all interscholastic or extracurricular athletic, academic, or other events sponsored by the School Board or in which students of the District participate.

L. All site visits shall be coordinated through Mr. Darren Ripley who can be reached at 618-201-4186.

M. Contractor shall maintain building free from entrance of water at all times during construction.

N. Contractor shall furnish, erect and maintain temporary ladders, ramps, or hoists as may be required for performance of his work.
   1. All such equipment shall be substantially designed, constructed, and maintained in accordance with applicable federal, state, and local laws, ordinances, and regulations, and shall be promptly removed when no longer needed.

O. Contractor shall design, furnish, erect, maintain, and move all ladders and scaffolding required for this work.
   1. All ladders and scaffolding shall be designed, constructed, and maintained in accordance with applicable federal, state, and local law, ordinances, and regulations, and shall be promptly removed when no longer needed.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
SECTION 01 20 00 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Schedule of values.
B. Applications for payment.
C. Change procedures.
D. Defect assessment.
E. Alternates.

1.2 SCHEDULE OF VALUES

A. Submit printed schedule on AIA Form G703 - Continuation Sheet for G702. Contractor's standard form or electronic media printout will be considered, if it is similar in format to AIA Form G703.
B. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.
C. Format: Utilize Table of Contents of this Project Manual. Identify each line item with number and title of major specification Section. Identify bonds and insurance.
D. Include within each line item, direct proportional amount of Contractor's overhead and profit.
E. Revise schedule to list approved Change Orders, with each Application For Payment.

1.3 APPLICATIONS FOR PAYMENT

A. Submit three copies of each application.
B. Content and Format: Utilize Schedule of Values for listing items in Application for Payment.
C. Submit updated construction schedule with each Application for Payment.
D. Payment Period: Submit at intervals stipulated in the Agreement or as established at the Pre-construction meeting.
E. Submit with transmittal letter as specified for Submittals in Section 01 33 00.
F. Submit lien waivers.

G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
   1. Partial release of liens from major subcontractors and vendors.
   2. Record documents for review by Owner which will be returned to Contractor.
   3. Affidavits attesting to off-site stored products.
   4. Construction progress schedules, revised and current.

H. Application for Progress Payment No. 1 shall be accompanied by a notarized statement on Contractor’s letterhead as follows:
   1. I certify that the funds requested for the accompanying Pay Request No. 1 will be used to pay all just and lawful bills against the undersigned and his subcontractors for labor, material, and equipment employed in the performance of the work. I further certify that such bills will be paid no later than ten (10) calendar days from date of receipt of the Owner’s disbursement.
   2. Execute statement with signature of a responsible officer of contracting firm.

I. Each subsequent application for progress payment shall be accompanied by the following supporting documents:
   1. Partial or final waivers of lien in monetary amount from Contractor, each material supplier and/or subcontractor reflecting amounts incorporated into preceding request for progress payment.
   2. A notarized Affidavit of Payment to Material Suppliers and Subcontractors.
      a. Affidavit shall be submitted in exact text as exhibit furnished by Architect/Engineers, signed by Contractor or Subcontractor.
      b. Include unit item, actual amount of contract without overhead or profit, amount paid to date, and amount to become due (balance of account).

J. Progress payments will be made for materials and equipment not incorporated in the work provided that:
   1. Such materials and equipment have been delivered to and suitable stored at site or some other location approved in writing by Owner and Architect/Engineer. All such materials stored off-site shall be marked or tagged with identification of project to which they are assigned.
   2. Contractor submits evidence of title to such materials and equipment.
   3. Care and custody of such materials and equipment and all costs incurred for movement and storage shall be responsibility of Contractor.
   4. Such materials and equipment are suitably insured by Contractor. Contractor shall submit a certificate of insurance showing the Owner as an additional insured and showing amount of insurance overage of suitable proof that material and equipment are stored in a bonded warehouse.

K. Refer to Section 01 70 00 for submittal requirements for application for final payment and related closeout procedures.
1.4 CHANGE PROCEDURES

A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions in writing.

C. The Architect/Engineer may issue a Proposal Request including a detailed description of proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with stipulation of overtime work required and/or the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within a reasonable time period.

D. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change, and effect on Contract Sum/Price and Contract Time with full documentation and a statement describing effect on Work by separate or other Contractors. Document requested substitutions in accordance with Section 01 60 00.

E. Stipulated Sum/Price Change Order: Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect/Engineer.

F. Architect/Engineer may issue directive, on HR Change Order form signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work, and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.


H. Maintain detailed records of work done on Time and Material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

I. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

J. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
K. Correlation Of Contractor Submittals:
1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
2. Promptly revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.

D. Defective Work will be partially repaired to instructions of Architect/Engineer and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Architect/Engineer to assess defects and identify payment adjustments is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.

1.6 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work.

C. Schedule of Alternates:

Alternate Bid #1: NONE
PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.
B. Preconstruction meeting.
C. Progress meetings.
D. Cutting and patching.
E. Special procedures.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
B. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

A. Architect/Engineer will schedule meeting after Notice of Award.
B. Attendance Required: Owner, Architect/Engineer, and Contractor.
C. Agenda:
1. Submission of executed bonds and insurance certificates.
3. Submission of list of products, schedule of values, and progress schedule.
5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Use of premises by Owner and Contractor.
8. Owner's requirements and occupancy.
9. Construction facilities and controls provided by Owner.
10. Temporary utilities provided by Owner.
12. Schedules.
14. Procedures for testing.
15. Procedures for maintaining record documents.
16. Requirements for start-up of equipment.
17. Inspection and acceptance of equipment put into service during construction period.

D. Architect/Engineer will record minutes and distribute copies with reasonable promptness after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

1.4 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.

B. Architect/Engineer will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

E. Architect/Engineer will record minutes and distribute copies with reasonable promptness after meeting to participants, with two copies to Architect/Engineer, Owner, and those affected by decisions made.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 CUTTING AND PATCHING

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

B. Submit written request in advance of cutting or altering elements affecting:
   1. Structural integrity of element.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of element.
   5. Work of Owner or separate contractor.

C. Execute cutting, fitting, and patching including excavation and fill, to complete Work, and to:
   1. Fit the several parts together, to integrate with other Work.
   2. Uncover Work to install or correct ill-timed Work.
   3. Remove and replace defective and non-conforming Work.
   4. Remove samples of installed Work for testing.
   5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.

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

E. Cut masonry and concrete materials using masonry saw or core drill.

F. Restore Work with new products in accordance with requirements of Contract Documents.

G. Fit Work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of penetrated element.

J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.

K. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.2 SPECIAL PROCEDURES

A. Materials: As specified in product sections; match existing with new products for patching and extending work.

B. Employ skilled and experienced installer to perform alteration work.

C. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.

D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.

E. Remove debris and abandoned items from area and from concealed spaces.

F. Prepare surface and remove surface finishes to permit installation of new work and finishes.

G. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.

H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to original or specified condition.

I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with neat transition to adjacent finishes.

J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.

L. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition; to Architect/Engineer for review.

M. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.
N. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.

O. Finish surfaces as specified in individual product sections.

END OF SECTION
SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.
B. Construction progress schedules.
C. Product data.
D. Shop drawings.
E. Samples.
F. Test reports.
G. Certificates.
H. Manufacturer's instructions.

1.2 SUBMITTAL PROCEDURES

A. Transmit each submittal with shop drawing submittal form found at the end of this section. A copy of the submittal form must be attached to each copy of the submittal; if not, the submittal will be rejected and returned to the Contractor.
B. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
C. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
D. Schedule submittals to expedite Project, and deliver to Architect/Engineer at business address. Coordinate submission of related items.
E. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
F. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.
G. Allow space on submittals for Contractor and Architect/Engineer review stamps.
H. When revised for resubmission, identify changes made since previous submission.
I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

J. Submittals not requested will not be recognized or processed.

1.3 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial schedules within 15 days after date established in Notice to Proceed. After review, resubmit required revised data within ten days.

B. Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, subcontractors, suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

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

F. Indicate estimated percentage of completion for each item of Work at each submission.

G. Submit separate schedule of submittal dates for shop drawings, product data, and samples and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.

H. Revisions To Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
   3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate contractors.

1.4 PRODUCT DATA

A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Submit number of copies Contractor requires, plus 3 copies Architect/Engineer will retain.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers’ standard data to provide information specific to this Project.
D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents described in Section 01 70 00.

1.5 SHOP DRAWINGS

A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Shop Drawings can be submitted electronically for review. Electronic submittal should be e-mailed to the Project Construction Manager and will be e-mailed back to the contractor once reviewed.

D. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00.

1.6 SAMPLES

A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.

B. Samples For Selection as Specified in Product Sections:
   1. Submit to Architect/Engineer for aesthetic, color, or finish selection.
   2. Submit samples of finishes from full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer selection.

C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

D. Include identification on each sample, with full Project information.

E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.

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

G. Samples will not be used for testing purposes unless specifically stated in specification section.

H. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01 70 00.
1.7 TEST REPORTS
A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.
B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES
A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.
B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS
A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

PART 2 PRODUCTS
Not Used.

PART 3 EXECUTION
Not Used.

END OF SECTION
SHOP DRAWING SUBMITTAL

PROJECT: HVAC Replacement – Phase 2
          Murphysboro Middle School
          Murphysboro CUSD #186

DATE: 

A/E PROJECT NO: HR #365-3198

CONTRACTOR: 

PRESENTED BY: (Subcontractor/Supplier)

Company Name
Address
Phone/Fax
Contact Person

ITEM: 

SPEC SECTION: 

By approving and submitting these shop drawings, product data and samples, we represent that we have determined and verified all materials, field measurements and field construction criteria related thereto, or will do so, and that we have checked and coordinated information contained within submittal with requirements of the work and contract documents.

Contractor’s Signature

Date
SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control and control of installation.
B. Tolerances
C. References.
D. Testing and inspection services.
E. Examination.
F. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
B. Comply with manufacturers' instructions, including each step in sequence.
C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
E. Perform Work by persons qualified to produce required and specified quality.
F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
C. Adjust products to appropriate dimensions; position before securing products in place.
1.4 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.5 TESTING AND INSPECTION SERVICES

A. Requirements include:
   1. Architect/Engineer will employ and pay for testing laboratory to perform specified services.
   2. Employment of testing laboratory will in no way relieve Contractor’s obligations to perform work in accord with the Contract.

B. Laboratory Duties – Limits of Authority
   1. Cooperate with Architect/Engineer and Contractor; provide qualified personnel promptly on notice.
   2. Perform specified inspections, sampling and testing of materials and construction methods:
      a. Comply with specified standards; ASTM, and other recognized authorities.
      b. Ascertain compliance with contract requirements.
      c. Obtain written acknowledgement of each inspection, sampling and test made from Contractor whose work is being tested or from his superintendent.
   3. Promptly notify Architect/Engineer and Contractor of irregularities or deficiencies of work which are observed during performance of services.
   4. Promptly submit three copies of reports of inspections and tests to Architect/Engineer, including:
      a. Date issued.
      b. Project title and number.
      c. Testing laboratory name and address.
      d. Name and signature of inspector.
      e. Date of inspection and sampling.
      f. Record of temperature and weather.
      g. Date of test.
      h. Identification of product and specification section.
      i. Location of project.
j. Type of inspection or test.
k. Observations regarding compliance with contract documents.

5. Perform additional services ordered by Architect/Engineer.

6. Laboratory is not authorized to:
a. Release, revoke, alter or enlarge on, contract requirements.
b. Approve or accept any portion of work.
c. Perform any duties of the Contractor.

C. Contractor’s Responsibilities
1. Furnish product mix design to meet or exceed contract requirements.
2. Cooperate with laboratory personnel; provide access to work and to manufacturer’s operations.
a. Monitor, or direct superintendent to monitor each inspection, sampling and test.
b. Provide laboratory with written acknowledgement of each inspection, sampling or test.
c. Within 24 hours, notify Architect/Engineer in writing of reasons for not accepting laboratory field procedures.

3. Provide to laboratory preliminary representative samples of materials to be tested, in specified quantities.
4. Furnish copies of mill test reports.
5. Furnish verification of compliance with contract requirements for materials and equipment.
6. Furnish labor and facilities:
a. To provide access to work to be tested.
b. To obtain and handle samples at site.
c. To facilitate inspections and test.
d. For laboratory’s exclusive use for storage and curing of test samples.

7. Notify laboratory sufficiently in advance of operations to allow for its assignment of personnel and scheduling of tests.
8. Correct work which is defective or which fails to conform to the contract documents in accordance with the General Conditions. Corrective work shall not delay the project schedule or the work of other contractors.
9. Pay all costs of retesting when test results indicate non-compliance with contract requirements.
10. Patch all surfaces and areas disturbed by testing operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION
SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary electricity.
   2. Temporary water service.
   3. Temporary sanitary facilities.

B. Construction Facilities:
   1. Vehicular access.
   2. Parking.
   3. Progress cleaning and waste removal.

C. Temporary Controls:
   1. Dust control.
   2. Noise control.
   3. Pollution control.

D. Removal of utilities, facilities, and controls.

1.2 TEMPORARY ELECTRICITY

A. Owner will pay cost of energy used. Exercise measures to conserve energy. Utilize Owner’s existing power service.

1.3 TEMPORARY WATER SERVICE

A. Owner will pay cost of temporary water. Exercise measures to conserve energy. Utilize Owner’s existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations.

1.4 TEMPORARY SANITARY FACILITIES

A. Existing designated facilities may be used during construction operations. Maintain daily in clean and sanitary condition.

B. At end of construction, return existing facilities used for construction operations to same or better condition as original condition.

1.5 VEHICULAR ACCESS

A. Location approved by Owner.

B. Provide unimpeded access for emergency vehicles. Maintain 20 feet wide driveways with turning space between and around combustible materials.
C. Provide and maintain access to fire hydrants free of obstructions.
D. Use designated existing on-site roads for construction traffic.

1.6 PARKING
A. Use of designated areas of existing parking facilities used by construction personnel is permitted.

1.7 PROGRESS CLEANING AND WASTE REMOVAL
A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.
B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.
C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.
E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.8 DUST CONTROL
A. Execute Work by methods to minimize raising dust from construction operations.

1.9 NOISE CONTROL
A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.10 POLLUTION CONTROL
A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS
A. Clean and repair damage caused by installation or use of temporary work.
B. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.
PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.
B. Product delivery requirements.
C. Product storage and handling requirements.
D. Product options.
E. Product substitution procedures.
F. Equipment electrical characteristics and components.

1.2 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
C. Furnish interchangeable components from same manufacturer for components being replaced.

1.3 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.
B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.
B. Store with seals and labels intact and legible.
C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
D. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

E. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.5 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.6 PRODUCT SUBSTITUTION PROCEDURES

A. Instructions to Bidders specify time restrictions for submitting requests for Substitutions during bidding period to requirements specified in this section.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.

B. Cord and Plug: Furnish minimum 6-foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

PART 3 EXECUTION

Not Used.

END OF SECTION
PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.
B. Final cleaning.
C. Protecting installed construction.
D. Project record documents.
E. Operation and maintenance data.
F. Manual for materials and finishes.
G. Product warranties and product bonds.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
B. Provide submittals to Architect/Engineer required by authorities having jurisdiction.
C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
D. Owner will occupy all of building as specified in Section 01 10 00.

1.3 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.
B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
D. Clean filters of operating equipment.
E. Clean debris from drainage systems.
F. Clean site; sweep paved areas, rake clean landscaped surfaces.
G. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.4 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.
   6. Manufacturer’s instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer’s name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish first floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

4. Field changes of dimension and detail.

5. Details not on original Contract drawings.

G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, capacity expansion binders with durable plastic covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

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

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Certificates.
      c. Photocopies of warranties and bonds.

1.7 MANUAL FOR MATERIALS AND FINISHES

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit two sets of revised final volumes in final form within 10 days after final inspection.

E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.


H. Additional Requirements: As specified in individual product specification sections.

I. Include listing in Table of Contents for design data, with tabbed flysheet and space for insertion of data.

1.8 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time Of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION
PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Demolishing designated construction.
   2. Protecting items designated to remain.
   3. Removing demolished materials.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.

C. Shop Drawings:
   1. Indicate demolition and removal sequence.
   2. Indicate location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.

C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

1.4 QUALITY ASSURANCE

A. Obtain required permits from authorities having jurisdiction.

B. Perform Work in accordance with State of Missouri standards.

C. Maintain one copy of each document on site.

1.5 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.6 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.
B. Sequence activities in the following order:
   1. Owner to remove items.
   2. Contractor to terminate all utilities.
   3. Protect all adjacent items surrounding the Work.

C. Owner will conduct salvage operations before demolition begins to remove materials Owner chooses to retain.

1.7 SCHEDULING

A. Section 01 30 00 - Administrative Requirements, 01 32 16 - Construction Progress Schedule: Requirements for scheduling.

B. Schedule Work to coincide with new construction.

C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation and in adjoining spaces and during scheduled events.

D. Perform noisy, malodorous work:
   1. Between hours of 9:00 a.m. and 4:00 p.m.

E. Coordinate utility and building service interruptions with Owner.
   1. Schedule tie-ins to existing systems to minimize disruption.

1.8 PROJECT CONDITIONS

A. Conduct demolition to minimize interference with adjacent areas.

B. Cease operations immediately if structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

PART 2 EXECUTION

2.1 PREPARATION

A. Notify affected utility companies before starting Work and comply with their requirements.

B. Mark location and termination of utilities.

C. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.

D. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.

E. Provide appropriate temporary signage.
2.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify components and equipment required to be removed and delivered to Owner.

B. Tag components and equipment Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove components and equipment indicated to be salvaged.

E. Disassemble as required to permit removal.

F. Package small and loose parts to avoid loss.

G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

2.3 DEMOLITION

A. Conduct demolition to minimize interference with adjacent areas.

B. Maintain protected egress from and access to adjacent areas at all times.

C. Do not close or obstruct roadways and sidewalks without permits.

D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer.

E. Disconnect and remove designated utilities within demolition areas.

F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

G. Demolish in orderly and careful manner. Protect existing improvements, and supporting structural members.

H. Carefully remove components indicated to be reused.
   1. Disassemble components as required to permit removal.
   2. Package small and loose parts to avoid loss.
   3. Mark components and packaged parts to permit reinstallation.
   4. Store components, protected from construction operations, until reinstalled.
I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.

J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

K. Remove temporary Work.

END OF SECTION
SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the following:
   1. Interior and Exterior non-gravity load bearing and non-load bearing wall framing.

B. Related Sections:
   1. Section 05 31 13 - Steel Floor Decking: Metal floor decking supported by wall stud metal framing.
   2. Section 06 10 53 - Miscellaneous Rough Carpentry: Rough wood blocking.
   3. Section 07 21 16 - Blanket Insulation: Insulation within framing members.
   4. Section 07 26 00 - Vapor Retarders.
   5. Section 07 27 00 - Air Barriers.
   7. Section 09 24 00 – Portland Cement Plastering.

1.2 REFERENCES

A. American Iron and Steel Institute:
   1. AISI General - Standard for Cold-Formed Steel Framing - General Provisions.
   2. AISI Header - Standard for Cold-Formed Steel Framing - Header Design.
   3. AISI NASPEC - North American Specification for Design of Cold-Formed Steel Structural Members.

B. ASTM International:
   1. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
   2. ASTM C955 - Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.

C. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.
   2. AWS D1.3 - Structural Welding Code - Sheet Steel.

D. National Association of Architectural Metal Manufacturers:

E. SSPC: The Society for Protective Coatings:
   1. SSPC Paint 15 - Steel Joist Shop Paint.
   2. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
F. Steel Stud Manufacturers Association:
   1. SSMA - Product Technical Information.

G. Steel Framing Industry Association:
   1. SFIA - Product Technical Information.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated and per the 2009 International Building Code.
   1. Design Loads: As indicated on Structural Drawings.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Non-Load-Bearing Framing: Maximum lateral deflection of 1/600 of the wall height.
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1-1/2 inches.

B. Cold-Formed Steel Framing, General: Design according to AISI’s “Standard for Cold-Formed Steel Framing – General Provisions.”
   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. AISI NAS - North American Specification for Design of Cold-Formed Steel Structural Members.
   3. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Provide shop drawings prepared by cold-formed metal stud manufacturer. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified Structural Engineer responsible for their preparation, licensed in the State of Illinois.

C. Product Data: For each type of cold-formed metal framing product and accessory indicated.
D. Welding certificates.

E. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
1. Steel sheet.
2. Expansion anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips.
7. Miscellaneous structural clips and accessories.

F. Research/Evaluation Reports: For cold-formed metal framing.
1. Metal stud manufacturer to have a 3rd party evaluation report for its products that are reviewed to the local building code or its model code (IBC 2009 and AISI S100).

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of shop drawings, design calculations, and other structural data by a qualified Structural Engineer responsible for their preparation, licensed in the State of Illinois.

B. Structural Engineer Qualifications: A Structural 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 cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.


E. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 and displaying a classification label form, by a testing and inspecting agency acceptable to authorities having jurisdiction.

F. AISI Specifications and Standards: Comply with AISI’s:
1. North American Specification for the Design of Cold-Formed Steel Structural Members.
2. Standard for Cold-Formed Steel Framing - General Provisions.
3. Standard for Cold-Formed Steel Framing - Header Design.
G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required in AISI’s “Code of Standard Practice”.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation as required in AISI’s “Code of Standard Practice”.

PART 2 PRODUCTS

2.1 COLD-FORMED METAL FRAMING

A. Manufacturers:
   2. MarinoWare; a division of Ware Industries.
   3. SCAFCO Corporation.
   5. Super Stud Building Products, Inc.
   6. Substitutions: Section 01 60 00 - Product Requirements.

B. Cold-Formed Metal Framing: ASTM C955.

2.2 MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Sheet: ASTM A 1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60.

C. Steel Sheet for Vertical Deflection Clips: ASTM A 653, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90.

2.3 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0329 inch.
2. Flange Width: 1-1/4 inches or as standard with the manufacturer.

C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MarinoWare, a division of Ware Industries.
   c. SCAFCO Corporation.
   d. Section 01 60 00 – Product Requirements.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure.
1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1 inch plus twice the design gap for other applications.

E. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
11. Joist hangers and end closures.
12. Drift Clips.
2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer’s standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.
3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to ASTM C 1007, AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

I. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: 16 inches on center maximum.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single-leg deflection tracks and anchor to building structure (or)
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
   4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
      a. Install solid blocking at centers indicated on Shop Drawings.
   2. Bridging: Cold-formed steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.
3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board.
2. Molded polystyrene foam-plastic board.
3. Polyisocyanurate foam-plastic board.
5. Glass-fiber board.
8. Loose-fill insulation.
11. Reflective insulations.

B. Related Requirements:

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to 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.
PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET

A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Manufacturers
   b. As selected by Architect.

B. Glass-Fiber Blanket, Polypropylene-Scrim-Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier).

1. Manufacturers
   b. As selected by Architect.

C. Glass-Fiber Blanket, Kraft Faced: ASTM C 665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

1. Manufacturers
   b. As selected by Architect.

D. Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers
   b. As selected by Architect.

E. Glass-Fiber Blanket, Foil Faced: ASTM C 665, Type III (reflective faced), Class B (faced surface with a flame-propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

1. Manufacturers
   b. As selected by Architect.
PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

1.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

2.

3.4 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.
1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.

2. Install insulation to fit snugly without bowing.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Interior standard steel doors and frames.
   2. Exterior standard steel doors and frames.
   3. Interior custom hollow-metal doors and frames.
   4. Exterior custom hollow-metal doors and frames.

B. Related Requirements:
   1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.
B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.

D. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 127 mm).
2. Fabrication: Prepare Samples approximately 12 by 12 inches (305 by 305 mm) to demonstrate compliance with requirements for quality of materials and construction:
   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

E. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
3. Or Engineer’s Approved Equal

2.2 PERFORMANCE REQUIREMENTS
A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Windborne-Debris Impact Resistance: Pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and testing information in ASTM E 1996.

1. Large-Missile Test: For glazed openings located within 30 feet (9.1 m) of grade.

D. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. (2.27 W/K x sq. m) when tested according to ASTM C 518.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES
A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
B. Standard-Duty Doors and Frames: SDI A250.8, Level 1; SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule.

1. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated steel sheet, minimum thickness of 0.032 inch (0.8 mm).
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   f. Core: Manufacturer's standard.
   g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

2. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down.


C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   f. Core: Manufacturer's standard.
   g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

2. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down.


D. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
   d. Edge Construction: Model 1, Full Flush.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Core: Manufacturer's standard.
g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

2. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down.


E. Maximum-Duty Doors and Frames: SDI A250.8, Level 4; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Uncoated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   f. Core: Manufacturer's standard.
   g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener core for fire-rated and temperature-rise-rated doors.

2. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.067 inch (1.7 mm).
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down.


2.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm), with minimum A40 (ZF120) coating.
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Manufacturer's standard.
i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Knocked down.


C. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3; SDI A250.4, Level A. At locations indicated in the Door and Frame Schedule.

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches (44.5 mm).
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3 mm), with minimum A40 (ZF120) coating.
   d. Edge Construction: Model 1, Full Flush.
   e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
   f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
   g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
   h. Core: Manufacturer's standard.
   i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053-inch (1.3 mm), with minimum A40 (ZF120) coating.
   b. Construction: Knocked down.

3. Exposed Finish: Prime

2.5 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

   a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.

   b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.

3. Floor Anchors: Secure with postinstalled expansion anchors.

   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.

5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

   b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 CLEANING AND TOUCHUP

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire rated, non-rated steel frames.
   1. Provide frames for interior glazed lights.

B. Related Sections:
   1. Section 08 13 14 - Standard Steel Doors.
   2. Section 08 14 16 – Flush Wood Doors.
   3. Section 08 71 00 - Door Hardware.
   4. Section 08 80 00 - Glazing.
   5. Section 09 90 00 – Painting and Coating: Field painting of frames.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
   1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. National Fire Protection Association:
   2. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and other Opening Protective.

D. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.
   2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   3. UL 1784 - Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.

C. Product Data: Submit frame configuration and finishes.

D. Manufacturer's Installation Instructions: Submit special installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
1.4 QUALITY ASSURANCE

A. Conform to requirements of ANSI A250.8.

B. Fire Rated Frame Construction: Conform to one of the following:
   1. NFPA 252; with neutral pressure level at 40 inches maximum above sill at 5 minutes into test.
   2. UL 10C.

C. Installed Fire Rated Frame Assembly: Conform to NFPA 80 for fire rated class same as fire door.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated door frame.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept frames on site in manufacturer's packaging. Inspect for damage.

C. Break seal on-site to permit ventilation.

1.7 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with frame opening construction, door, and hardware installation.

C. Sequence installation to accommodate required door hardware electric wire connections.

PART 2 PRODUCTS

2.1 STANDARD STEEL FRAMES

A. Manufacturers: (all hollow metal doors and frames shall be from the same manufacturer).
   1. Amweld Building Products, Inc.
   2. Ceco Door Products.
   3. Republic Builders Products.
   4. Steelcraft.
   5. Curries Company.
   6. Mesker Door Inc.
   7. Substitutions: Not Permitted.
B. Provide all standard steel doors and standard steel frames from a single manufacturer.

C. Product Description: Standard shop fabricated steel frames, fire rated and non-rated types.
   2. Interior Frames: Zinc-Iron Alloy-Coated galvannealed steel, ASTM A 653, Class A60, 16 gage/0.053 inch galvannealed steel.

D. Include galvannealed components and internal reinforcements with galvannealed frames.

2.2 ACCESSORIES

A. Removable Stops: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws and as required for fire ratings indicated.

B. Bituminous Coating: Non-asbestos fibered asphalt emulsion.

C. Primer: ANSI A250.10 rust inhibitive type.

D. Silencers: Resilient rubber fitted into drilled hole.

E. Weatherstripping: Specified in Section 08 71 00.

2.3 FABRICATION

A. Fabricate frames as welded unit. Knock down frames shall not be acceptable without written permission from Architect / Engineer.

B. Mullions for Double Doors: Removable type, of same profiles as jambs as specified in Section 08 71 00.

C. Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.

D. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.

E. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

F. Prepare frames for silencers. Provide three single silencers for single doors and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.

G. Attach fire rated label to each fire rated frame.

H. Fabricate frames to suit masonry wall coursing with 2 inch head member.
2.4 SHOP FINISHING

A. Steel Sheet: Galvannealed to ASTM A653 A60.

B. Primer: Frames and frame components are required to be cleaned, phosphatized, and finished with one coat of baked-on rust inhibiting prime paint in accordance with the ANSI/SDI A250.10 “Test Procedures and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.”

C. Coat inside of frame profile with bituminous coating to minimum thickness of 1/16 inch at all masonry walls.

D. Field finish per Section 09 90 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION

A. Install frames in accordance with ANSI A250.8.

B. Coordinate with masonry and gypsum board wall construction for anchor placement.

C. Coordinate installation of glass and glazing specified in Section 08 80 00.

D. Coordinate installation of frames with installation of hardware specified in Section 08 71 00 and doors in Section 08 13 14, and 08 14 16.

3.3 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.4 SCHEDULE

A. Refer to Door and Frame Schedule on Drawings.

END OF SECTION
SECTION 08 13 14

STANDARD STEEL DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes non-rated and thermally insulated steel doors.

B. Related Sections:
   1. Section 08 12 14 - Standard Steel Frames.
   2. Section 08 71 00 - Door Hardware.
   3. Section 08 80 00 - Glazing: Glass for doors.
   4. Section 09 90 00 - Painting and Coating: Field painting of doors.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   4. ASTM E413 - Classification for Rating Sound Insulation.

C. Hollow Metal Manufacturers Association:
   1. HMMA 810 - Hollow Metal Doors.

D. Steel Door Institute:

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and cut-outs for glazing.

C. Product Data: Submit door configurations, location of cut-outs for hardware reinforcement.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
1.4 QUALITY ASSURANCE
   A. Perform Work in accordance with ANSI A250.8.

1.5 QUALIFICATIONS
   A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
   B. Installer: Company specializing in performing work of this section with minimum three years experience.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
   B. Protect doors with resilient packaging sealed with heat shrunk plastic.
   C. Accept doors on site in manufacturer's packaging. Inspect for damage.
   D. Break seal on site to permit ventilation.

1.7 COORDINATION
   A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
   B. Coordinate Work with door opening construction, door frame, and door hardware installation.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS
   A. Manufacturers (all standard steel frames and standard steel door shall be from same manufacturer):
      1. Amweld Building Products, Inc.
      2. Ceco Door Products.
      3. Kewanee Corp.
      4. Mesker Door.
      5. Pioneer Industries.
      6. Republic Builders Products.
      7. Steelcraft.
   B. Product Description:
         a. Level 3 - Extra heavy Duty, Model 2, seamless design.
         a. Level 2 - Heavy Duty, Model 2, seamless design.
2.2 COMPONENTS
A. Face: Steel sheet in accordance with ANSI A250 and SDI 108.
B. End Closure: Channel, 0.04 inches thick, flush.
C. Core: Polystyrene foam, vertical steel stiffeners.
D. Thermal Insulated Door: Total insulation R-Value of 2.4 measured in accordance with ASTM C1363.

2.3 ACCESSORIES
A. Removable Stops: Rolled steel, channel shape, mitered corners; prepared for countersink style tamper proof screws.
B. Primer: ANSI A250.10 rust inhibitive type.

2.4 FABRICATION
A. Fabricate doors with hardware reinforcement welded in place.

2.5 SHOP FINISHING
A. Steel Sheet: Galvanized to ASTM A653 G90.
B. Primer: Baked.
C. Doors to be field painted per Section 09 90 00.

PART 3 EXECUTION

3.1 EXAMINATION
A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
B. Verify opening sizes and tolerances are acceptable.

3.2 INSTALLATION
A. Install doors in accordance with ANSI A250.8.
B. Coordinate installation of glass and glazing specified in Section 08 80 00.
C. Coordinate installation of doors with installation of frames specified in Section 08 12 14 and hardware specified in Section 08 71 00.
D. Touch-up damaged shop finishes.
3.3 ERECTION TOLERANCES
   A. Section 01 40 00 - Quality Requirements: Tolerances.
   B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.4 ADJUSTING
   A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for adjusting.
   B. Adjust door for smooth and balanced door movement.

3.5 SCHEDULE
   A. Refer to Door and Frame Schedule on Drawings.

END OF SECTION
SECION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

B. Related Requirements:
   1. Section 08 71 00 - Door Hardware.
   2. Section 08 80 00 - Glazing.
   3. Section 09 90 00 - Painting and Coating: Touch-up of factory finish.

1.2 REFERENCE STANDARDS

A. American National Standards Institute:
   1. ANSI A135.4 - Basic Hardboard.

B. ASTM International:
   1. E413 - Classification for Rating Sound Insulation.

C. Architectural Woodwork Institute:

D. Hardwood Plywood and Veneer Association:
   1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

E. Intertek Testing Services (Warnock Hersey Listed):
   1. ITS-WH – Certification Listings.

F. National Fire Protection Association:

G. Underwriters Laboratories Inc.:
   1. UL – Building Materials Directory.
   2. UL 10B – Fire Tests of Door Assemblies.
   3. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   4. UL 1784 - Air Leakage Tests of Door Assemblies.

H. Wood Window and Door Manufacturers Association:
   1. WDMA IS 1A - Architectural Wood Flush Doors.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Coordinate Work with door opening construction, door frame and door hardware installation.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Submit data for door core materials and construction.
   2. Submit data for veneer species, type and characteristics.
   3. Submit data for factory finishes.

C. Shop Drawings:
   1. Indicate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, and factory machining criteria.
   2. Indicate cutouts for glazing.

D. Samples:
   1. Submit two samples of door veneer, 6 x 6 inch in size illustrating wood grain, stain color, and sheen.

E. Manufacturers' Instructions: Submit special installation instructions.

F. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AWI AWS Custom Grade.

B. Finish doors in accordance with AWI AWS Custom Grade.

C. Fire Rated Door Construction: Conform to NFPA 252.

D. Installed Fire Rated Door Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

E. Attach label from agency approved by authority having jurisdiction to identify each fire rated door.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package, deliver and store doors in accordance with AWI AWS Section 2.

C. Accept doors on site in manufacturer's packaging. Inspect for damage.
1. Break seal on site to permit ventilation.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction. Include reasonable costs of re-finishing and re-installation.

C. Interior Doors:
   1. Factory Finished Doors: Furnish manufacturer’s life of installation warranty.

PART 2 PRODUCTS

2.1 FLUSH WOOD DOORS

A. Manufacturers:
   1. Basis of Design:
      a. Eggers Industries with 07 Dark Oak finish.
      2. Algoma Hardwoods Inc. with custom factory stain to match above finish.
      3. Graham Manufacturing Corp. with custom factory stain to match above finish.
      4. Marshfield Door Systems with custom factory stain to match above finish.
      5. Oshkosh Door Company with custom factory stain to match above finish.
      6. VT Industries with custom factory stain to match above finish.
      7. Section 01 60 00 – Not Permitted.

B. Flush Interior Doors: Solid core flush wood doors; wood veneer facing material; fire rated and non-rated types; flush design; without louvers; factory pre-fit; and factory finished.
   1. Flush Interior Doors: 1-3/4 inches thick, unless noted otherwise on Drawings; solid core, five ply construction, fire rated as indicated on Drawings.

2.2 MATERIALS

A. Door Cores: AWI AWS Section 9.
   1. Solid Core, Non-Fire Rated:
      a. Type: PC; particleboard.
   2. Solid Core, Fire Rated:
      a. Type FD; fire resistive composite.

B. Interior Door Faces: AWI AWS Section 4.

C. Facing Adhesive: Type I – water proof.
2.3 FABRICATION

A. Fabricate doors in accordance with AWI AWS Section 9 requirements.

B. Astragals for Fire Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge, specifically for double doors as specified in Section 08 71 00.

C. Furnish blocking as needed to eliminate through bolt holes and maintain warranty.

D. Vertical Exposed Edge of Stiles: Hardwood of same species and finish as veneer facing.

E. Bond stiles and rails to core and sand flat prior to application of cross band and face veneer.

F. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.

G. Factory fit doors for frame opening dimensions identified on shop drawings.

H. Provide edge clearances in accordance with AWI AWS Section 9.

2.4 FINISHES

A. Finish work in accordance with AWI AWS Section 5; Custom Grade.

B. Transparent Finish System: Stained, transparent color; satin sheen, as indicated.
   1. System 9; UV curable polyester, urethane.

C. Factory finish doors in accordance with approved sample.

D. Factory seal door top edge with clear sealer. Re-seal in field if field fitting is required.

2.5 ACCESSORIES

A. Door Glazing:
   1. Glass: As specified in Section 08 80 00.
   2. Glazing Stops: Wood, of same species as door facing with metal clips for rated doors.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.
3.2 INSTALLATION

A. Install doors in accordance with AWI AWS Section 9, manufacturer's instructions, NFPA 80, and ITS-WH/UL requirements.

B. Field Fitting and Trimming:
   1. Trim non-rated door width by cutting equally on both jamb edges.
   2. Trim door height by cutting bottom edges to maximum of 3/4 inch.
      a. Trim fire door height at bottom edge only, in accordance with fire rating requirements.

C. Coordinate installation of doors with installation of frames specified in Section 08 12 14 and hardware specified in Section 08 71 00.

D. Coordinate installation of glass and glazing specified in Section 08 80 00.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Conform to AWI AWS Section 9 requirements for fit and clearance tolerances and WDMA standards and testing methods for warp, cup, bow and telegraphing.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.

B. Adjust door for smooth and balanced door movement. Adjust door closer for full closure.

3.5 SCHEDULE

A. Refer to Door and Frame Schedule on Drawings.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes extruded aluminum windows with fixed and operating sash, factory glazed, insect screens and operating hardware.

B. Related Sections:
1. Section 07 27 00 - Air Barriers: Perimeter air seal between window frame and adjacent construction.
2. Section 07 90 00 - Joint Protection: Perimeter sealant and back-up materials.
3. Section 08 80 00 - Glazing.

1.2 REFERENCES

A. Aluminum Association:
1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:
2. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
7. AAMA MCWM-1 - Metal Curtain Wall manual.

C. American Society of Civil Engineers:

D. ASTM International:
10. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.

E. Consumer Product Safety Commission:

F. Glass Association of North America:

G. National Fenestration Rating Council Incorporated:
   1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

H. SSPC: The Society for Protective Coatings:
   1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
   2. SSPC Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 SYSTEM DESCRIPTION

A. Windows: Tubular aluminum sections, factory fabricated, factory finished, factory glazed vision glass, related flashings, anchorage and attachment devices.

B. Configuration: Conform with AAMA 101 Designations for windows required for Project; P-projected, F-fixed non-operable, sash.

C. Glazing: Interior.

D. Forced Entry Resistance: Conform to ASTM F588 Type C.

1.4 PERFORMANCE REQUIREMENTS

A. Primary Performance Requirements: Aluminum windows to meet performance criteria for AAMA 101 Designation HC40 Heavy Commercial or better.
B. Deflection: Limit member deflection to 0.2% of span with full recovery of glazing materials.

C. Assembly: To accommodate, without damage to components or deterioration of seals, movement between window and perimeter framing, deflection of lintel.

D. Thermal Transmittance of Assembly: Maximum U Value of 0.69 Btu/sq ft per hour per deg F when measured in accordance with AAMA 1503.

E. Air Infiltration: Limit air infiltration through assembly to 0.3 cfm/min/sq ft of wall area, measured at reference differential pressure across assembly of 6.24 psf as measured in accordance with ASTM E283.

F. Condensation Resistance Factor: CRF of not less than 50 when measured in accordance with AAMA 1503.

G. Water Leakage: None, when measured in accordance with ASTM E331, ASTM E547.

H. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, and migrating moisture occurring within system, to exterior by weep drainage network.

I. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air barrier and vapor retarder.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related Work; and installation requirements.

C. Product Data: Submit component dimensions, anchorage and fasteners, glass, internal drainage, and typical details.

D. Samples: Submit two 12 x 12 inches in size illustrating window frame section mullion section, factory finished aluminum surfaces, glass units, and glazing materials. Submit two samples of operating hardware.

E. Manufacturer's Certificates: Certify Product performance ratings by independent third party such as AAMA, CAWM, or NFRC as meeting or exceeding specified requirements.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the following:
   1. Aluminum Windows: Fabricate and label window assemblies in accordance with AAMA 101 for types of windows required.
2. Insulated Glass: Fabricate insulated glass units in accordance with GANA (formerly FGMA) Glazing Manual.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing commercial aluminum windows with minimum three years experience, and with service facilities within 100 miles of Project.

B. Installer: Company specializing in installation of commercial and institutional aluminum windows with minimum three years experience.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Handle Work of this section in accordance with AAMA MCWM-1 - Curtain Wall Manual #10.

C. Protect factory finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install glazing materials when ambient temperature is less than 40 degrees F.

C. Maintain this minimum temperature during and after installation of glazing materials.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ten-year manufacturer warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same.

C. Warranty: Furnish ten-year manufacturer’s warranty to include coverage for degradation of color finish.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOWS

A. Manufacturers:
1. EFCO Corp. Model Series 3902 Thermal.
2. Kawneer Co., Inc. Series 8325 TL.
3. Traco Model TR-3500.
5. Winco Model 3350 Series.
7. Substitutions: None Permitted.

B. Product Description: Aluminum windows thermally broken with interior portion of frame insulated from exterior portion applied glass stops of snap-on type.
   2. Depth of frame and sash shall not be less than 3 ¼ inches. Sash to project out.

2.2 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper.

B. Sheet Aluminum: ASTM B209; 5005 alloy, H15 or H34 temper.

C. Steel Sections: Profiled to suit mullion sections.

D. Insulating Glass: Sealed double pane units conforming with requirements in Section 08 80 00.
   1. Outer Pane: Gray tinted float glass.
   2. Inner Pane: Clear float glass with pyrolitic Low E coating.
   3. Pane Thickness: Minimum 1/4 inch thick.
   4. Minimum Total Unit Thickness: 1 inch.
   5. Glazing Materials: Manufacturer’s standard conforming with requirements specified in Section 08 80 00.

E. Hardware:
   1. Operator: Lever action handle fitted to projecting sash arms with limit stops.
   2. Projecting Sash Arms: Cadmium plated steel, friction pivot joints with nylon bearings, removable pivot clips for cleaning.
   3. Pulls: Manufacturer’s standard.
   4. Sash lock: Lever handle with cam lock.

F. Subframes: Provide thermally broken subframe receptors as indicated on Drawings.

G. Sills: Extruded aluminum; sloped for positive wash; fit under sash leg 1/2 inch beyond wall face; one piece full width of opening.

H. Insect Screen Frame: Rolled aluminum frame of rectangular sections; fit with adjustable hardware; nominal size similar to operable glazed unit.

I. Insect Screens: ASTM D3656, Class 2, 18 by 14 mesh, charcoal color.

J. Operable Sash Weather Stripping: Resilient plastic; permanently resilient, profiled to effect weather seal.
2.3 ACCESSORIES

A. Fasteners and Anchors: Stainless steel.

B. Bituminous Paint: Fibered asphaltic type.

C. Limit Stops: Resilient adjustable.

2.4 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to ensure concealment from view.

E. Prepare components with internal reinforcement for operating hardware.

F. Furnish internal reinforcement in mullions with galvanized steel members to maintain rigidity.

G. Permit internal drainage weep holes and channels to migrate moisture to exterior. Furnish internal drainage of glazing spaces to exterior through weep holes.

H. Double weatherstrip operable units.

I. Factory glaze window units. Install glass in accordance with Section 08 80 00, to glazing method required to achieve performance criteria.

2.5 SHOP FINISHING

A. Finish Coatings: Conform to AAMA 611.

B. Painted Aluminum Surfaces: AA-M12C12R1x non-specular as fabricated mechanical finish, chemically cleaned, and prepared for applied coating; with organic coating.
   1. High Performance Organic Coating: Fluoropolymer coating system complying with AAMA 2604 or 2605 minimum two-coat, with minimum 70 percent polyvinylidene fluoride resin.
2. Color: As selected by Architect / Engineer from manufacturer’s full range of color selections.

C. Locks, Operators, and Exposed Hardware: Enameled to color as selected.

D. Pull Handles: Manufacturer’s standard thermosetting finish, color as selected.

E. Apply coat of bituminous paint on concealed aluminum surfaces in contact with cementitious or dissimilar materials.

F. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.

G. Concealed Steel Items: Galvanized to ASTM A123; minimum 2.0 oz/sq ft coating thickness; Grade 85.


PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this section.

3.2 INSTALLATION

A. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

B. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent Work.

C. Install sill and sill end angles.

D. Install thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

E. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials.

F. Install operating hardware.

3.3 ERECTION TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.
B. Maximum Variation from Level or Plumb: 1/16 inches every 3 feet non-cumulative or 1/8 inches per 10 feet, whichever is less.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust hardware for smooth operation and secure weathertight closure.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Remove protective material from factory finished aluminum surfaces.

C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.

D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes bullet-resistant baffles with natural voice configuration.

B. Related Sections:
   1. Section 06 10 00 - Rough Carpentry: Wood perimeter shims.
   2. Section 07 90 00 - Joint Protection: Perimeter sealant and back-up materials.

1.2 REFERENCES

A. Underwriters Laboratory:

1.3 SYSTEM DESCRIPTION

A. Configuration: Two station; offset vertical standing vision panels and baffles to complete the natural voice design as well as to protect against angled ballistic penetrations.

B. Ballistic Level: The glazing must be UL Listed Level 3.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related Work; and installation requirements.

C. Product Data: Submit component dimensions, anchorage and fasteners, reinforcement size and locations, frame profiles, size, type and spacing of anchors.
   1. The provider of this window must be ISO 9001:2008 Certified by an accredited registrar and provide proof of such.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing bullet-resistant baffles with minimum three years experience.

B. Installer: Company specializing in installation of bullet-resistant baffles with minimum three years experience and approved by manufacturer.
1.6 DELIVERY, STORAGE, AND PROTECTION

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Protect factory finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install glazing materials when ambient temperature is less than 40 degrees F.

C. Maintain this minimum temperature during and after installation of glazing materials.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Warranty: All materials and workmanship shall be warranted against defects for a period of one (1) year from date of receipt at job site.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOWS

A. Manufacturers:
   1. Armortex.
   2. Interbank.
   3. Total Security Solutions.
   4. Diebold.

2.2 COMPONENTS

A. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper with Class I clear anodized finish.
   1. 1 ¼ by 1 ¼ by 1/8 inches at jambs.
   2. 2 by 1 by 1/8 inches at head.
   3. 1 ¼ by 1 9/16 inches U shaped channel at sill.

B. Dip Trays: 16 gage stainless steel; 10 inches wide and 16 inches long.

C. Spacers: 1 inch acrylic.
D. Fasteners: Stainless steel.

E. Glazing: Multi-ply polycarbonate or acrylic polycarbonate composite with all exposed edges polished clear.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify wall openings are ready to receive Work of this section.

3.2 INSTALLATION

A. Set frames and glaze in accordance with manufacturer’s instructions.

3.3 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Upon completion of the Work, clean exposed surfaces of frames and glazing products thoroughly in accordance with manufacturer’s instructions. Remove mastic smears and other unsightly marks.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes hardware for wood doors.

B. Related Sections:
   1. Section 08 14 16 - Flush Wood Doors.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A156.1 - Butts and Hinges.
   2. ANSI A156.2 - Bored and Preassembled Locks and Latches.
   3. ANSI A156.3 - Exit Devices.
   4. ANSI A156.4 - Door Controls - Closures.
   5. ANSI A156.5 - Auxiliary Locks and Associated Products.
   6. ANSI A156.6 - Architectural Door Trim.
   7. ANSI A156.7 - Template Hinge Dimensions.
   8. ANSI A156.8 - Door Controls - Overhead Holders.
   9. ANSI A156.12 - Interconnected Locks and Latches.
  10. ANSI A156.15 - Closer Holder Release Devices.
  11. ANSI A156.16 - Auxiliary Hardware.
  12. ANSI A156.18 - Materials and Finishes
  15. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.

B. Builders Hardware Manufacturers Association:
  1. BHMA Directory of Certified Products.

C. National Fire Protection Association:

D. Underwriters Laboratories Inc.:
  1. UL 10B - Fire Tests of Door Assemblies.
  2. UL 305 - Panic Hardware.

E. Intertek Testing Services (Warnock Hersey Listed):
  1. WH - Certification Listings.
1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by applicable authorities.
   1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
   2. Submit manufacturer's parts lists, and templates.

C. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

D. Keys and Keying:
   1. All keying nomenclature shall be prepared using symbols, nomenclature and overall method as described in ASAHC NBHA Handbook – AIA File.
   2. Hardware supplier shall provide keying in accordance with instructions of Owner and Architect/Engineer, including three keys for each lock and six master keys.
   3. Before hardware is ordered, a complete keying schematic drawing shall be furnished to Architect/Engineer for approval.
   4. All bitting records shall be delivered to Owner for use/reference on future projects.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of installed cylinders and their master key code.

C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the following requirements:
   1. ANSI A156 series.
   2. NFPA 80.
   3. UL 305.

B. Furnish hardware marked and listed in BHMA Directory of Certified Products.
1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years experience.

B. Hardware Supplier: Company specializing in supplying commercial and institutional door hardware with minimum ten years documented experience.

C. Hardware Supplier Personnel: Employ Architectural Hardware Consultant (AHC) to assist in work of this section.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for purpose specified and indicated.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

C. Include persons involved with installation of doors, frames, and hardware.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

C. Sequence installation to accommodate required utility connections.

D. Coordinate Owner's keying requirements during course of Work.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five year manufacturer warranty for locksets and door closers.
1.12 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance materials.

B. Furnish special wrenches, tools, and accessories applicable for each different and for each special hardware component supplied by hardware component manufacturer.

PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Manufacturers: Catalog numbers of manufacturers listed have been used to establish quality required. Only manufacturers listed in Paragraph B below are approved if listed under the individual product. Other manufacturers seeking approval shall do so in writing per General Requirements and shall list exact catalog numbers and description of items he proposes to furnish; include reference to this specification section for equal product reference; include cut sheets.

B. Designations: Following abbreviations identify listed manufacturers.

1. BAL Baldwin Hardware Mfg. Corp., Reading, PA.
2. BES Best Access Systems, Indianapolis, IN.
3. COR Corbin-Russwin Architectural Hardware, Berlin, CT.
4. DOR Dorma Architectural Hardware, Reamstown, PA.
5. GJ Glynn-Johnson, Div. of Dayton-Walter Corp, Chicago, IL.
6. HAG Hager Hinge Co., St. Louis, MO.
7. HOR Horton Automatics, Corpus Christi, TX.
8. IVE Ives, Div. of Leigh Products, New Haven, CT.
9. LAW Lawrence Brothers, Inc., Sterling, IL.
10. LCN LCN Closer, Princeton, IL.
11. MCK McKinney Products Co., Scranton, PA.
12. NAT National Guard Products, Memphis, TN.
13. NOR Norton Door Controls, Charlotte, NC.
14. PEM Pemko, Ventura, CA.
15. RED Reed Exit Hardware, Charlotte, NC.
16. REE Reese Enterprises, Inc., Rosemount, MN.
17. RIX Rixson-Firemark, Franklin Park, IL.
18. ROC Rockwood Manufacturing Co., Rockwood, PA.
19. SAR Sargent, Div. of Kidde, New Haven, CT.
20. SCH Schlage Lock Co., Palatine, IL.
21. STA Stanley Hardware, New Britain, CT.
22. VON Von DuPrin, Indianapolis, IN.

2.2 COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.
1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
4. Finish: Match hardware item being fastened.
5. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.
6. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Hinges: Continuous hinge, manufactured of 6063-T6 aluminum.
   1. Components: Two interlocking geared leaves and a cover channel applied the full length of the door without mortising (concealed).
      a. Ensure separation of different metals to avoid galvanic corrosion.
      b. Provide 3 piece or electric power transfer continuous hinge as necessary at doors scheduled for wiring connections.

   2. Components: Two interlocking geared leaves and a cover channel applied the full length of the door without mortising (surface mounted on frame and door).
      a. Ensure separation of different metals to avoid galvanic corrosion.
      b. Provide 3 piece or electric power transfer continuous hinge as necessary at doors scheduled for wiring connections.

   1. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.
   2. Auxiliary Locksets: ANSI A156.5, Grade 1, mortise dead locks unless otherwise indicated.

D. Latch Sets: Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.
   1. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated.

E. Exit Devices: ANSI A156.3, Grade 1 surface mounted vertical rod type and rim type, with push pad, unless otherwise indicated. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt.
   1. Types: Suitable for doors requiring exit devices.
   2. Coordinators: Furnish overhead concealed in frame type at pairs of doors.
   3. All exit devices shall be UL listed for panic. Exit devices for labeled doors shall be UL listed as “Fire Exit Hardware”.
   4. Provide exit devices factory cut to door width and height. Locate exit devices at a height recommended by the exit device manufacturer, allowable by governing building codes, and approved by the Architect/Engineer.
   5. Provide weatherseal gasketing at exterior applications.
   6. Provide cylinder-dogging feature for exit devices as indicated (hex key only).
7. Provide keyed removable mullions, as specified in the Hardware Groups.
8. Provide and install Schlage 20-079 IC Housing and Schlage 23-030 Conventional cores keyed to Owner’s master key system for all exterior doors. No substitutions. Ensure all other temporary or permanent hardware is compatible.
9. Provide and install Schlage 20-079 IC Housing and Schlage 23-030 Conventional cores keyed to Owner’s master key system for all interior exit devices. No substitutions. Ensure all other temporary or permanent hardware is compatible.

F. Cylinders: ANSI A156.5, Graded 1, 6 pin type cylinders.
   1. Keying: Keyed as directed by Owner. New master keying system to be built into existing grand master system.
   2. Include construction keying for contractor access prior to substantial completion.
   4. Supply keys in the following minimum quantities:
      a. 6 master keys.
      b. 3 grand master keys.
      c. 3 great grand master keys.
      d. 10 construction keys.
      e. 5 control keys.

G. Closers: ANSI A156.4 modern type with cover, surface mounted closers; full rack and pinion type with steel spring and non-freezing hydraulic fluid; closers required for fire rated doors unless otherwise indicated.
   1. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.
   2. Arms: Type to suit individual condition; parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.
   3. Location: Mount closers on inside of exterior doors, room side of interior doors typical; mount on pull side of other doors.
   4. Operating Pressure: Maximum operating pressure as follows.
      a. Interior Doors: Maximum 5 pounds.
      b. Exterior Doors: Maximum 8.5 pound.
      c. Fire Rated Doors: As required for fire rating, maximum 15 pounds.

2.3 ACCESSORIES

A. Lock Trim: Furnish levers as indicated in Schedule.
   1. Do not permit through bolts on solid wood core doors.

B. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible.
   1. Do not use through bolts on solid wood core doors.

2.4 FINISHING

A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule at end of section.
   1. Typical Exterior Exposed and High Use Interior Door Hardware:
      a. BHMA 630, satin finished stainless steel.
      b. BHMA 626, satin chromium plated brass or bronze.
2. Typical Interior Door hardware:
   a. BHMA 626, satin chromium plated brass or bronze.
   b. BHMA 630, satin finished stainless steel.
3. Closers: Finish appearance to match door hardware on same face of door.
   a. BHMA 628, satin aluminum, clear anodized.
4. Thresholds: Finish appearance to match door hardware on exterior face of door.
   a. BHMA 628, satin aluminum, clear anodized.
   b. BHMA 630, satin finished stainless steel.
5. Other Items: Furnish manufacturer’s standard finishes to match similar hardware types on
   same door, and maintain acceptable finish considering anticipated use and BHMA category
   of finish.

2.5 PRODUCTS

A. Hinges:
   1. Hinges: Continuous, geared aluminum, heavy duty, concealed left 180 degree opening, two-
   coat fluoropolymer coating system in custom color at exterior hollow metal doors, clear
   anodized at exterior aluminum doors, and clear anodized at interior doors.
      a. Manufacturers:
         1) HAG – 780-112HD.
         2) MCK – 12 HD.
         3) PEM – CFM83 SLFHD.

B. Locksets:
   1. Lockset: Cylindrical, heavy duty, classroom intruder function (F88).
      a. Manufacturer:
         1) SAR – 11L-26D-L ROSE J.

C. Exit Devices: (Lockset manufacturer shall provide cylinders for exit devices).
   1. Fire rated, touch bar, surface mounted, rim type, lever handle, interchangeable core, US26D
      X US32D push bar.
      a. Manufacturer:
         1) SAR – 12-8810 X ETL.

D. Closers:
      a. Manufacturer:
         1) SAR – 281-P Series.

E. Stops:
   1. Door Stop: Wall mount.
      a. Manufacturer:
         1) BAL – 4290 Series.
         2) GJ – 60W.
         3) IVE – Approved equal.
         4) SAR – Approved equal.
F. Sound Sealing System/Smoke and Draft Control Gaskets.
   1. Doorframe: Head and jamb, surface mount, self-adhesive silicone bulb, color as selected by Architect/Engineer.
      a. Manufacturer:
         1) NAT – 5050.
         2) PEM – S88
         3) REE – 638CH.
   2. Meeting Stile: Surface mount.
      a. Manufacturer:
         1) NAT – 137SA.
         2) PEM – 303AS.

G. Kickplates:
   1. Kickplate: Stainless steel, 0.050 inch thick, beveled three sides, 8 inches high x 2 inches less door width.
      a. Manufacturer:
         1) IVE – 8400 Series.
         2) HAG – 193S Series.
   2. Kickplate: Stainless steel, 0.050 inch thick, beveled three sides, 12 inches high x 2 inches less door width.
      a. Manufacturer:
         1) IVE – 8400 Series.
         2) HAG – 193S Series.

H. Cylinders:
   1. Cylinder, 6 pin.
      a. Manufacturer:
         1) Provide and install Sargent Conventional cores keyed to match Owner’s master key system on all interior doors. Provide key blanks on all interior doors. Contractor to provide all components related to locking and latching of interior doors. No substitutions.
            a) Contractor to provide temporary construction cylinders and cores.
            b) Contractor to provide all final cylinders and cores.
            c) Contractor to provide cylinders and cores for all overhead and coiling doors.
            d) Owner to provide keying.

I. Removable Mullions:
   1. Keyed removable mullion, steel, with strikes and weatherstripping (exterior) or gaskets (interior).
      a. Manufacturer:
         1) SAR – 980 Lockable

J. Push / Pull: Wrought, 0.050 inches thick, beveled edges, pull cast.
   a. Manufacturers:
      1) BAL – 2123 push x 2365 push/pull.
      2) IVE – 8200 3.5 x 15 push; 8200 x 15 x 8102-8 push/pull.
      3) ROC – 70B push x 107 x 70B push/pull.
PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings.

C. Verify electric power is available to power operated devices and is of correct characteristics.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights From Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
   1. Locksets: 38 inch.
   2. Push/Pulls: 42 inch.
   3. Dead Locks: 48 inch.
   4. Push Pad Type Exit Devices: 42 inch.

3.3 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Architectural Hardware Consultant inspect installation and certify hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.4 ADJUSTING

A. Section 01 70 00 - Execution Requirements: Testing, adjusting, and balancing.

B. Adjust hardware for smooth operation.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution Requirements: Protecting installed construction.

B. Do not permit adjacent work to damage hardware or hardware finish.

3.6 FINISH HARDWARE SCHEDULE

A. See hardware schedule on sheet A601.

END OF SECTION
SECTION 08 80 00 - GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes glass glazing, rated and non-rated for, doors.
   1. Glass glazing materials and installation requirements are included in this section for other sections referencing this section.

B. Related Sections:
   1. Section 08 14 16 - Flush Wood Doors: Glazed doors.

1.2 REFERENCES

A. American National Standards Institute:

B. American Society of Civil Engineers:

C. ASTM International:

D. Consumer Products Safety Commission:

E. Glass Association of North America:
   1. GANA - Sealant Manual.

F. National Fire Protection Association:

G. Underwriters Laboratories Inc.:
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   2. UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Interior Glass Deflection: Design glass partition system to withstand live loads in accordance 
   with 2009 International Building Code with maximum L/120 deflection.

B. Interior glass at full height glazed partitions shall comply with CPSC 16 CFR 1201 Category II.

C. Structural Design: Design in accordance with 2009 International Building Code for most critical 
   combination of wind, seismic, and dead loads.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Glass: Provide structural, physical, and thermal and solar optical performance 
      characteristics, size limitations, special handling or installation requirements.
   2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and 
      environmental characteristics, limitations, special application requirements. Identify full 
      range of available colors where exposed.

C. Design Data:
   1. Submit design calculations for glass resisting wind loads and live loads signed and sealed 
      by a professional engineer licensed in the State of Illinois.

D. Samples:
   1. Glass: Submit two samples 12 x 12 inch in size, illustrating each glass units, coloration 
      and design.
   2. Glazing Materials: Submit 12 inch long bead of glazing sealant and gaskets, color as 
      selected.

E. Manufacturer's Certificate: Certify sealed insulating glass, meets or exceeds specified 
   requirements.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual for glazing installation methods.
1.6 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years experience.

B. Design glass resisting wind and live loads under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of Illinois.

1.7 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week before starting Work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Do not install glazing when ambient temperature is less than 50 degrees F.

C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.9 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish ten year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

PART 2 PRODUCTS

2.1 GLAZING

A. Manufacturers:
   1. PPG Industries, Inc.
   2. Pilkington LOF.
   3. Nippon Electric Glass Company, Ltd.
   4. SAFTI FIRST Fire Rated Glazing Solutions.
   5. Substitutions: Section 01 60 00 – Product Requirements.

2.2 COMPONENTS

A. Safety Glass (Type SG): CPSC 16 CFR 1201 Category II, minimum thickness 1/4 inch unless otherwise indicated. Safety glass shall be labeled and label shall be visible after glazing.
   1. Clear Tempered Glass (Type SG-CT): ASTM C1048, Kind FT Fully tempered, Condition A, uncoated, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select; with horizontal tempering.
2. Tinted Tempered Glass (Type SG-TT-1): ASTM C1048, Kind FT Fully tempered, Condition A, Type 1 transparent flat, Class 2 tinted heat-absorbing and light reducing, Quality q3 glazing select.
   a. Tint: Blue (Pacifica from PPG or equal).

3. Tinted Tempered Glass (Type SG-TT-2): ASTM C1048, Kind FT Fully tempered, Condition C, Type 1 transparent flat, Class 2 tinted heat-absorbing and light reducing, Quality q3 glazing select with Low E coating.
   a. Tint: Blue/Gray (Solarban z50 from PPG or equal).

B. Fire Protective Glass (Type FP): FireLite Plus or Pyran Platinum L, laminated ceramic safety glazing conforming to NFPA 252 and ANSI Z97.1. Fire Protective Glass shall be permanently labeled and label shall be visible after glazing.
   1. Fire Rating: 90 minutes.
   4. Weight: 4 pounds per square foot.
   5. STC: 36 minimum.
   6. Safety Rating: CPSC Category II.

C. Insulated Glass Units (Type IG-1): Total unit thickness 1 inch.
   1. Double Pane Insulated Glass Units: ASTM E774 Class A and E773; with silicone sealant edge seal; purge interpane space with dry hermetic air.
      b. Inner Pane: Glass Type SG-TT-2 with Low E coating on third glass surface form building exterior.
      d. Shading Coefficient: 0.28.
      e. Solar Heat Gain Coefficient: 0.24.
   2. Insulated Glass Unit Edge Seal Construction: Aluminum mitered and spigoted corners.

2.3 ACCESSORIES

A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.
   1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component; chemical curing; capable of water immersion without loss of properties; non-bleeding, non-staining, cured Shore A hardness of 15 to 25.
      a. Acceptable Manufacturers and products:
         1) General Electric – “Silpruf”.
         2) General Electric – “Silglaze 2400”.
         3) Woodmount Products – “Chem-Caulk 1000”.
         4) Dow Corning – “790”.
         5) Pecora – “863”.
      b. Color: As selected by Architect / Engineer.
      c. Structural Silicone: Furnish high-modulus structural silicone glazing materials where sealant bonds glass to substrate.
B. Glazing Gaskets: ASTM C864 Option I or II, resilient polyvinyl chloride extruded shape to suit glazing channel retaining slot.

C. Pre-Formed Glazing Tape: Size to suit application.
   1. Glazing Tape: Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, designed for compression of 25 percent to effect an air barrier and vapor retarder seal.

D. Setting Blocks: ASTM C864 Option I, Neoprene, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.

E. Spacer Shims: ASTM C864 Option I, Neoprene, 50 to 60 Shore A durometer hardness, minimum 3 inch long x one half the height of glazing stop x thickness to suit application, self adhesive on one face.

F. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify openings for glazing are correctly sized and within acceptable tolerance.

C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual.
   2. Fire Rated Openings: Comply with NFPA 80.

B. Interior Wet/Dry Method (Tape and Sealant) Installation:
   1. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
   2. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.
3. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
4. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
5. Fill gaps between pane and applied stop with elastomeric glazing sealant to depth equal to bite on glazing, to uniform and level line.
6. Trim protruding tape edge.

C. Interior Wet Method (Compound and Compound) Installation:
   1. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24-inch centers, kept 1/4 inch below sight line.
   2. Locate and secure glazing pane using glazers' clips.
   3. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.4 FIELD QUALITY CONTROL
   A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
   B. Monitor quality of glazing.

3.5 CLEANING
   A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
   B. Remove glazing materials from finish surfaces.
   C. Remove labels after Work is complete.
   D. Clean glass and adjacent surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION
   A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
   B. After installation, mark pane with an 'X' by using removable plastic tape or paste.

3.7 SCHEDULE
   A. Exterior Storefront and Curtain Wall Doors, Transoms and Sidelites: Type IG-1, blue/gray tint, wet/dry method with silicone glazing sealant.
B. Interior Non-Fire Rated Doors and Frames: Type SG-CT, interior wet method with paintable polyurethane glazing sealant.

C. Interior Fire Rated Metal Doors and Frames: Type FP for 90 minute rating at openings less than or equal to 100 square inches.

D. Non-Fire Rated All Glass Partitions: Type SG-CT, 1/2 inch thick clear tempered safety glass.

END OF SECTION
SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Metal stud wall framing.

1.2 REFERENCE STANDARDS

A. ASTM International:
8. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.

B. American National Standards Institute:
1. ANSI A108.11- Specifications For Interior Installations Of Cementitious Backer Units.
2. ANSI A118.9 - Test Methods and Specifications for Cementitious Backer Units.

C. American Society of Civil Engineers:

D. Gypsum Association:
   1. GA 214 - Recommended Levels of Gypsum Board Finish.
   2. GA 216 - Application and Finishing of Gypsum Board.

E. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

F. National Fire Protection Association:
   1. NFPA 265 - Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Coverings on Full Height Panels and Walls, Method B.

G. Underwriters Laboratories Inc.:
   1. UL - Fire Resistance Directory.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on metal framing, gypsum board, joint tape, and acoustic accessories.

C. Shop Drawings:
   1. Indicate special details associated with acoustic seals.
   2. Indicate installation details required for seismic design loads.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C840, ASTM C1280; GA-214, GA-216 and GA-600.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.
PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

A. Manufacturer List:
   1. CertainTeed.
   2. Georgia-Pacific.
   4. United States Gypsum Co.
   5. Substitutions: Section 01 60 00 – Product Requirements.

B. Performance / Design Criteria:
   1. Seismic Loads: Design and size components to withstand seismic loads and sway
displacement as calculated according to ASCE 7 and applicable codes for Seismic Design
Category indicated on Drawings.

2.2 COMPONENTS

A. Framing Materials:
   1. Studs and Tracks: ASTM C645; GA-216 and GA-600; galvanized sheet steel, 20 gauge
minimum, unless indicated otherwise on Drawings; C shape, of depth as shown on
Drawings.
   4. Anchorage to Substrate: Tie wire, screws, and other metal supports, of type and size to suit
application; to rigidly secure materials in place.
   5. Seismic Bracing: As required for seismic performance requirements.

B. Steel Framing Components for Suspended Gypsum Board Ceilings (flat).
   1. Grid suspension system shall be manufacturer’s standard grid suspension system
composed of main beams and cross furring members which interlock to form a
modular supporting network conforming to ASTM C645.
   3. Acceptable products:
      a. Chicago Metallic.  640 Furring System.
      b. Donn.    Rigid X.
      c. Gold Bond.   Drywall Suspension System.

C. Gypsum Board Materials: ASTM C1396.
   1. Fire Rated Gypsum Board: ASTM C36; fire resistive type, UL or WH rated; 5/8 inch thick,
maximum available length in place; ends square cut, tapered edges.
   2. Fire-Rated Abuse-Resistant Gypsum Board: (Install to height of 8 feet above floor level at
gypsum board partitions throughout building). A gypsum core wall panel with additives
to enhance fire resistance, surface indentation resistance, and impact resistance of the core
and surfaced with abrasion resistant paper on front and long edges with heavy liner paper
bonded to the back side; and complying with ASTM C 36 / C 1396, Type X.
b. Width: 4 feet.
c. Length: 8 feet through 12 feet.
d. Edges: Tapered.
e. Abuse Resistance: Not less than the following classification levels when tested in accordance with ASTM C 1629:
   1) Surface Abrasion: Classification Level 2.
   2) Surface Indention: Classification Level 1.

3. Moisture Resistant Gypsum Board: ASTM C630; 5/8 inch thick, maximum available length in place; ends square cut, tapered edges.

D. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 5/8 inch thick; 2 inch wide coated glass fiber tape for joints and corners.

2.3 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced, 4 inch thick.

B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

C. Gypsum Board Accessories: ASTM C1047; plastic; corner beads, edge trim, and expansion joints.

D. Joint Materials: ASTM C475; GA-216; reinforcing tape, joint compound, and water.

E. Gypsum Board Screws: ASTM C1002; length to suit application.
   1. Screws for Steel Framing: Type S.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.

B. Verify site conditions are ready to receive Work and opening dimensions are as indicated on shop drawings and as instructed by manufacturer.

3.2 INSTALLATION

A. Metal Stud Installation:
   1. Install studs in accordance with ASTM C754, ASTM C1007, GA-216 and GA-600.
   2. Metal Stud Spacing: 16 inches on center.
   3. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
4. Door Opening Framing: Install double studs at door frame jambs. Install box beam and stud track at frame head height.
5. Blocking: Nail wood blocking to studs.

B. Ceiling Framing Installation:
1. Install in accordance with ASTM C754 and GA-216.
2. Coordinate location of hangers with other work.
3. Install ceiling framing independent of walls, columns, and above ceiling work.
4. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing.
5. Laterally brace entire suspension system as required for seismic design category as indicated on Drawings.

C. Acoustic Accessories Installation:
1. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
2. Install acoustic sealant within partitions.

D. Gypsum Board Installation:
1. Install gypsum board in accordance with GA-216 and GA-600.
2. Erect single layer fire rated gypsum board horizontally, with edges and ends occurring over firm bearing.
3. Use screws when fastening gypsum board to metal furring or framing.
4. Double Layer Applications: Use fire rated gypsum backing board for first layer, placed perpendicular to framing or furring members.
   a. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.
5. Place control joints consistent with lines of building spaces, as per manufacturer’s recommendations consistent with lines of building spaces and at all openings.
6. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated on Drawings.
7. Install cementitious backing board over metal studs.
8. Install abuse-resistant gypsum board, as specified in Paragraph 2.2.C.2, to height of 8 feet above floor level at gypsum board partitions throughout building.
9. Install moisture resistant gypsum board at walls and suspended gypsum board ceilings as scheduled on Drawings.

E. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer’s installation instructions. Tape joints and corners, cover with skim coat of dry-set mortar to feather edge.

F. Joint Treatment:
1. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
2. Feather coats on to adjoining surfaces so that camber is maximum 1/32 inch.

G. Provide skim coat of joint compound in accordance with GA-214 to provide a Level 5 finish as specified.
3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet.

3.4 SCHEDULE

A. Finishes in accordance with GA-214 Level:
   1. Level 1: Above finished ceilings concealed from view.
   2. Level 5: Walls exposed to view.
   3. Level 5: Ceilings exposed to view.

END OF SECTION
SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes suspended metal grid ceiling system, perimeter trim and acoustic panels, and accessories.

B. Related Requirements:
   1. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.

1.2 REFERENCE STANDARDS

A. ASTM International:
   6. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

B. Ceilings and Interior Systems Construction Association:
   1. CISCA - Acoustical Ceilings: Use and Practice.

C. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

D. National Fire Protection Association:

E. Underwriters Laboratories Inc.:
   1. UL - Fire Resistance Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:240.
1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on metal grid system components and acoustic units.

C. Shop Drawings:
   1. Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to system. Indicate method of suspension where interference exists.
      a. Indicate installation details required for seismic design loads.

D. Samples:
   1. Submit two samples 4 x 4 inch in size illustrating material and finish of acoustic units.
   2. Submit two samples each, 12 inches long, of suspension system main runner, cross runner, perimeter molding.

E. Manufacturer's Instructions: Submit special procedures, perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

A. Conform to CISCA requirements.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing Work of this section.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Maintain uniform temperature of minimum 55 degrees F, and maximum humidity of 65 to 70 percent prior to, during, and after acoustic unit installation.
1.9 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

B. Sequence Work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

C. Install acoustic units after interior wet work is dry.

1.10 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish 2.5 percent of total acoustic unit area of extra panels to Owner.

PART 2 PRODUCTS

2.1 SUSPENDED ACOUSTICAL CEILINGS

A. Manufacturers:
   1. Armstrong World Industries:
      a. Type 1 Ceiling: Fine Fissured (1713) panel.
   2. CertainTeed Corporation:
      a. Type 1 Ceiling: Fine Fissured (HHF-457 DP) panel
   3. USG Interiors:
      a. Type 1 Ceiling: Radar ClimaPlus (2211) panel
   4. Substitutions: Section 01 60 00 - Product Requirements.

2.2 COMPONENTS

A. Acoustic Panels (Type 1): ASTM E1264, conforming to the following:
   1. Size: 24 x 24 inches.
   2. Thickness: 3/4 inch.
   4. NRC: 0.70.
   5. SAC: 0.70, 0.94, and 0.85 at 500Hz, 1000Hz, and 2000Hz respectively.
   7. Surface Color: White.

B. Grid:
   1. Non-fire Rated Grid: ASTM C635, Heavy Duty; exposed T components die cut and interlocking.
      a. Armstrong: Prelude XL.
      b. Celotex: Classic Stab System.
      c. USG: Donn DX.
      d. Substitutions: Section 01 60 00 - Product Requirements.
2. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
3. Exposed Grid Surface Width: As per applicable code for seismic design category indicated on Drawings.
5. Accessories: Stabilizer bars, clips, splices, perimeter moldings, and hold down clips, as required for suspended grid system.
6. Support Channels and Hangers: Galvanized Primed steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

2.3 ACCESSORIES

A. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.
B. Touch-up Paint: Type and color to match acoustic and grid units.
C. Seismic Bracing: As required to meet seismic performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
B. Verify layout of hangers will not interfere with other Work.

3.2 INSTALLATION

A. Lay-In Grid Suspension System:
   1. Install suspension system in accordance with ASTM C636 and as supplemented in this section.
   2. Install suspension system in accordance with ASTM E580.
   3. Install system capable of supporting imposed loads with maximum deflection of 1/240 maximum.
   4. Locate system on room axis according to reflected plan.
   5. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
   6. Install hanger clips during steel deck erection. Install additional hangers and inserts as required.
   7. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
   8. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
   9. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
   10. Do not eccentrically load system, or produce rotation of runners.
11. Perimeter Molding:
   a. Install edge molding at intersection of ceiling and vertical surfaces with continuous gasket.
   b. Use longest practical lengths.
   c. Miter corners.
   d. Install at junctions with other interruptions.
12. Install light fixture boxes constructed of acoustic panel above light fixtures in accordance with UL assembly requirements and light fixture ventilation requirements.
13. Laterally brace entire suspended system as required for seismic design category as indicated on Drawings.

B. Acoustic Units:
   1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
   2. Install units after above ceiling work is complete.
   3. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
   4. Cutting Acoustic Units:
      a. Cut to fit irregular grid and perimeter edge trim.
      b. Cut square reveal edges to field cut units.
   5. Where bullnosed concrete block corners and round obstructions occur, install preformed closures to match perimeter molding.
   6. Install hold-down clips to retain panels tight to grid system within 20 feet of exterior door.

3.3 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.
PART 1 GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paints and other coatings.

1.2 REFERENCES

A. ASTM International:

B. Green Seal:
   1. GC-03 - Anti-Corrosive Paints.
   2. GS-11 - Product Specific Environmental Requirements.

C. National Fire Protection Association:

D. Painting and Decorating Contractors of America:

E. South Coast Air Quality Management District:
   1. SCAQMD Rule 1113 - Architectural Coatings.

F. SSPC: The Society for Protective Coatings:
   1. SSPC - Steel Structures Painting Manual.

G. Underwriters Laboratories Inc.:

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.
1.4 SUBMITTALS
A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
B. Product Data: Submit data on finishing products and special coatings.
C. Samples:
   1. Submit two paper chip samples illustrating full range of colors available for each
      surface finishing product scheduled.
D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, and substrate conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS
A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
D. Paint Materials: Store at minimum ambient temperature of 45 degrees F and maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS
A. Section 01 60 00 - Product Requirements.
B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
C. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

D. Provide lighting level of 80 foot candle measured mid-height at substrate surface.

1.9 SEQUENCING

A. Section 01 10 00 - Summary: Work sequence.

B. Verify existing conditions and requirements of other trades before starting Work.

C. Sequence application to the following:
   1. Do not apply finish coats until paintable sealant is applied.
   2. Back prime wood trim before installation of trim.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five-year manufacturer warranty for paints and coatings.

1.11 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Supply 1 gallon of each color, type, and surface texture; store where directed by Owner.

C. Label container with color, type, and room locations, in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

A. Manufacturers:
   1. The Glidden Co.
   2. MAB Paints.
   5. Pittsburg Paints.
2.2 COMPONENTS

A. Coatings: Ready mixed, except field catalyzed coatings. Prepare coatings:
   1. To soft paste consistency, capable of being readily and uniformly dispersed to 
      homogeneous coating.
   2. For good flow and brushing properties.
   3. Capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials 
   not specifically indicated but required to achieve finishes specified; commercial quality.

C. Patching Materials: Latex filler.

D. Fastener Head Cover Materials: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify existing conditions and requirements of other trades before starting Work.

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by 
   product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of Work. Report 
   conditions capable of affecting proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Do not apply paint pavement markings to concrete surfaces until concrete has cured for 
   28 days.

F. Measure moisture content of surfaces using electronic moisture meter. Do not apply 
   finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete and Concrete Unit Masonry: 12 percent.

3.2 PREPARATION

A. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, 
   escutcheons, and fittings prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces capable of affecting Work of this section. 
   Remove or repair existing coatings exhibiting surface defects.

C. Marks: Seal with shellac those which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium 
   phosphate and bleach. Rinse with clean water and allow surface to dry.
E. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

F. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

G. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

H. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.

I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

J. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

K. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

L. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

M. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

N. Existing Glazed Block: Clean all surfaces and abrade with heavy grit scouring pad as per paint manufacturer to ensure warranty coverage.

3.3 APPLICATION

A. Multiple colors shall be selected and accent walls shall be a component of the Project.

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.
E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.

H. Finishing Mechanical And Electrical Equipment:
1. Refer to Division 22, Division 23, Division 26, and Division 27 for schedule of color-coding and identification banding of equipment, ductwork, piping, and conduit.
2. Paint shop primed equipment.
3. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
4. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.
5. Paint interior surfaces of air ducts visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, and grilles to match face panels.
6. Paint exposed conduit and electrical equipment occurring in finished areas.
7. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.
8. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

B. Inspect and test questionable coated areas.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.

B. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. Protect Work of other trades and surfaces not being painted.

B. Automatic fire sprinklers must not be painted and must be protected from paint over spray. Any sprinklers inadvertently painted must be replaced rather than cleaned.

C. Protect completed Work from damage by other trades.
3.7 SCHEDULE - SHOP PRIMED ITEMS FOR SITE FINISHING

A. Structural Steel Framing (Section 05 12 00): Exposed surfaces.
B. Steel Joist Framing (Section 05 21 00): Exposed surfaces.
C. Steel Roof Decking (Section 05 31 23): Exposed surfaces.
D. Metal Fabrications (Section 05 50 00): Exposed surfaces of interior and exterior lintels, exposed surfaces of beams, and ledge and shelf angles, ladders, and bollards.
E. Metal Stairs (Section 05 51 00): Exposed surfaces.
F. Metal Railings (Section 05 52 00): Exposed surfaces.
G. Standard Steel Frames (Section 08 12 14): Exposed surfaces.
H. Standard Steel Doors (Section 08 13 14): Exposed surfaces.
I. Access Doors (Section 08 31 13): Exposed surfaces of doors.
J. Sectional Doors (Section 08 36 13): Exposed surfaces of doors.

3.8 SCHEDULE - INTERIOR SURFACES

A. Steel:
   1. One coat SW Pro Industrial Pro-Cryl Primer; B66-310 or approved equal.
      a. Two to four mils dry.
   2. Two coats SW ProMar 200 Alkyd Semi-Gloss; B34W200 or approved equal.
      a. Four mils wet, 1.7 mils dry.

B. Steel - Galvanized:
   1. One coat SW Pro Industrial Pro-Cryl Primer; B66-310 or approved equal.
      a. Two to four mils dry.
   2. Two coats SW ProMar 200 Alkyd Semi-Gloss; B34W200 or approved equal.
      a. Four mils wet, 1.7 mils dry per coat.

D. Interior Ferrous Metal (Exposed Structure / Decking) Finish Dry Fall-Out:
   1. One coat SW Save-Lite Dry Fall; B47W62 or approved equal.
      a. Three point two mils wet.

E. Gypsum Board Ceilings:
   1. One coat SW PrepRite 200 Latex Primer; B28W200 or approved equal.
      a. Four mils wet, 1.2 mils dry.
   2. Two coats SW ProMar 200 Latex Semi-Gloss; B300W200 or approved equal.
      a. Four mils wet, 1.4 mils dry per coat.
F. Gypsum Board Walls:
1. One coat SW PrepRite 200 Latex Primer; B28W200 or approved equal.
   a. Four mils wet, 1.2 mils dry.
2. Two coats SW ProMar 200 Latex Semi-Gloss; B300W200 or approved equal.
   a. Four mils wet, 1.4 mils dry per coat.

G. Interior Wood Items (Semi-Transparent Finish):
1. One coat SW Wood Classics Oil Stain, A49 Series, or approved equal.
   a. Four hundred fifty to 500 square feet per gallon.
2. One coat SW Wood Classics Waterborne Polyurethane Varnish, A68 Series, or approved equal.
   a. Four hundred to 500 square feet per gallon.
3. One coat SW Wood Classics Waterborne Polyurethane Varnish, A68 Series, or approved equal.
   a. Four hundred to 500 square feet per gallon.

H. Concrete Floor Sealer:
1. One coat SW ArmorSeal WB Epoxy Primer / Sealer clear, or approved equal.
   a. Two to 3.0 mils dry.
2. Two coats SW ArmorSeal Floor-Plex 7100 WB Epoxy, or approved equal.
   a. One point five to 2 mils dry per coat.

I. Concrete Block / Tilt-up Concrete:
1. One coat SW Heavy Duty Block Filler; B42W46 or approved equal.
   a. Seventy five to 125 square feet per gallon.
2. Two coats SW Water Based Catalyzed Epoxy; B70 or approved equal.
   a. Four mils wet, 1.4 mils dry per coat.

J. Glazed Block:
1. One coat of SW Kem Bond HS Primer; B50Z Series or approved equal.
   a. Four mils wet, 1.2 mils dry.
2. Two coats of SW Water Based Catalyzed Epoxy; B70 or approved equal.
   a. Four mils wet, 1.4 mils dry per coat.

K. Brick:
1. One coat SW Loxon Acrylic Masonry Primer, A24W8300 or approved equal.
   a. Eight mils wet, 3.2 mils dry.
2. Two coats SW Metalatex Acrylic Semi-Gloss, B42 Series or approved equal.
   a. Four mils wet, 15 mils dry per coat.

3.8 SCHEDULE – EXTERIOR SURFACES

A. Steel:
1. One coat SW Pro Industrial Pro-Cryl Universal Primer, B66-310 Series or approved equal.
   a. Ten mils wet, 4 mils dry.
2. Two coats SW Metalatex Acrylic Semi-Gloss, B42 Series or approved equal.
   a. Four mils wet, 1.5 mils dry per coat.
B. Steel Galvanized:
   1. Two coats SW Metalatex Semi-Gloss, B42 Series or approved equal.
      a. Four mils wet, 1.5 mils dry per coat.

C. Brick:
   1. One coat SW Loxon Acrylic Masonry Primer, A24W8300 or approved equal.
      a. Eight mils wet, 3.2 mils dry.
   2. Two coats SW Metalatex Acrylic Semi-Gloss, B42 Series or approved equal.
      b. Four mils wet, 15 mils dry per coat.

D. Tilt-up Concrete:
   1. One coat SW Loxon Acrylic Masonry Primer, A24S8300 or approved equal.
      a. Two point 5 to 3.5 mils dry.
   2. Two coats SW Conflex XL Smooth Elastomeric High Build Coating, A5-400 Series or approved equal.
      a. Seven point five mils dry per coat.
         1. A total dry film thickness of 15 mils and less than 10 pinholes per square foot is required.

END OF SECTION
SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION
   A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
      1. Motor controllers.
      2. Torque, speed, and horsepower requirements of the load.
      3. Ratings and characteristics of supply circuit and required control sequence.
      4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
   A. Comply with NEMA MG 1 unless otherwise indicated.
   B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS
   A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
   B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.
2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Equipment curbs.
   B. Related Sections:
      1. Section 23 81 03 - Packaged Rooftop Air Conditioning Units - Small Capacity: Execution requirements for packaged RTU’s specified by this section.

1.2 REFERENCES
   A. American Society of Mechanical Engineers:
      1. ASME B31.9 - Building Services Piping.

1.3 SUBMITTALS
   A. Product Data:
      1. Roof curb adapters: Submit manufacturers catalog data including load capacity and configurations.

1.4 QUALITY ASSURANCE
   A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Accept materials on site in original factory packaging, labeled with manufacturer’s identification.
   B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.6 FIELD MEASUREMENTS
   A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 EQUIPMENT CURBS
   A. Manufacturers:
      1. Thybar.

B. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, 1 inch thick insulation, factory installed wood nailer.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not drill or cut structural members.

3.2 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

3.3 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 230548 - VIBRATION AND SEISMIC CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Housed-spring isolators.
6. Restrained-spring isolators.
8. Pipe-riser resilient supports.
9. Resilient pipe guides.
10. Air-spring isolators.
11. Restrained-air-spring isolators.
12. Elastomeric hangers.
13. Spring hangers.
15. Restraint channel bracings.
17. Seismic-restraint accessories.
18. Mechanical anchor bolts.
19. Adhesive anchor bolts.
20. Vibration isolation equipment bases.

B. Related Requirements:

1. Section 210548 "Vibration and Seismic Controls for Fire Suppression" for devices for fire-suppression equipment and systems.
2. Section 220548 "Vibration and Seismic Controls for Plumbing" for devices for plumbing equipment and systems.

1.3 DEFINITIONS

C. OSHPD: Office of Statewide Health Planning & Development (for the State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
   2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device and seismic-restraint component required.
      a. Annotate to indicate application of each product submitted and compliance with requirements.
   3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:
   1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal: For each vibration isolation and seismic-restraint device.
   1. Include design calculations and details for selecting vibration isolators, seismic restraints, and vibration isolation bases complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic\[and wind\] forces required to select vibration isolators and seismic\[and wind\] restraints and for designing vibration isolation bases.
      a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
   3. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system was examined for excessive stress and that none exists.
   4. Seismic[- and Wind]-Restraint Details:
      a. Design Analysis: To support selection and arrangement of seismic\[and wind\] restraints. Include calculations of combined tensile and shear loads.
      b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and
values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

d. Preapproval and Evaluation Documentation: By [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction], showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of vibration isolation device installation and seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For [professional engineer] [and] [testing agency].

C. Welding certificates.

D. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data [performed by an independent agency].

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For [air-spring mounts] [and] [restrained-air-spring mounts] to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are unavailable, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:
   1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform
      loading over pad area.
   2. Size: Factory or field cut to match requirements of supported equipment.
   3. Pad Material: Oil and water resistant with elastomeric properties.
   4. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
   5. Infused nonwoven cotton or synthetic fibers.
   7. Sandwich-Core Material: [Resilient] [and] [elastomeric]
      a. Surface Pattern: [Smooth] [Ribbed] [Waffle] pattern.
      b. Infused nonwoven cotton or synthetic fibers.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:
   1. Mounting Plates:
      a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded
         [ with threaded studs or bolts].
      b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to
         support structure.
   2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric
      material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:
   1. Description: All-directional isolator with seismic restraints containing two separate and
      opposing elastomeric elements that prevent central threaded element and attachment
      hardware from contacting the housing during normal operation.
      a. Housing: Cast-ductile iron or welded steel.
      b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric
         material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Top housing with [attachment and leveling bolt] [threaded mounting holes and internal leveling device] [elastomeric pad].

2.7 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Top plate with [threaded mounting holes] [elastomeric pad].
   c. Internal leveling bolt that acts as blocking during installation.

2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
2.8 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:

1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with [adjustable] [non-adjustable] snubbers to limit vertical movement.
   a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.9 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch- (13-mm-) thick neoprene

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig (3.45 MPa) on isolation material providing equal isolation in all directions.

2.10 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch- (13-mm-) thick neoprene

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.11 AIR-SPRING ISOLATORS

A. Freestanding, Single or Multiple, Compressed-Air Bellows:

1. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
2. Maximum Natural Frequency: 3 Hz.
3. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
5. Tank valves.

2.12 RESTRAINED-AIR-SPRING ISOLATORS
A. Freestanding, Single or Multiple, Compressed-Air Bellows with Vertical-Limit Stop Restraint:

1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
   a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447 kPa).
   b. Top plate with [threaded mounting holes] [elastomeric pad].
   c. Internal leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Bellows Assembly: Upper and lower powder-coated steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows or similar elastomeric material.
8. Maximum Natural Frequency: 3 Hz.
9. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
10. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
11. Tank valves.

2.13 ELASTOMERIC HANGERS
A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
   1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
   2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.14 SPRING HANGERS
A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.15 SNUBBERS
A. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
   1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
   2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
   3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

2.16 RESTRAINT CHANNEL BRACINGS
A. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.17 RESTRAINT CABLES
A. Restraint Cables: [ASTM A603 galvanized] [ASTM A492 stainless]-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.18 SEISMIC-RESTRAINT ACCESSORIES
A. Hanger-Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod.
B. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to [rigid channel bracings] [and] [restraint cables].

C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.19 MECHANICAL ANCHOR BOLTS

A. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.20 ADHESIVE ANCHOR BOLTS

A. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.21 VIBRATION ISOLATION EQUIPMENT BASES

A. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

B. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.
2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Concrete Inertia Base: [Factory-fabricated] [or] [field-fabricated], welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.22 RESTRAINED ISOLATION ROOF-CURB RAILS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic[ and wind] forces.

B. Upper Frame: The upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic[ and wind] forces.

C. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support the upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

D. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

E. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflushed over roof materials.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic[-and wind]-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction].

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength is adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction] that provides required submittals for component.
E.  Piping Restraints:

1.  Comply with requirements in MSS SP-127.
2.  Space lateral supports a maximum of \([40 \text{ feet}\ (12 \text{ m})]\) o.c., and longitudinal supports a maximum of \([80 \text{ feet}\ (24 \text{ m})]\) o.c.
3.  Brace a change of direction longer than 12 feet (3.7 m).

F.  Install cables so they do not bend across edges of adjacent equipment or building structure.

G.  Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES] [OSHPD] [an agency acceptable to authorities having jurisdiction] that provides required submittals for component.

H.  Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

I.  Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

J.  Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

K.  Drilled-in Anchors:

1.  Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2.  Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3.  Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4.  Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5.  Set anchors to manufacturer's recommended torque, using a torque wrench.
6.  Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4  ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A.  Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 232113 "Hydronic Piping" for piping flexible connections.
3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
4. Test at least [four] of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Test and adjust restrained-air-spring isolator controls and safeties.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.7 AIR-SPRING ISOLATOR INSTALLATION

A. Independent Isolator Installation:

1. Install tank valve into each air isolator.
2. Inflate each isolator to [height] [and] [pressure] specified on Drawings.

B. Pressure-Regulated Isolator Installation:

1. Coordinate the constant pressure-regulated air supply to air springs with the requirements for piping and connections specified in Section 221513 "General-Service Compressed-Air Piping."
2. Connect all pressure regulators to a single dry, filtered [facility] [constant] air supply.
3. Inflate isolators to [height] [and] [or] [pressure] specified on Drawings.
3.8 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."

END OF SECTION
SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stencils.

PART 2 PRODUCTS

2.1 STENCILS

A. Stencils: With clean cut symbols and letters of following size:


PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting.

B. Identify packaged RTU's with stencil painting.

END OF SECTION
SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Testing adjusting, and balancing of air systems.

B. Related Sections:
   1. Section 23 09 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.2 REFERENCES

A. Associated Air Balance Council:

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

C. Natural Environmental Balancing Bureau:
   1. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. Testing Adjusting and Balancing Bureau:
   1. TABB - International Standards for Environmental Systems Balance.

1.3 SUBMITTALS

A. Test Reports: Indicate data forms containing information indicated in Schedules.

B. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

C. Submit draft copies of report for review prior to final acceptance of Project.

D. Furnish reports binder manuals, complete with table of contents 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.
1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance/NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems or TABB International Quality Assurance program.

1.6 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.7 COORDINATION

A. TAB Contractor shall have received software training from the selected Controls Supplier applicable to the software and hardware which will be provided for this project.

B. TAB Contractor shall have on the project site all required software and hardware necessary from the selected Controls Supplier to perform testing, adjusting and balancing required tasks.

1.8 SCHEDULING

A. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:
   1. Systems are started and operating in safe and normal condition.
   2. HVAC control systems are installed complete and operable.
   3. Proper thermal overload protection is in place for electrical equipment.
   4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
   5. Duct systems are clean of debris.
   6. Fans are rotating correctly.
   7. Fire and volume dampers are in place and open.
   8. Air coil fins are cleaned and combed.
   9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations.
B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.
B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
D. Report defects and deficiencies noted during performance of services, preventing system balance.
E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
B. Make air flow rate measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
C. Measure air quantities at air inlets and outlets.
D. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
E. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
F. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
G. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

H. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

3.6 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. Packaged Roof Top Heating/Cooling Units.

B. Report Forms
   1. Title Page:
      a. Name of Testing, Adjusting, and Balancing Agency
      b. Address of Testing, Adjusting, and Balancing Agency
      c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
      d. Project name
      e. Project location
      f. Project Architect
      g. Project Engineer
      h. Project Contractor
      i. Project altitude
      j. Report date
   2. Summary Comments:
      a. Design versus final performance
      b. Notable characteristics of system
      c. Description of systems operation sequence
      d. Summary of outdoor and exhaust flows to indicate building pressurization
      e. Nomenclature used throughout report
      f. Test conditions
   3. Instrument List:
      a. Instrument
      b. Manufacturer
      c. Model number
      d. Serial number
      e. Range
      f. Calibration date
   4. Electric Motors:
      a. Manufacturer
      b. Model/Frame
      c. HP/BHP and kW
      d. Phase, voltage, amperage; nameplate, actual, no load
      e. RPM
      f. Service factor
      g. Starter size, rating, heater elements
      h. Sheave Make/Size/Bore
   5. V-Belt Drive:
      a. Identification/location
      b. Required driven RPM
c. Driven sheave, diameter and RPM

d. Belt, size and quantity

e. Motor sheave diameter and RPM

f. Center to center distance, maximum, minimum, and actual

6. Air Cooled Condenser:

a. Identification/number

b. Location

c. Manufacturer

d. Model number

e. Serial number

f. Entering DB air temperature, design and actual

g. Leaving DB air temperature, design and actual

h. Number of compressors

7. Cooling Coil Data:

a. Identification/number

b. Location

c. Service

d. Manufacturer

e. Air flow, design and actual

f. Entering air DB temperature, design and actual

g. Entering air WB temperature, design and actual

h. Leaving air DB temperature, design and actual

i. Leaving air WB temperature, design and actual

j. Saturated suction temperature, design and actual

k. Air pressure drop, design and actual

8. Heating Coil Data:

a. Identification/number

b. Location

c. Service

d. Manufacturer

e. Air flow, design and actual

f. Entering air temperature, design and actual

g. Leaving air temperature, design and actual

h. Air pressure drop, design and actual

9. Air Moving Equipment:

a. Location

b. Manufacturer

c. Model number

d. Serial number

e. Arrangement/Class/Discharge

f. Air flow, specified and actual

g. Return air flow, specified and actual

h. Outside air flow, specified and actual

i. Total static pressure (total external), specified and actual

j. Inlet pressure

k. Discharge pressure

l. Sheave Make/Size/Bore

m. Number of Belts/Make/Size
n. Fan RPM
10. Return Air/Outside Air Data:
   a. Identification/location
   b. Design air flow
   c. Actual air flow
   d. Design return air flow
   e. Actual return air flow
   f. Design outside air flow
   g. Actual outside air flow
   h. Return air temperature
   i. Outside air temperature
   j. Required mixed air temperature
   k. Actual mixed air temperature
   l. Design outside/return air ratio
   m. Actual outside/return air ratio

END OF SECTION
SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 230716 "HVAC Equipment Insulation."
2. Section 230719 "HVAC Piping Insulation."
3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Sustainable Design Submittals:

1.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches (300 mm) square.
2. Sheet Jacket Materials: 12 inches (300 mm) square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Ductwork Mockups:
   a. One 10-foot (3-m) section each of rectangular and round straight duct.
   b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
d. One rectangular and round transition fitting.
e. Four support hangers for round and rectangular ductwork.
f. Each type of damper and specialty.

2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.
PART 2 - PRODUCTS

2.1 INSULATION MATERIALS


B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Double click here to find, evaluate, and insert list of manufacturers and products.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, [Type I] [Type II with factory-applied vinyl jacket] [Type III with factory-applied FSK jacket] [Type III with factory-applied FSP jacket]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Double click here to find, evaluate, and insert list of manufacturers and products.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation [without factory-applied jacket] [with factory-applied ASJ] [with factory-applied FSK jacket]. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Double click here to find, evaluate, and insert list of manufacturers and products.

I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied [ASJ] [FSK jacket] complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Double click here to find, evaluate, and insert list of manufacturers and products.

J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a [1] [2]-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2. <Double click to insert sustainable design text for VOC content of plastic foam adhesive.>

3. <Double click to insert sustainable design text for low emitting adhesives.>

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2. <Double click to insert sustainable design text for fiberglass pipe adhesive.>

3. <Double click to insert sustainable design text for low emitting adhesives.>


1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2. <Double click to insert sustainable design text for adhesive.>

3. <Double click to insert sustainable design text for low emitting adhesives.>

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2. <Double click to insert sustainable design text for adhesive.>
2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. <Double click to insert sustainable design text for mastic coatings.>

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1.  
   <Double click here to find, evaluate, and insert list of manufacturers and products.>
2.  
   <Double click to insert sustainable design text for VOC content of adhesive.>
3.  
   <Double click to insert sustainable design text for low emitting adhesives.>
4.  Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
5.  Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1.  
      <Double click here to find, evaluate, and insert list of manufacturers and products.>
   2.  Materials shall be compatible with insulation materials, jackets, and substrates.
   3.  Fire- and water-resistant, flexible, elastomeric sealant.
   4.  Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   5.  Color: Aluminum.
   6.  <Double click to insert sustainable design text for sealant.>
   7.  <Double click to insert sustainable design text for sealants.>

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:
   1.  
      <Double click here to find, evaluate, and insert list of manufacturers and products.>
   2.  Materials shall be compatible with insulation materials, jackets, and substrates.
   3.  Fire- and water-resistant, flexible, elastomeric sealant.
   4.  Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
   6.  <Double click to insert sustainable design text for sealant.>
   7.  <Double click to insert sustainable design text for sealants.>

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1.  ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2.  ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
   3.  FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
   4.  FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
   5.  Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.
   1. [Double click here to find, evaluate, and insert list of manufacturers and products.]

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.
   1. [Double click here to find, evaluate, and insert list of manufacturers and products.]

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).
   1. [Double click here to find, evaluate, and insert list of manufacturers and products.]

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. [Double click here to find, evaluate, and insert list of manufacturers and products.]
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: [White] [Color-code jackets based on system. Color as selected by Architect].

D. Metal Jacket:
   1. [Double click here to find, evaluate, and insert list of manufacturers and products.]
      a. [Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].
      b. Finish and thickness are indicated in field-applied jacket schedules.
      c. Moisture Barrier for Indoor Applications: [1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].
      d. Moisture Barrier for Outdoor Applications: [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].
   3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
a. [Sheet and roll stock ready for shop or field sizing] [Factory cut and rolled to size].

b. Material, finish, and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Indoor Applications: [1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper] [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].

d. Moisture Barrier for Outdoor Applications: [3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper] [2.5-mil- (0.063-mm-) thick polysurlyn].

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with [white] [stucco-embossed] aluminum-foil facing.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
   2. Width: 2 inches (50 mm).
   3. Thickness: 3.7 mils (0.093 mm).
   4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:
   1. <Double click here to find, evaluate, and insert list of manufacturers and products.>
   2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, [Type 304] [or] [Type 316]; 0.015 inch (0.38 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [or] [closed seal].
   3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, [1/2 inch (13 mm)] [3/4 inch (19 mm)] wide with [wing seal] [or] [closed seal].

B. Insulation Pins and Hangers:
   1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated.
      a. <Double click here to find, evaluate, and insert list of manufacturers and products.>
   2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
      a. <Double click here to find, evaluate, and insert list of manufacturers and products.>
   3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      a. <Double click here to find, evaluate, and insert list of manufacturers and products.>
      b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: [Copper- or zinc-coated, low-carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

b. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

b. Spindle: [Copper- or zinc-coated, low-carbon steel] [Aluminum] [Stainless steel], fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

c. Adhesive-backing base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, [galvanized-steel] [aluminum] [stainless-steel] sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
C. Staples: Outward-clinching insulation staples, nominal 3/4-inch (19-mm) wide, stainless steel or Monel.

D. Wire: [0.080-inch (2.0-mm) nickel-copper alloy] [0.062-inch (1.6-mm) soft-annealed, stainless steel] [0.062-inch (1.6-mm) soft-annealed, galvanized steel].

1. <Double click here to find, evaluate, and insert list of manufacturers and products.>

2.13 CORNER ANGLES

A. PVC Corner Angles: [30 mils (0.8 mm)] <Insert dimension> thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: [0.040 inch (1.0 mm)] <Insert dimension> thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: [0.024 inch (0.61 mm)] <Insert dimension> thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, [Type 304] [or] [Type 316].

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
   4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
   1. Comply with requirements in Section 078413 "Penetration Firestopping."

E. Insulation Installation at Floor Penetrations:
   1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for [100] [50] <Insert number> percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

   b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

   d. Do not overcompress insulation during installation.

   e. Impale insulation over pins and attach speed washers.

   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

   b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for \[100\] \[50\] \(<\text{Insert number}\>\) percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
   b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not overcompress insulation during installation.
   e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
   b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
   1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
   2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
   3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:
   1. Draw jacket material smooth and tight.
   2. Install lap or joint strips with same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."
3.9 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: [Two] <Insert number> finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.


B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

   1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to [one] <Insert number> location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

   1. Indoor, concealed supply and outdoor air.
   2. Indoor, exposed supply and outdoor air.
   3. Indoor, concealed return located in unconditioned space.
   4. Indoor, exposed return located in unconditioned space.
   5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
   6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
   7. Indoor, concealed oven and warewash exhaust.
   8. Indoor, exposed oven and warewash exhaust.
   9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:
1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
5. Flexible connectors.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
   kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
   [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

B. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
   kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
   [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

C. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
   kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
   [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.
D. Concealed, round and flat-oval, exhaust-air duct insulation shall be [one of] the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

E. Concealed, rectangular, supply-air duct insulation shall be [one of] the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

F. Concealed, rectangular, return-air duct insulation shall be [one of] the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

G. Concealed, rectangular, outdoor-air duct insulation shall be [one of] the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

H. Concealed, rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be [one of] the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
   <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
   [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

I. Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated
   [blanket] [or] [board]; thickness as required to achieve 2-hour fire rating.

J. Concealed, supply-air plenum insulation shall be one of the following:
   1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
   2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
      kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
   3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
      [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
   4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

K. Concealed, return-air plenum insulation shall be one of the following:
   1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
   2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
      kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
   3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
      [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
   4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

L. Concealed, outdoor-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
      kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
   2. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
      [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

M. Concealed, exhaust-air plenum insulation shall be one of the following:
   1. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
      kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
   2. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
      <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
      [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

N. Exposed, round and flat-oval, supply-air duct insulation shall be one of the following:
   1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

4. Mineral-Fiber Pipe and Tank: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick.

5. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

O. Exposed, round and flat-oval, return-air duct insulation shall be one of the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.

2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

4. Mineral-Fiber Pipe and Tank: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick.

5. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

P. Exposed, round and flat-oval, outdoor-air duct insulation shall be one of the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.

2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

4. Mineral-Fiber Pipe and Tank: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick.

5. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

Q. Exposed, round and flat-oval, exhaust-air duct insulation shall be one of the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.

2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

4. Mineral-Fiber Pipe and Tank: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick.

5. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

R. Exposed, rectangular, supply-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

S. Exposed, rectangular, return-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

T. Exposed, rectangular, outdoor-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

U. Exposed, rectangular, exhaust-air duct insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

V. Exposed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated [blanket] [or] [board]; thickness as required to achieve 2-hour fire rating.

W. Exposed, supply-air plenum insulation shall be one of the following:
1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
[6-lb/cu. ft. (96-kg/cu. m)] nominal density.

4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

X. Exposed, return-air plenum insulation shall be one of the following:

1. Flexible Elastomeric: [1 inch (25 mm)] <Insert dimension> thick.
2. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
3. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
[6-lb/cu. ft. (96-kg/cu. m)] nominal density.
4. Polyolefin: [1 inch (25 mm)] <Insert dimension> thick.

Y. Exposed, outdoor-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
[6-lb/cu. ft. (96-kg/cu. m)] nominal density.

Z. Exposed, exhaust-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-
kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)]
<Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
[6-lb/cu. ft. (96-kg/cu. m)] nominal density.

3.13 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for
a duct system, selection from materials listed is Contractor's option.

B. Concealed, round and flat-oval, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and
[0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)]
nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick
and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)]
nominal density.

C. Concealed, round and flat-oval, return-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

D. Concealed, round and flat-oval, outdoor-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

E. Concealed, rectangular, supply-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

F. Concealed, rectangular, return-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

G. Concealed, supply-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

H. Concealed, return-air plenum insulation shall be one of the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.

2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
I. Exposed, round and flat-oval, supply-air duct insulation shall be [one of] the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.
3. Mineral-Fiber Pipe and Tank: [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick.

J. Exposed, round and flat-oval, return-air duct insulation shall be [one of] the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

K. Exposed, rectangular, supply-air duct insulation shall be [one of] the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

L. Exposed, rectangular, return-air duct insulation shall be [one of] the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

M. Exposed, supply-air plenum insulation shall be [one of] the following:

1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

N. Exposed, return-air plenum insulation shall be [one of] the following:
1. Mineral-Fiber Blanket: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> and [0.75-lb/cu. ft. (12-kg/cu. m)] [1.5-lb/cu. ft. (24-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] nominal density.
2. Mineral-Fiber Board: [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> thick and [2-lb/cu. ft. (32-kg/cu. m)] [3-lb/cu. ft. (48-kg/cu. m)] [6-lb/cu. ft. (96-kg/cu. m)] nominal density.

### 3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.
2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
4. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
5. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
6. <Insert jacket type>.

D. Ducts and Plenums, Exposed:

1. None.
2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
4. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
5. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.010 inch (0.25 mm)] [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
6. <Insert jacket type>.

### 3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.
C. Ducts and Plenums, Concealed:

1. None.
2. [PVC] [PVC, Color-Coded by System]: [20 mils (0.5 mm)] [30 mils (0.8 mm)] thick.
3. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
4. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
5. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
6. <Insert jacket type>.

D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
2. Painted Aluminum, [Smooth] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
3. Stainless Steel, [Type 304] [or] [Type 316], [Smooth 2B Finish] [Corrugated] [Stucco Embossed]: [0.016 inch (0.41 mm)] [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
4. <Insert jacket type>.

E. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

1. [Painted] Aluminum, [Smooth] [Stucco Embossed] with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep Corrugations] [4-by-1-Inch (100-by-25-mm) Box Ribs]: [0.032 inch (0.81 mm)] [0.040 inch (1.0 mm)] thick.
2. Stainless Steel, [Type 304] [or] [Type 316], [Smooth] [Stucco Embossed], with [1-1/4-Inch- (32-mm-) Deep Corrugations] [2-1/2-Inch- (65-mm-) Deep Corrugations] [4-by-1-Inch (100-by-25-mm) Box Ribs]: [0.020 inch (0.51 mm)] [0.024 inch (0.61 mm)] thick.
3. <Insert jacket type>.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control sequences for DDC for HVAC systems, subsystems, and equipment.

1.3 DEFINITIONS

A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).
B. Binary Output: On/off output signal or contact closure.
C. DDC: Direct digital control.
D. Digital Output: Data output that must be interpreted digitally.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
   2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

1.5 AIR-HANDLING-UNIT CONTROL SEQUENCES

A. Air-Handling Unit Time Schedule:
   1. Time Schedule:
      a. Unit will operate in three modes
         1) Occupied
         2) Unoccupied
         3) Game Day

      2. Occupied Mode
a. Play area unit will activate
b. Spectator areas units will activate if
   1) Zone Temperature is more than 10 F greater (cooling) or 10 F lower (heating)
   2) Units have not activated in more than 10 days
c. Units will maintain
   1) 75 F (adjustable) Cooling Setpoint
   2) 65 F (adjustable) Heating Setpoint

3. Unoccupied Mode (Night Setback mode)
   a. Unit will maintain
      1) 90 F (adjustable) Cooling Setpoint
      2) 55 F (adjustable) Heating Setpoint

4. Game Day (Override)
   a. All units will activate (Spectator area units and Play area units)
   b. Unit will maintain
      1) 75 F (adjustable) Cooling Setpoint
      2) 65 F (adjustable) Heating Setpoint

5. Supply Fan
   a. The supply fan will run anytime the unit is commanded to run, unless shut down on safeties (factory installed). To prevent short cycling, the supply fan will have a user definable, adjustable minimum run time

6. Cooling Mode:
   a. The controller will measure the zone temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there will be a user definable (adjustable) delay between stages and each stage will have a minimum runtime.
   b. Cooling will be enabled when all of the following conditions are met
      1) Outside air temperature is greater than 60 F (adjustable)
      2) The zone temperature is above the cooling setpoint deadband (adjustable)
      3) The supply fan status is on
      4) No safety shutdowns are enabled

7. Gas Heating Mode:
   a. The controller will measure the zone temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there will be an adjustable delay between stages, and each stage will have an adjustable minimum runtime.
   b. The heating will be enabled when all of the following conditions are met
      1) Outside air temperature is less than 65 F (adjustable)
      2) The zone temperature is below the heating setpoint deadband (adjustable)
      3) The supply fan status is on
      4) No safety shutdowns are enabled
8. **Economizer**

   a. The controller will measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint below the cooling setpoint deadband
   
   b. The outside air dampers will maintain a minimum adjustable position to accommodate ventilation air requirements.
   
   c. The economizer will be enabled when all of the following conditions are met
      1) Outside air temperature is less than 75 F (adjustable)
      2) The outside air enthalpy is less than adjustable setpoint
      3) The outside air temperature is less than the zone temperature is less than the zone temperature setpoint by 3 F
      4) The supply fan status is on
   
   d. The economizer will close whenever any of the conditions are met
      1) The Mixed air temperature drops below 35 F (adjustable)
      2) Supply Fan is off
   
   e. The outside and exhaust air dampers will close and return air damper will open when the unit is off. If Optimal Start Up is available, the mixed air damper will operate as described in occupied mode except the outside air damper will modulate to fully closed.

9. **Minimum Outside Air Ventilation**

   a. When in occupied mode or game day mode, the outside air damper will open to the minimum position to maintain ventilation requirements

B. **Supply Fan(s) Variable-Volume Control:**

   1. **Fan Speed Control:**

      a. **Action:**

      1) Maintain constant supply-duct static-pressure set point to maintain minimum air flows
      2) Set-Point Reset (for Systems with DDC of Individual Zone Terminals): Reset static-pressure set point based on the zone requiring the most pressure; reset set point lower until one zone damper is nearly wide open.
      3) Set variable-frequency drive to minimum speed when fan is stopped.

C. **Return Fan(s) Variable-Volume Control:**

   1. **Fan Speed Control:**

      a. **Action:**

      1) Maintain constant airflow offset between supply- and return-air fans.
      2) Set variable-frequency drive to minimum speed when fan is stopped.
PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION
SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Natural gas piping above grade.
   2. Unions and flanges.
   3. Valves.
   4. Pipe hangers and supports.

1.2 REFERENCES

A. American National Standards Institute:

B. American Society of Mechanical Engineers:
   1. ASME B16.3 - Malleable Iron Threaded Fittings.
   2. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
   3. ASME B31.9 - Building Services Piping.
   4. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. ASTM International:

D. American Welding Society:
   1. AWS D1.1 - Structural Welding Code - Steel.

E. American Water Works Association:

F. Manufacturers Standardization Society of the Valve and Fittings Industry:
   1. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   2. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
   3. MSS SP 110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
G. National Fire Protection Association:

H. Underwriters Laboratories Inc.:
   1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.

B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.

C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 69.

D. Use plug or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

A. Product Data:
   1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
   2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, piping system, and system components.

1.6 QUALITY ASSURANCE

A. Perform natural gas Work in accordance with NFPA 54.

B. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.
PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
   2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.2 UNIONS AND FLANGES

A. Unions for Pipe 2 inches and Smaller:
   1. Ferrous Piping: Class 150, malleable iron, threaded.
   2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.3 BALL VALVES

A. 1/4 inch to 1 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.

2.4 PLUG VALVES

A. 2 inches and Smaller: MSS SP 78, Class 150, semi-steel construction, round port, full pipe area, pressure lubricated, teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.

2.5 PIPE HANGERS AND SUPPORTS

A. Conform to NFPA 54, ASME 31.9, ASTM F708, MSS SP 69.
B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.
C. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
B. Remove scale and dirt, on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.
3.2 INSTALLATION - PIPE HANGERS AND SUPPORTS

A. Install hangers and supports in accordance with ASME B31.9, ASTM F708 and MSS SP 69.
B. Support horizontal piping hangers as scheduled.
C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
D. Place hangers within 12 inches of each horizontal elbow.
E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

3.3 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

A. Install natural gas piping in accordance with NFPA 54.
B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
C. Route piping in orderly manner and maintain gradient.
D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.
E. Install piping to conserve building space and not interfere with use of space.
F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.
G. Group piping whenever practical at common elevations.
H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
I. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. 
   **PAINT ANY NEW GAS PIPING EXTENSIONS YELLOW.**
J. Install valves with stems upright or horizontal, not inverted.
K. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
3.4 FIELD QUALITY CONTROL

A. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.

B. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.

C. Pressure test natural gas piping in accordance with NFPA 54.

D. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.

E. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

F. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.
   1. Where leakage is detected, shut off gas supply until necessary repairs are complete.

G. Do not place appliances in service until leak testing and repairs are complete.

H. Pipe Hanger Spacing:

<table>
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<tr>
<th>PIPE SIZE</th>
<th>COPPER TUBING MAXIMUM HANGER SPACING Feet</th>
<th>STEEL PIPE MAXIMUM HANGER SPACING Feet</th>
<th>COPPER TUBING MINIMUM HANGER ROD DIAMETER Inches</th>
<th>STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches</th>
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</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
4. Double-wall round ducts and fittings.
5. Sheet metal materials.
6. Duct liner.
7. Sealant and gaskets.
8. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA’s "HVAC Duct Construction Standards - Metal and Flexible" and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.
C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE


PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers:
   2. MKT Metal Manufacturing.
   3. Sheet Metal Connectors, Inc.
4. Substitutions: Section 016000 - Product Requirements.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

H. Inner Duct: Minimum 0.028-inch solid sheet steel.

I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

A. Manufacturers:
1. Ductmate Industries, Inc.
2. Linx Industries.
4. MKT Metal Manufacturing.
5. SEMCO Incorporated.
6. Sheet Metal Connectors, Inc.
7. Spiral Manufacturing Co. Inc.
8. Stamped Fittings, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers:
1. Linx Industries.
3. MKT Metal Manufacturing.
4. SEMCO Incorporated.
5. Sheet Metal Connectors, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
   b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch solid sheet steel.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2.5 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Factory- or Shop-Applied Antimicrobial Coating:
   1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
   2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
   3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
   4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   5. Shop-Applied Coating Color: Black.
   6. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.

G. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
   1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.
2.6 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

B. Manufacturers:
1. CertainTeed Corporation.
2. Johns Manville.
4. Owens Corning.
5. Substitutions: Section 016000 - Product Requirements.
   a. Maximum Thermal Conductivity:
      1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
      2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

6. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

7. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

C. Flexible, Elastomeric Foam Duct Liner: Preformed, closed-cell, sheet materials complying with ASTM C 534 (Type I - Sheet Grade 1), ASTM D 1056 (2C1), ASTM E 84, NFPA 255, UL 723.

D. Manufacturers:
1. Armacell LLC.
2. Aeroflex USA, Inc.
3. Rubatex International, LLC.
4. Substitutions: Section 016000 - Product Requirements.
5. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
6. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

E. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

F. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.

8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.
   2. Type: S.
   3. Grade: NS.
   5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
   1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
   2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
   3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
   3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.9 SEISMIC-RESTRAINT DEVICES

A. Manufacturers:
   1. B-line
   2. Ductmate Industries, Inc.
   3. Hilti, Inc.
   5. Mason Industries, Inc.
   6. TOLCO
   7. Unistrut
   8. Vibrationa & Seismic Technologies, LLC
   9. Substitutions: Section 01 60 00 - Product Requirements.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by a professional engineer in an agency acceptable to authorities having jurisdiction.
   1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.
PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.


3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.
3. Outdoor, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
4. Outdoor, Exhaust Ducts: Seal Class C.
5. Outdoor, Return-Air Ducts: Seal Class A.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
7. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg Seal Class A.
8. Unconditioned Space, Exhaust Ducts: Seal Class C.
9. Unconditioned Space, Return-Air Ducts: Seal Class B.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
11. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
12. Conditioned Space, Exhaust Ducts: Seal Class B.
13. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
2. Brace a change of direction longer than 12 feet.

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by a professional engineer in an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Set anchors to manufacturer’s recommended torque, using a torque wrench.
5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Leakage Tests:
   2. Test the following systems:
      a. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      b. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      c. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
      d. Outdoor Air Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

B. Supply Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive 1-inch wg.
   b. SMACNA Leakage Class for Rectangular: 12.
   c. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:
   a. Pressure Class: Positive 2-inch wg.
   b. SMACNA Leakage Class for Rectangular: 6.
   c. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative 1-inch wg.
   b. SMACNA Leakage Class for Rectangular: 12.
   c. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.
b. SMACNA Leakage Class for Rectangular: 6.
c. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
   a. Pressure Class: Negative 2-inch wg.
   b. SMACNA Leakage Class for Rectangular: 12.
   c. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. SMACNA Leakage Class for Rectangular: 6.
   c. SMACNA Leakage Class for Round and Flat Oval: 6.

E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
   a. Pressure Class: Positive or negative 1-inch wg.
   b. SMACNA Leakage Class for Rectangular: 12.
   c. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:
   a. Pressure Class: Positive or negative 2-inch wg.
   b. SMACNA Leakage Class for Rectangular: 6.
   c. SMACNA Leakage Class for Round and Flat Oval: 6.

F. Intermediate Reinforcement:

2. PVC-Coated Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Galvanized.

3. Stainless-Steel Ducts:
   a. Exposed to Airstream: Match duct material.
   b. Not Exposed to Airstream: Galvanized.


G. Liner:

1. All rectangular, indoor, exposed air duct located in conditioned space shall be lined with insulation of an equivalent R-value of 2.0 or greater, such as:
c. Fibrous-Glass Liner (ASTM C 1071): 1/2” thick.

2. All rectangular, indoor, exposed air duct located in unconditioned space shall be lined with insulation of an equivalent R-value of 8.0 or greater, such as:

3. All round, indoor exposed air duct located in conditioned space shall be lined with insulation of an equivalent R-value of 2.0 or greater, such as:
   c. Fibrous-Glass Liner (ASTM C 1071): 1/2” thick.

H. Double-Wall Duct Interstitial Insulation:
   1. All round, indoor, exposed duct shall be double wall duct with interstitial insulation. Interstitial liner shall be in accordance with Part 3.11(G)3 above.

I. Elbow Configuration:
   1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Velocity 1000 fpm or Lower:
         1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
      b. Velocity 1000 to 1500 fpm:
         1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
      c. Velocity 1500 fpm or Higher:
         1) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
      a. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
   3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
      a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

J. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
   a. Rectangular Main to Rectangular Branch: 45-degree entry.
   b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
   a. Velocity 1000 fpm or Lower: 90-degree tap.
   b. Velocity 1000 to 1500 fpm: Conical tap.
   c. Velocity 1500 fpm or Higher: 45-degree lateral.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fabric Duct and Accessories

B. Related Requirements:
   1. Section 230548 "Vibration and Seismic Controls for HVAC" for vibration-isolated and restrained ductwork hangers and supports.
   2. Section 230548.13 "Vibration Controls for HVAC" for vibration-isolated ductwork and hangers.
   3. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following products:
   1. Fabric Duct and Accessories

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Duct layout indicating sizes and pressure classes.
   3. Elevation of top of ducts.
   4. Dimensions of main duct runs from building grid lines.
   5. Fittings.
   6. Reinforcement and spacing.
   7. Seam and joint construction.
   8. Penetrations through fire-rated, smoke-rated, and other partitions.
   9. Fire and smoke damper locations.
   10. Equipment installation based on equipment being used on Project.
   11. Hangers and supports, including methods for duct and building attachment[seismic restraints,] and vibration isolation.

C. Delegated-Design Submittal: For nonmetal ducts, signed and sealed by a qualified professional engineer.
   1. Duct materials and thicknesses.
   2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports[and seismic restraints].
5. Design calculations for selecting hangers and supports[and seismic restraints].[Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.]

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, including electrical, plumbing, fire protection, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items provided by all trades mounted on or penetrating finished ceiling.

B. Seismic Qualification Data: Certificates, for nonmetal ducts, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Hanger and Support Welding Qualifications: Qualify procedures and personnel according to the following:


B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including duct closure, reinforcements, and hangers and supports, shall comply with the following and with the Works' performance requirements and design criteria:

1. SMACNA's "Fibrous Glass Duct Construction Standards."
2. SMACNA's "Phenolic Duct Construction Standards."
4. SMACNA's "Thermoset FRP Duct Construction Manual."
5. Static-Pressure Classes:
   a. Supply Ducts (except in Mechanical Rooms): [2-inch wg (500 Pa)]
   b. Supply Ducts (Upstream from Air Terminal Units): [2-inch wg (500 Pa)]
   c. Supply Ducts (Downstream from Air Terminal Units): [1-inch wg (250 Pa)]
   d. Supply Ducts (in Mechanical Equipment Rooms): [2-inch wg (500 Pa)] Return Ducts (Negative Pressure): [1-inch wg (250 Pa)]
   e. Exhaust Ducts (Negative Pressure): [1-inch wg (250 Pa)]

B. Structural Performance: Duct hangers and supports[ and seismic restraints] shall withstand the effects of gravity[ and seismic] loads and stresses within limits and under conditions to comply with [ASCE/SEI 7.][SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1, Section 5.4 - "Airstream Surfaces."

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

2.2 Fabric Duct and Fittings

A. Manufacturer

1. Duct Sox
2. Substitution to be approved by Engineer/Architect

B. Duct Materials: Woven polyester with non-permeable coating, fire retardant in accordance with UL 2518

1. Weight: 5.5 oz/yd^2 per ASTM D3776
2. Air Permeability: 0 CFM/ft² per ASTM D737
3. Integrated air dispersion shall be specified and approved by manufacturer
4. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches to be secured to metal duct via standard fasteners.
5. Inlet connection to include method for easy removal/maintenance
6. Each end cap to include opening method (i.e. zipper) for maintenance
7. Each section shall include identification labels documenting order number, section number, section length, piece number, and other pertinent information.

C. Fabrication:

1. Install system in accordance with requirements of manufacturer

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Zinc-plated steel rods and nuts.
B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
D. Steel Cables: [ASTM A603, galvanized] [ASTM A492, stainless]-steel cables with end connections made of [zinc-plated] [stainless]-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
F. Trapeze and Riser Supports: Steel shapes complying with ASTM A36/A36M.

2.4 SEISMIC-RESTRAINT DEVICES

A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by [an evaluation service member of ICC-ES] [an agency acceptable to authorities having jurisdiction].

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least [four] times the maximum seismic forces to which they will be subjected.
B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
C. Restraint Cables: [ASTM A603, galvanized] [ASTM A492, stainless]-steel cables with end connections made of [zinc plated] [stainless]-steel assemblies with brackets, swivel, and bolts.
designed for restraining cable service; with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E488/E488M.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install duct sections in maximum practical lengths with fewest possible joints.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

E. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

F. Install ducts with a minimum clearance of 1 inch (25 mm), plus allowance for insulation thickness.

G. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

H. Where ducts pass through non-fire-rated interior partitions and exterior walls, and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

I. Install fire[,] combination fire/smoke[,] and smoke dampers where indicated on Drawings and as required by code and by authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the fire damper UL listing.

J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation.[Comply with SMACNA's "IAQ Guidelines for Occupied

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L. Elbows: Use long-radius elbows wherever they fit.
   1. Fabricate 90-degree rectangular mitered elbows to include turning vanes, and 90-degree round elbows with a minimum of three segments for 12 inches (300 mm) and smaller and a minimum of five segments for 14 inches (350 mm) and larger.

M. Branch Connections: Use lateral or conical branch connections.

N. Install fibrous-glass ducts and fittings to comply with [NAIMA AH116, "Fibrous Glass Duct Construction Standards."] [SMACNA's "Fibrous Glass Duct Construction Standards."]

O. Install phenolic-foam ducts and fittings to comply with SMACNA's "Phenolic Duct Construction Standards."

P. Install thermoset FRP ducts and fittings to comply with SMACNA's "Thermoset FRP Duct Construction Manual."

Q. Install PVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

R. Install CPVC ducts and fittings to comply with SMACNA's "Thermoplastic Duct (PVC) Construction Manual."

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for textile duct in accordance with manufacturer’s requirements.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with [SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."] [ASCE/SEI 7.]
1. Space lateral supports a maximum of [40 feet (12 m)] <Insert dimension> o.c., and longitudinal supports a maximum of [80 feet (24 m)] <Insert dimension> o.c.
2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select sizes of components so strength will be adequate to carry present and future static and seismic loads within restraint device capacity.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints where ducts are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by [an evaluation service member of the ICC Evaluation Service] [an agency acceptable to authorities having jurisdiction].

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and water and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque, using a torque wrench.
   5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.4 FIELD QUALITY CONTROL

A. Leakage Tests:
   2. Where static pressure and leakage values shown below differ from those in the SMACNA manual, the more stringent values shall apply.
   3. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections[, selected by Architect from sections installed,] totaling no less than 25 percent of total installed duct area for each designated pressure class.
      b. Supply Ducts with a Pressure Class of [2-Inch wg (500 Pa)] [3-Inch wg (750 Pa)] [4-Inch wg (1000 Pa)] or Higher: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than [50] [100] percent of total installed duct area for each designated pressure class.
c. Return Ducts with a Pressure Class of [2-Inch wg (500 Pa)] [3-Inch wg (750 Pa)] [4-Inch wg (1000 Pa)] or Higher: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than [50] [100] percent of total installed duct area for each designated pressure class.

d. Exhaust Ducts with a Pressure Class of [2-Inch wg (500 Pa)] [3-Inch wg (750 Pa)] [4-Inch wg (1000 Pa)] or Higher: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than [50] [100] percent of total installed duct area for each designated pressure class.

e. Outdoor Air Ducts with a Pressure Class of [2-Inch wg (500 Pa)] [3-Inch wg (750 Pa)] [4-Inch wg (1000 Pa)] or Higher: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than [50] [100] percent of total installed duct area for each designated pressure class.

4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

5. Test for leaks before applying external insulation.

6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

7. Give [seven] days' advance notice for testing.

B. Duct System Cleanliness Tests:

1. Test protocols shall be performed according to NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems," "Section 5 - Cleanliness Verification and Documentation."

2. Visually inspect duct system to ensure that no visible contaminants are present.

3. Test sections of fibrous-glass duct system chosen randomly by Owner for cleanliness according to "Method 2 Protocol."

4. Test sections of Phenolic-foam, Thermoset FRP, PVC, and CPVC duct systems chosen randomly by Owner, for cleanliness according to "Method 3 - NADCA Vacuum Test."

   a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 DUCT CLEANING

A. Clean duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch duct as recommended by duct manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:
1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:
1. All duct cleaning shall be performed according to NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of ducts or duct accessories.
4. Clean fibrous-glass duct with HEPA vacuuming equipment; do not permit duct to get wet. Replace fibrous-glass duct that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for washdown procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removing surface deposits and debris.
3.6 STARTUP SERVICE

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION
SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
4. Control dampers.
5. Flange connectors.
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
10. Duct accessory hardware.

B. Related Requirements:

1. Section 233113 "Metal Ducts" for insulated metal ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

   a. Special fittings.
   c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION


B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Mill phosphatized.
B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 2 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Description: Gravity balanced.

B. Maximum Air Velocity: 1250 fpm.

C. Maximum System Pressure: 2-inch wg.

D. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, 0.094-inch-thick, galvanized sheet steel, 0.063-inch-thick extruded aluminum, 0.03-inch-thick stainless steel, or 0.05-inch-thick stainless steel, with welded corners or mechanically attached and mounting flange.

E. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum or 0.050-inch-thick aluminum sheet with sealed edges.

F. Blade Action: Parallel.

G. Blade Seals: Neoprene, mechanically locked.

H. Blade Axles:
   1. Material: Galvanized steel, Stainless steel or Aluminum.
   2. Diameter: 0.20 inch.

I. Tie Bars and Brackets: Aluminum or Galvanized steel.

J. Return Spring: Adjustable tension.

K. Bearings: Steel ball or synthetic pivot bushings.

L. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
a. Sleeve Thickness: 20 gage minimum.
b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.
7. Screen Material: Galvanized steel or Aluminum.
8. Screen Type: Bird and Insect.
9. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Suitable for horizontal or vertical mounting.
B. Maximum Air Velocity: 1250 fpm.
C. Maximum System Pressure: 2-inch wg.
D. Frame: Hat-shaped, 0.05-inch-thick, galvanized sheet steel, 0.094-inch-thick, galvanized sheet steel, 0.063-inch-thick extruded aluminum, 0.03-inch-thick stainless steel, or 0.05-inch-thick stainless steel, with welded corners or mechanically attached and mounting flange.
E. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum or 0.050-inch-thick aluminum sheet with sealed edges.
F. Blade Action: Parallel.
G. Blade Seals: Neoprene, mechanically locked.
H. Blade Axles:
   1. Material: Galvanized steel, Stainless steel or Aluminum.
   2. Diameter: 0.20 inch.
I. Tie Bars and Brackets: Aluminum or Galvanized steel.
J. Return Spring: Adjustable tension.
K. Bearings: Steel ball or synthetic pivot bushings.
L. Accessories:
   1. Flange on intake.
   2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Standard leakage rating, with linkage outside airstream.
   2. Suitable for horizontal or vertical applications.
   3. Frames:
a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel or 0.05-inch-thick stainless steel.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized or Stainless-steel, 0.064 inch thick.

5. Blade Axles: Galvanized steel or Stainless steel Nonferrous metal.

6. Bearings:
   a. Stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:
   1. Standard leakage rating, with linkage outside airstream.
   2. Suitable for horizontal or vertical applications.
   3. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
   4. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
      e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

5. Blade Axles: Galvanized steel or Stainless steel.

6. Bearings:
   a. Stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:
   1. Comply with AMCA 500-D testing for damper rating.
   2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat shaped.
b. 0.094-inch-thick, galvanized sheet steel or 0.05-inch-thick stainless steel.
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized or Stainless, roll-formed steel, 0.064 inch thick.

7. Bearings:
   a. Stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

10. Tie Bars and Brackets: Galvanized steel or Aluminum.
11. Accessories:
   a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Comply with AMCA 500-D testing for damper rating.
2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
   d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

7. Bearings:
   a. Stainless-steel sleeve.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Jamb Seals: Cambered Stainless Steel or Aluminum.
10. Tie Bars and Brackets: Galvanized steel or Aluminum.
11. Accessories:
a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:
   2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
   3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:
   2. Include center hole to suit damper operating-rod size.
   3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Manufacturers
   1. American Warming and Ventilating.
   2. Arrow United Industries.
   3. Cesco Products.
   5. Greenheck Fan Corporation.
   7. McGill AirFlow LLC.
   8. Metal Form Manufacturing, Inc.
   10. NCA Manufacturing, Inc.
   11. Pottorff.
   12. Ruskin Company.
   13. Vent Products Co., Inc

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:
   1. Hat shaped.
   2. 0.094-inch-thick, galvanized sheet steel or 0.05-inch-thick stainless steel.
   3. Mitered and welded corners.

D. Blades:
   1. Multiple blade with maximum blade width of 6 inches.
   2. Opposed-blade design.
   3. Galvanized-steel, Stainless steel or Aluminum.
4. 0.064 inch thick single skin or 0.0747-inch-thick dual skin.
5. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; galvanized steel or stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
   1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:
   1. Stainless-steel sleeve.
   2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   3. Thrust bearings at each end of every blade.

2.7 FLANGE CONNECTORS
A. Manufacturers
   1. CL Ward & Family Inc.
   2. Ductmate Industries, Inc.
   3. Hardcast, Inc.
   4. Nexus PDQ
   5. Ward Industries
B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
C. Material: Galvanized steel.
D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES
A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.
2.9 REMOTE DAMPER OPERATORS

A. Description: Cable system designed for remote manual damper adjustment.
B. Tubing: Copper or Aluminum.
C. Cable: Stainless steel or Steel.
D. Wall-Box Mounting: Recessed where possible. Surface everywhere else.
E. Wall-Box Cover-Plate Material: Stainless steel.

2.10 DUCT-MOUNTED ACCESS DOORS


1. Door:
   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. Vision panel.
   d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

B. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
2.11 DUCT ACCESS PANEL ASSEMBLIES

A. Labeled according to UL 1978 by an NRTL.

B. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

C. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

D. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

E. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.12 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Compliance with ASHRAE/IESNA 90.1-2004 includes Section 6.4.3.3.3 - "Shutoff Damper Controls," restricts the use of backdraft dampers, and requires control dampers for certain applications. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

I. Connect ducts to duct silencers with flexible duct connectors.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
2. Upstream and downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot spacing.
8. Upstream and downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.

M. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

Q. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

S. Install duct test holes where required for testing and balancing purposes.

T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.
3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Insulated flexible ducts.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For flexible ducts.
   1. Include plans showing locations and mounting and attachment details.

1.4 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION
B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. JP Lamborn Co.
3. McGill AirFlow LLC.
4. Thermaflex; a Flex-Tek Group company.
5. Ward Industries; a brand of Hart & Cooley, Inc.
6. Substitutions: Section 016000 – Product Requirements

B. Insulated, Flexible Duct: UL 181, Class 1, two-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-Value: Comply with ASHRAE/IES 90.1.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

B. Non-Clamp Connectors: Adhesive plus sheet metal screws.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts directly or with maximum lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

F. Install duct test holes where required for testing and balancing purposes.
G. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Centrifugal Exhaust Fans.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes.
6. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fans, include manufacturer’s published operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.

B. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans in accordance with AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
C. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

D. ASHRAE Compliance:
   1. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 CENTRIFUGAL FANS

A. Ratings: See schedule on drawings.
B. Description: Roof Mounted on curb, centrifugal exhaust fan. Belt or Direct drive as specified.
C. Fan Wheel: Backward inclined centrifugal type.
D. Motor and Drive Mounting: Out of air stream.
E. Motor: Open drip-proof type mounted on vibration isolators.
F. Bearings: ABMA 9 life at 200,000 hours.
G. Accessories:
   1. Belt guard.
   2. Motor cover.
   3. Disconnect switch: NEMA 250 Type 1.
   4. Flanged inlet and outlet.
   5. Fan speed controller.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb.
B. Install fans in accordance with manufacturer’s instructions.
C. Install units with adequate clearances for service and maintenance.
D. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
E. Verify existing conditions compatible with new fans
3.2 ELECTRICAL CONNECTIONS
   A. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
   B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

3.3 ADJUSTING
   A. Adjust damper linkages for proper damper operation.
   B. Adjust exhaust fans to function properly
   C. Adjust belt tension.
   D. Lubricate bearings.
   E. Adjust drive for final system balancing
   F. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.4 CLEANING
   A. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

3.5 PROTECTION
   A. Protect installed product and finished surfaces from damage during construction
   B. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion

END OF SECTION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Rectangular and square ceiling diffusers.
   2. Perforated diffusers.
   3. Louver face diffusers.

B. Related Requirements:
   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Actual size of smallest diffuser indicated.

C. Samples for Initial Selection: For diffusers with factory-applied color finishes. Actual size of smallest diffuser indicated.

D. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected. Actual size of smallest diffuser indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers:
   1. Titus (Basis of Design).
   2. Krueger.
   3. Hart & Cooley Inc.
   5. Nailor Industries, Inc.
   7. Tuttle & Baily
   8. Substitutions: Section 016000 - Product Requirements.

B. Material: Aluminum.

C. Finish: Baked enamel, color selected by Architect.

D. Face Size: As indicated in Schedule.

E. Mounting: As indicated in Schedule.

F. Pattern: Adjustable.

G. Accessories:
   1. Equalizing grid.
   2. Plaster ring.
   4. Wire guard.
   5. Sectorizing baffles.
   6. Operating rod extension.

2.2 ROUND CEILING DIFFUSERS

A. Manufacturers:
   1. Titus.
   2. Krueger.
   3. Hart & Cooley Inc.
5. Nailor Industries, Inc.
7. Tuttle & Baily
8. Substitutions: Section 016000 - Product Requirements.

B. Material: Steel.

C. Finish: Baked enamel, color selected by Architect.

D. Face Size: As indicated in Schedule.

E. Mounting: As indicated in Schedule.

F. Pattern: 360 degree.

G. Accessories:
   1. Equalizing grid.
   2. Plaster ring.
   4. Wire guard.

2.3 PERFORATED DIFFUSERS AND GRILLES

A. Manufacturers:
   1. Titus.
   2. Krueger.
   3. Hart & Cooley Inc.
   5. Nailor Industries, Inc.
   7. Tuttle & Baily
   8. Substitutions: Section 016000 - Product Requirements.

B. Material: Aluminum.

C. Finish: Baked enamel, color selected by Architect.

D. Face Size: As indicated in Schedule.

E. Duct Inlet: As indicated in Schedule.

F. Mounting: As indicated in Schedule.

G. Accessories:
   1. Equalizing grid.
   2. Plaster ring.
   4. Wire guard.
   5. Operating rod extension.
2.4 LOUVER FACED DIFFUSERS AND GRILLES

A. Manufacturers:
1. Titus.
2. Krueger.
3. Hart & Cooley Inc.
5. Nailor Industries, Inc.
7. Tuttle & Baily
8. Substitutions: Section 016000 - Product Requirements.

B. Material: Aluminum.

C. Finish: Baked enamel, color selected by Architect.

D. Face Size: As indicated in Schedule.

E. Mounting: As indicated in Schedule.

F. Pattern: As indicated in Schedule.

G. Accessories:
   1. Square to round neck adaptor (if required).
   2. Adjustable pattern vanes.
   3. Throw reducing vanes.
   4. Equalizing grid.
   5. Plaster ring.
   7. Wire guard.
   8. Sectorizing baffles.
   9. Operating rod extension.

2.5 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Packaged rooftop air conditioning units.
   2. Seismic isolation stands as specified in section 23 05 48.

B. Related Sections:
   1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Vibration isolators.
   2. Section 23 09 93 - Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.
   4. Section 23 33 00 - Air Duct Accessories: Flexible connections.
   5. Section 25 50 00 - Integrated Automation Facility Controls: Control system remote from unit.
   6. Section 26 05 03 - Equipment Wiring Connections: Electrical connection to units.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:
   1. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

B. Air Movement and Control Association International, Inc.:
   1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

D. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA MG 1 - Motors and Generators.

E. National Fire Protection Association:
1.3 DEFINITIONS

A. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.

B. Integrated Part-Load Value (IPLV): Single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on basis of weighted operation at various load capacities for the equipment.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data indicating:
   1. Cooling and heating capacities.
   2. Dimensions.
   3. Weights.
   4. Rough-in connections and connection requirements.
   5. Duct connections.
   6. Electrical requirements with electrical characteristics and connection requirements.
   7. Controls.
   8. Accessories.

C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Manufacturer’s Field Reports: Submit start-up report for each unit.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Cooling Capacity: Rate in accordance with ARI 340/360.

B. Sound Rating: Measure in accordance with ARI 270.

C. Insulation and adhesives: Meet requirements of NFPA 90A.
D. Minimum heating efficiency: as scheduled on drawing sheets.
E. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.7 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing Work of this section with minimum three years documented experience and/or approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS
A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING
A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
B. Accept units on site. Inspect for damage.
C. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.10 COORDINATION
A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
B. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

1.11 WARRANTY
A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
B. Furnish five-year manufacturers warranty for compressors.
C. Furnish five-year manufacturers warranty for heat exchangers.

1.12 MAINTENANCE SERVICE
A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
B. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and
maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

1.13 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish one set of fan belts for each unit.

C. Furnish one set of disposable filters for each unit.

PART 2 PRODUCTS

2.1 PACKAGED ROOFTOP UNITS

A. Manufacturer Base of Design: AAON

B. Other Acceptable Manufacturers:
   1. Daikin.
   2. Carrier.
   3. Trane.
   4. Substitutions as approved.

C. Configuration: Fan and coil section plus scheduled accessories, including, but not exclusive to:
   1. DX Cooling coil section.
   2. Gas-Fired Heating coil.
   3. Filter section.
   4. Economizer
   5. Energy recovery wheel.

D. Fabrication: Conform to AMCA 99 and ARI 430.

E. Seismic Rated Isolation Stand:
   1. Seismic Rated Vibration Isolation Stand per Section 23 05 48.
   2. Unit with factory assembled full-perimeter support frame for sealed attachment to vibration isolation curb.
   4. Furnish supply and return opening duct frames as part of curb structure allowing duct connections to be made directly to unit curb vertical sleeves.
   5. Furnish gaskets for field mounting.
   6. Vibration isolation manufacturer shall furnish integral structural steel base to be supported on SLR or SLRSO Mountings as described in Specification 25 05 48. All perimeter members shall be constructed of structural tubing with a minimum width equal to 1 3/8". Steel members shall be selected to keep deflection and misalignment within acceptable limits as determined by the manufacturer. Unit shall be supported on all sides and fully overhang the base. Base shall be
positively attached to SLR or SLRSO mount to resist seismic loads. Incorporate minimum 6” spacer tubes to provide adequate clearances between underside of unit and top of mount. Basis of design shall be type RSLRSO as manufactured by Mason Industries, Inc.

F. CASING
1. Channel base and drain pan support of structural steel. Assemble sections with gaskets and bolts.
2. Outside Casing with Finish: Baked enamel, Inside Casing to enclose insulation.
3. Insulation: Neoprene coated, glass fiber, applied to internal surfaces with adhesive and weld pins with exposed edges of insulation coated. Density: 1 inch thick minimum, 1-1/2lbs/cu ft.
4. Inspection/Access Doors: galvanized steel for flush mounting, with gasket, latch, and handle assembly.
5. Drain Pans: Double thickness stainless steel with welded corners or non-corroding material. Cross break and pitch to drain connection. Furnish drain pans under heating coil section and cooling coil section.
6. Strength: Furnish structure to brace casings for suction pressure expected, with maximum deflection of 1 in 200.
7. Louvers: Stationary, of galvanized steel, with plenum, 1/2 inch mesh, 0.04 inch galvanized wire bird screen in galvanized frame, and bearing AMCA Certified Ratings Seal in accordance with AMCA 500.

G. FANS
1. Type: double width, double inlet, centrifugal type fan.
3. Sound Ratings: AMCA 301, tested to AMCA 300.
4. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings.
5. Mounting: Locate fan and motor internally on welded steel base coated with corrosion resistant paint. Factory mount motor on slide rails. Furnish access to motor, drive, and bearings through removable casing panels or hinged access doors. Mount base on vibration isolators.

H. BEARINGS AND DRIVES
1. Bearings: Pillow block type, self-aligning, grease-lubricated ball bearings with grease fittings, with ABMA 9 L-10 life at 50,000 hours.
2. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves for motors 15 hp and under selected so required rpm is obtained with sheaves set at mid-position; fixed sheave for 20 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
4. Belt Guard: Fabricate to SMACNA Standard; 0.106 inch thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

I. COILS
1. Casing with access to both sides of coils.
2. Eliminators: stainless steel, mounted over drain pan.
3. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.
4. Tubes: seamless copper expanded into fins, brazed joints.
5. Fins: Aluminum.
8. Liquid Distributors: Brass or copper venturi distributor with seamless copper distributor tubes.
11. The hot gas heat is piped to the refrigerant circuit including a three-way hot gas diverting valve, check valve and liquid drain solenoid valve.

J. FILTERS
1. 4” Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates.
2. Filter Media: UL 900 listed, Class I.
3. All Filters must have a minimum MERV 13 Rating.

K. DAMPERS
1. Damper Leakage: Maximum 4 percent at 4 inch wg differential pressure when sized for 2000 fpm face velocity.
2. Damper Actuators: Furnish factory installed electronic damper actuators for outside air, return air, and exhaust air dampers.

L. CONTROLS
1. Unit Controller and related sensors as indicated on Drawings, shall perform the Sequence of Operations noted in Section 230993.
2. Provide factory options as required for low ambient cooling.
3. Onboard controls shall include:
   a. Coil Freeze Protection: Provide low limit thermostat in supply air to close outside air dampers and stop supply fan.
   b. Provide auxiliary contacts as required for supply duct smoke detector control module provided by fire alarm contractor, under provisions of Section 28 31 00.
   c. All factory hardware, options, safeties, and related equipment to ensure a complete and functioning system.
   d. 24 volt AC contactor for compressor control.
   e. Terminal strip.
f. Safety lockout relay to prevent cycling of compressor during adverse conditions of operation. Capable of being reset at remote thermostat or zone sensor or by cycling power to unit.
g. High pressure switch.
h. Low pressure switch.

M. CAPACITIES:
1. As scheduled on drawing sheets.

N. CURB:
1. Seismic Rated Mason RSC Curb (or equivalent to be approved by engineer) with acoustical package, per specification Section 23 05 48.

O. ELECTRICAL CHARACTERISTICS AND COMPONENTS
1. Electrical Characteristics: In accordance with Section 26 05 03 and as scheduled on drawings: See schedule M-601
2. 208 volts, three phase, 60 Hz.
3. Provide transformer on line-side of power supply with separate fuse protection wired to 120V GFI protected convenience receptacle in unit control section.
4. Coordinate with electrical trade to have power for injection pump extended from separate circuit to injection pump with relay as needed such that pump runs automatically upon compressor operation. Pump shall have dedicated service disconnect toggle switch within 36” of pump.
5. Disconnect Switch: Factory mount, field wired on equipment from concealed curb entry.

PART 3 EXECUTION

3.1 EXAMINATION
A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
B. Verify roof curbs are installed and dimensions are as instructed by manufacturer.

3.2 INSTALLATION
A. Roof Curb: Install units on seismic rated vibration isolation curb or equivalent supports. Refer to Section 23 05 48.
   1. Assemble roof curb.
   2. Install roof curb level.
   3. Coordinate curb installation and flashing.
   4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
   5. Install gasket material between unit base and roof curb.
B. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.
C. Install condensate piping with trap and route from drain pan to nearest roof drain. Refer to Section 23 21 13.

D. Install components furnished loose for field mounting.

E. Install electrical devices furnished loose for field mounting.

F. Install control wiring between unit and field installed accessories.

G. Remove from roof and dispose off-site panels removed from units during installation of economizer and dampers.

H. Provide sheaves for constant volume belt drive fans as required for final air balance.

3.3 INSTALLATION - NATURAL GAS HEATING SECTION

A. Connect natural gas piping in accordance with NFPA 54.

B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.

C. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23. Install natural gas piping accessories above roof.
   1. Provide requirements to other trades and coordinate to ensure regulator (by others) is selected for utility/trunk pressure to supply final pressure and capacity meeting manufacturer’s gas train requirements.
   2. Install strainer, pressure gage, shutoff valve, pressure reducing valve.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer’s field services.

B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

C. Furnish services of factory trained representative for minimum of two days to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.5 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Vacuum clean coils and inside of cabinets.

C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.
3.6 DEMONSTRATION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

B. Demonstrate unit operation and maintenance.

C. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.7 SCHEDULES - See drawings for packaged outdoor unit schedule.

END OF SECTION
SECTION 23 81 03
PACKAGED ROOFTOP AIR CONDITIONING UNITS - SMALL CAPACITY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Packaged rooftop air conditioning unit.

B. Related Sections:
   1. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment: Vibration isolators.
   3. Section 23 33 00 - Air Duct Accessories: Flexible connections.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:
   1. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

B. Air Movement and Control Association International, Inc.:
   1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

D. ASTM International:

E. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA MG 1 - Motors and Generators.

F. National Fire Protection Association:

1.3 DEFINITIONS

A. Energy Efficiency Ratio (EER) - Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.
B. Integrated Part-Load Value (IPLV): Single-number figure of merit based on part-load EER, COP, or kW/ton expressing part-load efficiency for air-conditioning and heat pump equipment on basis of weighted operation at various load capacities for the equipment.

1.4 SUBMITTALS

A. Product Data: Submit data indicating:
   1. Cooling and heating capacities.
   2. Dimensions.
   3. Weights.
   4. Rough-in connections and connection requirements.
   5. Duct connections.
   6. Electrical requirements with electrical characteristics and connection requirements.
   7. Controls.
   8. Accessories.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of controls installed remotely from units.

B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

A. Cooling Capacity: Rate in accordance with ARI 340/360.

B. Sound Rating: Measure in accordance with ARI 270.

C. Insulation and adhesives: Meet requirements of NFPA 90A.

D. Minimum heating efficiency: 80 percent.

E. Performance Requirements: Conform to minimum EER prescribed by ASHRAE 90.1 when tested in accordance with ARI 340/360.

F. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Accept units on site. Inspect for damage.

B. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.8 COORDINATION

A. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.
1.9 WARRANTY

A. Furnish five year manufacturers warranty for compressors.
B. Furnish five year manufacturers warranty for heat exchangers.

1.10 MAINTENANCE SERVICE

A. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer’s operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.

PART 2 PRODUCTS

2.1 ROOFTOP AIR CONDITIONING UNITS

A. Manufacturers:
   1. Aaon.
   2. Daikin.
   3. Valient.
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Product Description: Self-contained, packaged, factory assembled and wired, consisting of cabinet, supply fan, variable frequency drive, evaporator coil, compressor, refrigeration circuit, condenser, gas-fired heating section, air filters, outdoor air section, exhaust-return section, and controls.

C. Configuration: Downflow air delivery.

D. Roof Mounting Curb: Refer to Section 23 05 48.

E. Cabinet:
   1. Designed for outdoor installation with weatherproof construction.
   2. Panels: Galvanized steel with baked enamel. Furnish hinged access doors with handles and rubber gaskets at edges.
   3. Insulation: Factory applied to exposed vertical panels, horizontal panels, and access doors. 2 inch thick, 1.5 pound per cubic foot density, glass fiber with edges protected from erosion.
   4. Interior Surfaces: Sheet metal lined creating double wall construction.

F. Supply Fan:
   1. Fan: Backward inclined airfoil type, statically and dynamically balanced, resiliently mounted.
   2. Fan Drive: VFD direct drive type, Cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Furnish solid shaft construction. Select Variable and adjustable pitch motor sheave to obtain required rpm with sheaves set at mid-position as recommended by manufacturer.
3. Fan motor: Three phase, NEMA MG1, Design B, continuously rated at 40 degrees C, open drip-proof high efficiency, open drip-proof NEMA T frame, with permanently lubricated bearings and integral overload protection.


G. Supply Fan Modulation:
   1. Variable Frequency Drive:
      a. Furnished for supply fan and return fan.
      b. Factory installed, wired, and tested.
      c. With bypass.
      d. Full digital control.
      e. Insulated Gate Bi-Polar Transistors used to produce output pulse width modulation waveform allowing quiet operation.
      f. NEMA 250 Type 1 enclosure.
      g. Self diagnostics.
      h. Proportional-integral-derivative setpoint control.
      i. Communication port.
      j. Electronic thermal overload protection.
   2. Controlled from duct static pressure by unit mounted controller. Static pressure sensed by duct mounted sensor.
   3. Furnish field adjustable duct high limit safety control to protect duct work from excessive duct pressure.

H. Evaporator Coil:
   1. Constructed of seamless copper tubes mechanically expanded into aluminum fins. Factory leak tested under water.
   2. Galvanized drain pan and piping connection.
   3. Furnish for multiple circuited units alternate row circuiting.

I. Compressors:
   1. Hermetically sealed, resiliently mounted with positive lubrication, and internal motor overload protection.
   2. Furnish each compressor with independent refrigeration circuit.
   3. Furnish external vibration isolators.
   4. Furnish short cycle protection.

J. Refrigeration circuit:
   1. Dehydrate and factory charge each circuit with oil and refrigerant.
   2. Furnish the following for each circuit:
      a. Thermostatic expansion device.
      b. Filter-drier.
      c. Suction, discharge, and liquid line service valves with gauge ports.
      d. Sight glass.
      e. High and low pressure safety controls.
   3. Furnish capacity control by hot gas bypass.

K. Condenser:
1. Constructed of copper tubing mechanically bonded to aluminum fins with sub-cooling rows. Factory leak tested under water.
3. Furnish factory installed coil guard.

L. Gas-Fired Heating Section:
   1. Fuel: Natural gas.
   3. Gas Burner: Induced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.

M. Air Filters: 2 inch thick glass fiber disposable media in metal frames.

N. Outdoor Air Section:
   1. Economizer: Provide economizer components and controls in accordance with ICC IECC. Furnish fully integrated factory installed fully modulating from 0 to 100 percent outside air economizer. Economizer operation through microprocessor based primary temperature controls automatically modulate dampers to maintain space temperature conditions.
      a. Furnish economizer with differential enthalpy control.
      b. Furnish adjustable minimum position control located remotely in space.
      c. Furnish spring return motor for outside air damper closure during unit shutdown or power interruption.

O. Exhaust and Return Section:

P. Controls: Microprocessor based controls, factory mounted with the following features:
   1. Variable Air Volume Controls: To operate VAV rooftop from supply air temperature including supply air sensor, and variable frequency drive. Microprocessor coordinates economizer control and stages of cooling with supply air temperature reset capability based upon outdoor air temperature.
   2. Control Functions: Furnish the following:
      a. Unit scheduling.
      b. Occupied-unoccupied mode.
      c. Start-up and coast-down modes.
      d. Nighttime free-cool purge mode.
      e. Demand limiting.
      f. Night setback.
      g. Timed override.
      h. Alarm shutdown.
      i. Discharge air set point adjustment.
      j. Static pressure setpoint adjustment.
3. Furnish the following setpoints and diagnostic functions accessible in unit control panel:
   a. Unit operating mode.
   b. Unit failure status.
   c. Supply fan start-stop.
   d. Supply fan status.
   e. Supply fan inlet guide vane position.
   f. Supply fan variable frequency drive percent.
   g. Return fan start-stop.
   h. Return fan status.
   i. Return fan inlet guide vane position.
   j. Return fan variable frequency drive percent.
   k. Exhaust fan start-stop.
   l. Exhaust fan status.
   m. Exhaust fan variable frequency drive percent.
   n. Supply air temperature.
   o. Supply air temperature high-low limit with alarm.
   p. Return air temperature.
   q. Return air temperature high-low limit with alarm.
   r. Mixed air temperature.
   s. Mixed air temperature high-low limit with alarm.
   t. Duct static pressure.
   u. Duct static pressure high-low limit with alarm.
   v. Cooling control.
   w. Cooling status - all stages.
   x. Heating control.
   y. Heating status.
   z. Number of stages activated.
   aa. Damper control.
   bb. Economizer status.
   cc. Requested minimum position.
   dd. Damper positions.
   ee. Space temperature.
   ff. Space temperature high-low limit with alarm.
   gg. Filter status.
   hh. Smoke detector status.
   ii. Outside air temperature.
   jj. Outside relative humidity.

4. Indoor Air Quality Control: Furnish demand ventilation control through economizer with carbon dioxide sensor. Sensor adjustable wall mounted.

Q. Accessories:
      Factory wired from transformer internal to unit.
   2. All other accessories as scheduled.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical Characteristics: In accordance with Section 26 05 03 and the following:
   1. 208 volts, three phase, 60 Hz.
B. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof curbs are installed and dimensions are as shown on shop drawings.

3.2 INSTALLATION

A. Roof Curb:
   1. Assemble roof curb.
   2. Install roof curb level.
   3. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
   4. Install gasket material between unit base and roof curb.

B. Install units on vibration isolators. Refer to Section 23 05 48.

C. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.

D. Install condensate piping with trap and route from drain pan to splash block on roof.

E. Install components furnished loose for field mounting.

F. Install electrical devices furnished loose for field mounting.

G. Install control wiring between unit and field installed accessories.

H. Remove from roof and dispose off-site panels removed from units during installation of economizer.

3.3 INSTALLATION - NATURAL GAS HEATING SECTION

A. Connect natural gas piping in accordance with NFPA 54.

B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.

C. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23.
   1. Strainer.
   2. Pressure gage.
   4. Pressure reducing valve.

D. Install natural gas piping accessories above roof.
3.4 MANUFACTURER'S FIELD SERVICES

A. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

B. Furnish services of factory trained representative for minimum of one day to leak test, refrigerant pressure test, evacuate, dehydrate, charge, start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.5 CLEANING

A. Vacuum clean coils and inside of cabinets.

B. Install new throwaway filters in units at Substantial Completion.

3.6 DEMONSTRATION

A. Demonstrate unit operation and maintenance.

B. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

END OF SECTION
SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes building wire and cable and wiring connectors and connections.

B. Related Sections:

1.2 REFERENCES

A. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:
   1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
   2. Stranded conductors for control circuits.
   3. Conductor not smaller than 12 AWG for power and lighting circuits.
   4. Conductor not smaller than 16 AWG for control circuits.
   5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.

B. Wiring Methods: Provide the following wiring methods:
   1. Exterior Locations: Use only building wire, Type THHN/THWN XHHW insulation, in raceway.

1.4 DESIGN REQUIREMENTS

A. Conductor sizes are based on copper.

1.5 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit for building wire and each cable assembly type.

C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.

D. Test Reports: Indicate procedures and values obtained.
1.6 FIELD MEASUREMENTS
   A. Verify field measurements are as indicated on Drawings.

PART 2 PRODUCTS

2.1 BUILDING WIRE
   A. Manufacturers:
      1. AETNA
      2. American Insulated Wire Corp.
      3. Colonial Wire
      4. Encore Wire
      5. General Cable Co.
      6. Republic Wire
      7. Rome Cable
      8. Service Wire Co.
      9. Southwire
     10. Superior Essex
     B. Product Description: Single conductor insulated wire.
     C. Conductor: Copper.
     D. Insulation Voltage Rating: 600 volts.
     E. Insulation Temperature Rating: 75 degrees C.
     F. Insulation Material: Thermoplastic

2.2 TERMINATIONS
   A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
   B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify interior of building has been protected from weather.
   B. Verify mechanical work likely to damage wire and cable has been completed.
   C. Verify raceway installation is complete and supported.
3.2 PREPARATION
A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK
A. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified.
B. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION
A. Route wire and cable to meet Project conditions.
B. Neatly train and lace wiring inside equipment.
C. Special Techniques--Building Wire in Raceway:
   1. Pull conductors into raceway at same time.
   2. Install building wire 4 AWG and larger with pulling equipment.
D. Special Techniques - Wiring Connections:
   1. Clean conductor surfaces before installing lugs and connectors.
   2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
   3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
   4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
   5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
   6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.5 FIELD QUALITY CONTROL
A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.END OF SECTION
PART 1 GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Rod electrodes.
   2. Wire.
   3. Mechanical connectors.
   4. Exothermic connections.

1.2 REFERENCES
A. Institute of Electrical and Electronics Engineers:
   2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.
B. International Electrical Testing Association:
C. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION
A. Grounding systems use the following elements as grounding electrodes:
   1. Rod electrode.

1.4 PERFORMANCE REQUIREMENTS
A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS
A. Division 01 - Submittal Procedures: Requirements for submittals.
B. Product Data: Submit data on grounding electrodes and connections.
C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
D. Manufacturer's Installation Instructions: Submit for active electrodes.
1.6 CLOSEOUT SUBMITTALS
A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE
A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.9 COORDINATION
A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 PRODUCTS

2.1 ROD ELECTRODES
A. Manufacturers:
   1. Erico, Inc.
   2. O-Z Gedney Co.
   3. Thomas & Betts, Electrical
B. Product Description:
   1. Material: Copper.
   2. Diameter: 3/4 inch
   3. Length: 10 feet.
C. Connector: Connector for exothermic welded connection. U-bolt clamp.

2.2 WIRE
A. Material: Stranded copper.
B. Grounding Electrode Conductor: Copper conductor bare.
C. Bonding Conductor: Copper conductor bare.
2.3 MECHANICAL CONNECTORS
A. Manufacturers:
   1. Erico, Inc.
   2. ILSCO Corporation
   3. O-Z Gedney Co.
   4. Thomas & Betts, Electrical
B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS
A. Manufacturers:
   1. Copperweld, Inc.
   2. ILSCO Corporation
   3. O-Z Gedney Co.
   4. Thomas & Betts, Electrical
B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION
3.1 EXAMINATION
A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION
A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.3 EXISTING WORK
A. Modify existing grounding system to maintain continuity to accommodate renovations.
B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

3.4 INSTALLATION
A. Install in accordance with IEEE 142 & 1100
B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
C. Install grounding and bonding conductors concealed from view.
D. Install AWG bare copper wire in foundation footing as indicated on Drawings.

E. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.

F. Bond together metal siding not attached to grounded structure; bond to ground.

G. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.

H. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

I. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

J. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

K. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.

L. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

M. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

N. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground resistance testing in accordance with IEEE 142.

D. Perform leakage current tests in accordance with NFPA 99.
E. Perform continuity testing in accordance with IEEE 142.

F. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION
SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Conduit supports.
   2. Formed steel channel.

1.2 REFERENCES

A. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.
B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
C. Product Data:
   1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
E. Manufacturer’s Installation Instructions:
   1. Hangers and Supports: Submit special procedures and assembly of components.
F. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer’s identification.
B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

A. Manufacturers:
1. Allied Tube & Conduit Corp.
2. Electroline Manufacturing Company
3. O-Z Gedney Co.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self locking.

2.2 FORMED STEEL CHANNEL

A. Manufacturers:
   1. Allied Tube & Conduit Corp.
   2. B-Line Systems
   3. Midland Ross Corporation, Electrical Products Division
   4. Unistrut Corp.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.3 SPRING STEEL CLIPS

A. Product Description: Mounting hole and screw closure.

PART 3 EXECUTION

3.1 PREPARATION

A. Do not drill or cut structural members.

3.2 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:
   1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
   2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
   3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
   5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
   7. Wood Elements: Provide wood screws.
B. Inserts:
   1. Install inserts for placement in concrete forms.
   2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:
   1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
   2. Install surface mounted cabinets and panelboards with minimum of four anchors.
   3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
   4. Support vertical conduit at every other floor.

3.3 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION
SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Conduit and tubing, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 29 - Hangers and Supports for Electrical Systems.
   3. Section 26 05 53 - Identification for Electrical Systems.
   4. Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

A. National Electrical Manufacturers Association:
   1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
   2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and
      Cable Assemblies.
   3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box
      Supports.
   4. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
   5. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for
   splices, taps, wire pulling, equipment connections, and compliance with regulatory
   requirements. Raceway and boxes are shown in approximate locations unless
dimensioned. Provide raceway to complete wiring system.

B. Underground outside Foundation Wall: Provide rigid steel conduit or nonmetallic
   conduit. Provide cast metal boxes or nonmetallic handhole.

C. In or Under Slab on Grade: Provide rigid steel conduit or nonmetallic conduit. Provide
   cast or nonmetallic metal boxes and rigid steel risers above stab “90° Bends”.

D. Outdoor Locations, Above Grade & Exterior Wall Outdoor Conditions: Provide rigid
   steel or conduit. Provide cast metal outlet, pull, and junction boxes.

E. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes.
   Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large
   pull boxes.
F. **Exposed Dry Locations:** Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 **DESIGN REQUIREMENTS**

   A. **Minimum Raceway Size:** ½ if 4 or fewer conductors, 4 conductors or more minimum size ¾” inch unless otherwise specified.

1.5 **SUBMITTALS**

   A. **Division 01 - Submittal Procedures:** Submittal procedures.

   B. **Product Data:** Submit for the following:
      1. Flexible metal conduit.
      2. Liquidtight flexible metal conduit.
      3. Nonmetallic conduit.
      4. Flexible nonmetallic conduit.
      5. Raceway fittings.
      6. Conduit bodies.
      7. Pull and junction boxes.

   C. **Manufacturer's Installation Instructions:** Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 **CLOSEOUT SUBMITTALS**

   A. **Project Record Documents:**
      1. Record actual routing of conduits larger than 2 inch.
      2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 **DELIVERY, STORAGE, AND HANDLING**

   A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

   B. Protect PVC conduit from sunlight.

1.8 **COORDINATION**

   A. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.

   B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.
PART 2 PRODUCTS

2.1 METAL CONDUIT
A. Rigid Steel Conduit: ANSI C80.1.
B. Rigid Aluminum Conduit: ANSI C80.5.
C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT
A. Product Description: Interlocked steel construction.
B. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT
A. Product Description: Interlocked steel aluminum construction with PVC jacket.
B. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)
A. Product Description: ANSI C80.3; galvanized tubing.
B. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, compression set screw indenter type.

2.5 NONMETALLIC CONDUIT
A. Product Description: NEMA TC 2; Schedule 40 PVC.
B. Fittings and Conduit Bodies: NEMA TC 3.

2.6 OUTLET BOXES
A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
   1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.
   2. Concrete Ceiling Boxes: Concrete type.
B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

2.7 PULL AND JUNCTION BOXES
A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
   1. Material: Galvanized cast iron or Cast aluminum.
   2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

C. Fiberglass Handholes: Die-molded, glass-fiber hand holes:
   1. Cable Entrance: Pre-cut 6 inch x 6 inch cable entrance at center bottom of each side.
   2. Size: As indicated on the drawings.
   3. Cover: Glass-fiber, weatherproof cover with nonskid finish

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK
   A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
   B. Remove concealed abandoned raceway to its source.
   C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
   D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
   E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
   F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION
   A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
   B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
   C. Identify raceway and boxes in accordance with Section 26 05 53.
   D. Arrange raceway and boxes to maintain headroom and present neat appearance.
3.4 INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 26 05 29.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.

J. Route conduit in and under slab from point-to-point.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using saw or pipe cutter; de-burr cut ends.

N. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
S. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

V. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.

W. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings. Specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.

H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

I. Install stamped steel bridges to fasten flush mounting outlet box between studs.

J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

K. Install adjustable steel channel fasteners for hung ceiling outlet box.

L. Do not fasten boxes to ceiling support wires or other piping systems.

M. Support boxes independently of conduit.

N. Install gang box where more than one device is mounted together. Do not use sectional box.
O. Install gang box with plaster ring for single device outlets.

P. At all exterior wall “Exterior” fixture and device boxes provide cast metal or nonmetallic boxes for exposed and flush with wall locations.

3.6 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified.

C. Locate outlet boxes to allow luminaires positioned as indicated on reflected ceiling plan.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

A. Adjust flush-mounting outlets to make front flush with finished wall material.

B. Install knockout closures in unused openings in boxes.

3.8 CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION
SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Labels.
   3. Wire markers.
   5. Underground Warning Tape.

1.2 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Product Data:
   1. Submit manufacturer’s catalog literature for each product required.
   2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Install labels nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.
PART 2 PRODUCTS

2.1 NAMEPLATES
   A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
   B. Letter Size:
      1. 1/8 inch high letters for identifying individual equipment and loads.
      2. 1/4 inch high letters for identifying grouped equipment and loads.
   C. Minimum nameplate thickness: 1/8 inch.

2.2 LABELS
   A. Labels: Embossed adhesive tape, with 3/16 inch black letters on clear background.

2.3 WIRE MARKERS
   A. Description: Tape type wire markers.
   B. Legend:
      1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.
      2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams. shop drawings. Drawings.

2.4 CONDUIT AND RACEWAY MARKERS
   A. Description: Labels fastened with adhesive.
   B. Color:
      1. 208 Volt System: Black lettering on white background.
   C. Legend:
      1. 208 Volt System: 208 VOLTS.

2.5 UNDERGROUND WARNING TAPE
   A. Description: 4 inch wide plastic tape, colored red with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 PREPARATION
   A. Degrease and clean surfaces to receive adhesive for identification materials.
B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:
   1. Install nameplate parallel to equipment lines.
   2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
   3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
   4. Secure nameplate to equipment front using screws, or adhesive.
   5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
   6. Install nameplates for the following:
      a. Switchboards.
      b. Panelboards.
      c. Transformers.
      d. Service Disconnects.
      e. Receptacles.
      f. Switches.

C. Label Installation:
   1. Install label parallel to equipment lines.
   2. Install label for identification of individual control device stations.
   3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:
   1. Install wire marker for each conductor at panelboard gutters, outlet and junction boxes, and each load connection.
   2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
   3. Install labels at data outlets identifying patch panel and port designation.

E. Conduit, Raceway Marker Installation:
   1. Install conduit raceway marker for each conduit & raceway longer than 6 feet.
   2. Conduit & Raceway Marker Spacing: 20 feet on center.

F. Underground Warning Tape Installation:
   1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

G. Label all fire alarm pull & J-Boxes with red paint and permanent label to identify conductors.
H. Label all pull and J-Boxes above accessible ceilings and in mechanical spaces with permanent marker to identify conductor circuits and originating panels. Label covers on all pull & J-Boxes in finished areas with engraved tag.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section includes distribution and branch circuit panelboards.

B. Related Sections:
   1. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
   2. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:
   1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

B. National Electrical Manufacturers Association:
   1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
   2. NEMA FU 1 - Low Voltage Cartridge Fuses.
   3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
   4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
   5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   6. NEMA PB 1 - Panelboards.
   7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

C. International Electrical Testing Association:

D. National Fire Protection Association:
   1. NFPA 70 - National Electrical Code.

E. Underwriters Laboratories Inc.:
   1. UL 67 - Safety for Panelboards.
   2. UL 1283 - Electromagnetic Interference Filters.
   3. UL 1449 - Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Requirements for submittals.
B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

A. Furnish two of each panelboard key. Panelboards keyed alike to Owner’s current keying system.

PART 2 PRODUCTS

2.1 DISTRIBUTION PANELBOARDS (600A – 2000A)

A. Manufacturers:
   1. GE Electrical
   2. Siemens
   3. Square D
   4. Cutler Hammer/Eaton

B. Product Description: NEMA PB 1, circuit breaker type panelboard.

C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

D. Minimum integrated short circuit rating: 65,000 amperes rms symmetrical for 240 208 volt panelboards.

E. Molded Case Circuit Breakers: Less than 100A NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

F. Molded Case Circuit Breakers with Current Limiters: 100A and greater NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal
and instantaneous magnetic trip in each pole. Also furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

G. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.

H. Enclosure: NEMA PB 1, Type 1 3R, inches deep, inches wide, cabinet box.

I. Cabinet Front: Surface door-in-door type, fastened with concealed trim clamps screws hinge and latch, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS (400A & Less)

A. Manufacturers:
   1. GE Electrical
   2. Siemens
   3. Square D
   4. Cutler Hammer/Eaton

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

D. Minimum Integrated Short Circuit Rating: 22,000.

E. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

F. Enclosure: NEMA PB 1, Type 1.

G. Cabinet Box: 6 inches deep, 20 inches wide for 208 volt and less panelboards.

H. Cabinet Front: Cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.1 EXISTING WORK

A. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.
3.2 INSTALLATION

A. Install panelboards in accordance with NEMA PB 1.1.
B. Install panelboards plumb.
C. Install recessed panelboards flush with wall finishes.
D. Height: 6 feet to top of panelboard and load center; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
E. Install filler plates for unused spaces in panelboards.
F. Provide typed circuit directory for each branch circuit panelboard and load center. Revise directory to reflect circuiting changes to balance phase loads.
G. Install engraved plastic nameplates in accordance with Section 26 05 53.
H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.
I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.
J. Verify final sizes of all breakers with specific loads served and coordinate with equipment to be used.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.
B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.4 ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION