AT: NORTHEASTERN ILLINOIS UNIVERSITY
5500 North St. Louis Avenue
Chicago, Illinois 60625

DATE: February 6, 2012

OWNER: The Board of Trustees
Northeastern Illinois University

PROJECT MANAGER: Robin Mahaffey
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Northeastern Illinois University
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Chicago, IL 60607
Tel: 312.829.1987 Fax: 312.666.8967
gary.badik@bldd.com

ISSUE FOR BID

PROJECT NAME: Organic Chemistry Lab and Instrument Room

PROJECT NO. 11-0226-0911
DIVISION 01 - PROCUREMENT AND CONTRACT REQUIREMENTS

ORGANIC CHEMISTRY LAB & INSTRUMENT ROOM
Issue for Bid
02.06.2012

PROJECT MANUAL
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DIVISION 00 - PROCUREMENT AND CONTRACT REQUIREMENTS

ORGANIC CHEMISTRY LAB RENOVATIONS
100% CD Review
01.27.12

DOCUMENT 00015
LIST OF DRAWING SHEETS – OC

Abatement/Demolition Bid Package:

GENERAL SHEETS
GD.1OC  COVER SHEET
G002OC  CODE MATRIX, DRAWING SYMBOLS AND ABBREVIATIONS
G003OC  LIFE SAFETY PLANS
G004OC  CONSTRUCTION LIMIT AND ACCESS PLAN

DEMOLITION SHEETS
D101OC  SECOND FLOOR DEMOLITION PLAN WEST – ROOMS 226 & 238
D801OC  SECOND FLOOR DEMOLITION RCP WEST – ROOMS 226 & 238

ARCHITECTURAL SHEETS (FOR REFERENCE ONLY)
A101OC  SECOND FLOOR PLAN WEST – ROOMS 226 & 238 (FOR REFERENCE ONLY)
P000OC  PLUMBING LEGEND & GENERAL NOTES
P100OC  PLUMBING OVERALL PLANS
P101OC  PLUMBING DEMOLITION PLANS
M000OC  MECHANICAL ABBREVIATIONS, GENERAL NOTES & SYMBOLS
M100OC  MECHANICAL OVERALL PLANS
M101OC  MECHANICAL DEMOLITION PLANS
E000OC  ELECTRICAL ABBREVIATIONS, GENERAL NOTES & SYMBOLS
E100OC  ELECTRICAL OVERALL PLANS
E101OC  ELECTRICAL DEMOLITION PLANS

Renovation Bid Package:

GENERAL SHEETS
G001OC  COVER SHEET
G002OC  CODE MATRIX, DRAWING SYMBOLS AND ABBREVIATIONS
G003OC  LIFE SAFETY PLANS
G004OC  CONSTRUCTION LIMIT AND ACCESS PLAN

DEMOLITION SHEETS (FOR REFERENCE ONLY)
D101OC  SECOND FLOOR DEMOLITION PLAN WEST – ROOMS 226 & 238 (FOR REFERENCE ONLY)
D801OC  SECOND FLOOR DEMOLITION RCP WEST – ROOMS 226 & 238 (FOR REFERENCE ONLY)

ARCHITECTURAL SHEETS
A101OC  SECOND FLOOR PLAN WEST – ROOMS 226 & 238
A401OC  DOOR AND ROOM FINISH SCHEDULES
A701OC  INTERIOR ELEVATIONS
A702OC  INTERIOR ELEVATIONS
A710OC  CASEWORK DETAILS
A711OC  CASEWORK DETAILS
A801OC  SECOND FLOOR REFLECTED CEILING PLANS
A901OC  SECOND FLOOR FINISH PLANS WEST - ROOMS 226 & 238

FURNITURE SHEETS (FOR REFERENCE ONLY)
F101OC  SECOND FLOOR FURNITURE PLAN WEST – ROOMS 226 & 238 (FOR REFERENCE ONLY)

PLUMBING SHEETS
P000OC  PLUMBING LEGEND & GENERAL NOTES
P100OC  PLUMBING OVERALL PLANS
P101OC  PLUMBING DEMOLITION PLANS (FOR REFERENCE ONLY)
P201OC  PLUMBING PLANS
P301OC  PLUMBING SCHEDULES
P401OC  PLUMBING DETAILS

MECHANICAL SHEETS
M000OC  MECHANICAL ABBREVIATIONS, GENERAL NOTES & SYMBOLS
M100OC  MECHANICAL OVERALL PLANS
M101OC  MECHANICAL DEMOLITION PLANS (FOR REFERENCE ONLY)
M201OC  MECHANICAL PLANS
M301OC  MECHANICAL SCHEDULES
M401OC  MECHANICAL DETAILS
M402OC  MECHANICAL DETAILS
M403OC  TEMPERATURE CONTROLS

ELECTRICAL SHEETS
E000OC  ELECTRICAL ABBREVIATIONS, GENERAL NOTES & SYMBOLS
E100OC  ELECTRICAL OVERALL PLANS
E101OC  ELECTRICAL DEMOLITION PLANS (FOR REFERENCE ONLY)
E201OC  ELECTRICAL PLANS
E301OC  ELECTRICAL SCHEDULES
E401OC  ELECTRICAL DETAILS

All drawings are dated 01/27/2012

End of Section  00015
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00030
ADVERTISEMENT FOR BIDS

Northeastern Illinois University (NEIU) at its bid receiving office, Purchasing Department, Building C, 4th Floor at 5500 N. St. Louis Ave. (for personal or messenger delivery only) will receive sealed bids for:

Organic Chemistry Lab & Instrument Room
11-0226-0911

Bids to be mailed shall be addressed to Purchasing Department, 5500 N. St. Louis Ave., Chicago, IL 60625-4699.

Bid opening on Friday, March 9, 2012 in the Student Union, Room 218, at 5500 N. St. Louis Ave. at 10:00 a.m. prevailing time for the following work:

Project Description:
Furnish and install all necessary labor, material, and equipment to complete the project known as, Organic Chemistry Lab and Instrument Room; Project No., 11-0226-0911, consisting of Organic Chem Lab/ Lecture Room (BBH 226); an Instrument Lab (BBH238). Renovation of existing lab spaces with approximately 1400 s.f. new laboratory casework, new floor finishes, acoustical ceiling, plumbing fixtures and mechanical and electrical upgrades. Provide all conduit for telecom, media services ( AV ) and security cabling as indicated on Documents.

Separate Contracts will be awarded for:
1. General Construction
2. Plumbing
3. HVAC
4. Electrical

A MANDATORY pre-bid meeting will be held on Wednesday, February 22, 2012 @ 10:00 a.m. in the Student Union, Room 215, at 5500 N. St. Louis Ave.

Bids shall include Bidder's Illinois DHR Identification Number for all bids. Project manual, drawings, and addenda will be available via the Illinois Public Higher Education Procurement Bulletin website: http://www.procure.stateuni.state.il.us/. Bid opening dates and securities will be as follows:

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<th>TRADE</th>
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<th>TIME</th>
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<tr>
<td>General</td>
<td>$12,694.97</td>
<td>March 9, 2012</td>
<td>10:00 a.m.</td>
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<tr>
<td>Plumbing</td>
<td>$3706.16</td>
<td>March 9, 2012</td>
<td>10:00 a.m.</td>
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<tr>
<td>HVAC</td>
<td>$4738.86</td>
<td>March 9, 2012</td>
<td>10:00 a.m.</td>
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<td>Electrical</td>
<td>$2268.38</td>
<td>March 9, 2012</td>
<td>10:00 a.m.</td>
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MAFBE Contracting Goal

Northeastern Illinois University strongly supports the participation of businesses owned by Minorities, Females and Persons with Disabilities (MAFBE) and has established a goal that 20% of its contracts be awarded to MAFBE owned businesses. The University desires participation either on a direct basis or through sub-contracting efforts.
Information about the Bidder’s MAFBE status must be included in the Bidder Application Form as part of its submission. The Bidder, if awarded a contract, agrees to notify the University of any change to its status as a MAFBE owned business within fifteen (15) business days of the occurrence of such a change.

If the Bidder’s firm is not owned by a minority, female or person with a disability, the Bidder agrees to submit a Business Enterprise Program (BEP) Utilization Plan in accordance with Section 00315 of this bid document.

Sharon K. Hahs, President Northeastern Illinois University
Board of Trustees of Northeastern Illinois University

End of Section 00030
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00100
INSTRUCTIONS TO BIDDERS

00101 - IDHR CERTIFICATION

Illinois Department of Human Rights:

Prior to Bid opening, Bidder shall either be prequalified by the Illinois Department of Human Rights (IDHR) or have filed an application (IDHR Form PC-1) with the IDHR. For information regarding IDHR requirements, contact the Illinois Department of Human Rights, Public Contract Unit, 100 West Randolph Street, Suite 10-100, Chicago, Illinois 60601, 312-814-6200. Bidder shall comply with the IDHR requirements which appear in the General Conditions. Please be aware that, as of January 1, 2010, per Public Act 096-1786, all those filling for, or renewing an IDHR number will be charged a $75.00 registration fee which will be valid for five years from the date issuance.

00102 - NEIU CERTIFICATION

Northeastern Illinois University (NEIU) reserves the right to qualify bidders. All information must be provided on Application for Qualification if included in bid document. Failure to provide all of the required information, or misrepresentations made in completing the form will be grounds to disqualify the bidder and reject their bid.

00103 - OBTAINING BIDDING DOCUMENTS

Bidding Documents may be obtained in accordance with the "Advertisement for Bids". There is no Bidding Document deposit when Bidding Documents have been prepared by NEIU's Technical Staff.

Successful Bidder/Contractor (these words shall be used interchangeably throughout this document and are meant to be one and the same) will receive electronic copies of the Construction Documents.

00104 - PRE-BID CONFERENCES

There will be a MANDATORY Pre-Bid Meeting on Wednesday, February 22, 2012 at 10:00 a.m. in the Student Union, Room 215, at 5500 N. St. Louis Ave.
00105 - EXAMINATION OF BIDDING DOCUMENTS AND SITE

Bidder shall carefully examine Bidding Documents and inspect the project site to obtain first-hand knowledge of existing conditions. Contractor, by submitting Bid, represents that he has examined the Bidding Documents and inspected the site, that he understands the provisions of the Bidding Documents, and that he has familiarized himself with the local conditions under which the Work is to be performed. All inquires must be submitted in writing to the Project Manager no later than 2 business days after the Pre-Bid Meeting. Bidder will not be given extra payment or contract time for conditions which could have been determined by such examinations.

00106 - BID PREPARATION

1. Bid shall be prepared on the enclosed Bid Form. The Bidder shall not make changes in the standard Bid Form provided by NEIU with the Bidding Documents. The Bidder shall fill in all relevant blank spaces including Alternate Bids and unit prices in ink or by typewriter only, pencil is not acceptable. When any Base Bid, Alternate Bid or unit price is omitted, NEIU will reject the entire Bid. Bids containing conditional or qualified statements will not be accepted. Show all amounts in both words and figures. In the case where words and figures are not identical in form or amount, the amount shown in words will govern, where such words are not ambiguous. When the intention and meaning are clear, omissions or misspellings of words will not render the words ambiguous. No conditional bids will be accepted. When a Bidder submits a Bid with spaces containing erasures or other changes, each erasure or change shall be initialed by the person signing the Bid. Bidders are requested to submit the original bid form (noted on right edge “Required Bid Submittal Form”) and two copies of the bid which can be obtained in the Illinois Public Higher Education Procurement Bulletin website: http://www.procure.stateuniv.state.il.us/

2. Bidders shall be responsible for the delivery of their Bids during regular business hours, to NEIU's designated bid receiving office, prior to the bid closing time as stated in the Advertisement for Bids. Each Bid shall be submitted in a sealed opaque envelope, including express delivery envelopes, showing the name and address of the Bidder in the upper left-hand corner and addressed for direct delivery to Purchasing Department, Northeastern Illinois University, 5500 N. St. Louis Ave, Chicago, IL 60625-4699. The lower left-hand corner of the envelope shall be marked as follows:

   BID FOR: Organic Chemistry Lab & Instrument Room

   PROJECT NO.: NEIU # 11-0226-0911

   It shall not be sufficient to show that Bid was mailed in time to be received before scheduled closing time for receipt of Bids. Bid envelopes, including delivery envelopes, which are received unsealed or improperly identified as specified herein, will be rejected.

3. Modification or withdrawal of Bids shall be made in writing, including fax or e-mail and must be received at NEIU no later than one (1) day prior to the time of the bid opening. Modifications must not reveal the Bid price, but must provide an addition or subtraction so that the final Bid price can be determined only after the sealed Bid is opened. If the modification reveals the Bid price, the Bid will be rejected. When modifications or withdrawals are made by fax or e-mail, a signed confirmation statement shall be sent to NEIU via registered or certified mail, bearing:
A. A U.S. Post Office date stamp at least one (1) day prior to the time of the Bid opening date; or,

B. Evidence of time of processing by the U.S. Post Office, hand written and initialed by the postal clerk, indicating receipt by the U.S. Post Office one (1) day prior to the time of Bid opening.

4. All bids must include completed “Bid Form” (00300); “Bidder Application Form” (00310); “Financial Disclosures and Potential Conflicts of Interests” (00311); “State Board of Elections Certification” (00312); “Certifications and Statutory Requirements” (00313); “Subcontractor Attachment for Bids” (00314), and “Business Enterprise Program (BEP) Utilization Plan (00315).

00107 - ALTERNATE BIDS

Where Alternate Bids are included in the Bid Form, Bidders shall fill in each Alternate Bid with a Bid price. Failure to submit a Bid price for each Alternate Bid will result in rejection of the entire Bid. There will be no division of awards between base bid and accepted Alternate Bids.

00108 - UNIT PRICE ITEMS

1. Definition: A fixed price for a specified unit of work.

2. Unit prices may be a component of the Base Bid. The Bidder shall multiply the unit Bid price times the specified quantity, and enter the extension, in figures in the column provided in the Bid Form. In case of a conflict between the unit price and the extension, the Unit Bid prices shall govern, and the Base Bid will be corrected. The acceptance of Base Bid Unit Prices shall be a condition of Contract award. When NEIU does not accept the Unit Price of the low Bidder, all Bids for that Contract will be rejected.

Quantities specified in the Bid Form, although approximate, are included in the Base or Alternate Bids. Payment to the Contractor will be made only for the actual work performed and accepted or materials furnished in accord with the Contract. NEIU may at any time, without invalidating the Contract, increase, decrease, or omit any of the Unit Price items in accord with specified change order procedures.

A. Increased quantities will be paid for at the accepted Bid Price.

B. Decreased or omitted quantities will be deducted from the Contract sum at the accepted Unit Bid Price.

C. No payment will be made for any anticipated change in profit resulting from a change in the specified quantities.

3. Unit Prices may be a separate component outside the Base Bid. In these cases, the Bidder shall provide all requested Unit Prices as a condition of the Bid. NEIU reserves the right to accept or reject any or all Unit Prices. The award of the Base Bid is not conditionial upon the acceptance of Unit Prices, outside the Base Bid. NEIU also reserves the right to negotiate these Unit Prices prior to award. Unit Prices not specifically incorporated into the Contract shall not be binding upon NEIU or the Contractor. NEIU may formulate additive and deductive Unit Prices for the same item of work.
4. The acceptance of Unit Prices by NEIU does not alter the change order process. The Contractor may not increase, decrease, or omit work without a properly executed Change Order.

00109 - SCHEDULE REQUIREMENTS

1. The current major milestone schedule for this Project is as follows:

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release of Project Manual</td>
<td>February 6, 2012</td>
</tr>
<tr>
<td>Mandatory Pre-Bid Meeting</td>
<td>February 22, 2012</td>
</tr>
<tr>
<td>Bid Opening</td>
<td>March 9, 2012</td>
</tr>
<tr>
<td>Issue Letter of Intent</td>
<td>March 21, 2012</td>
</tr>
<tr>
<td>Board Approval (if required)</td>
<td>April 12, 2012</td>
</tr>
<tr>
<td>Issue P.O. &amp; Notice to Proceed</td>
<td>April 13, 2012</td>
</tr>
<tr>
<td>Pre-Construction Meeting</td>
<td>April 19, 2012</td>
</tr>
<tr>
<td>On Site Construction Start Date</td>
<td>May 14, 2012</td>
</tr>
<tr>
<td>Substantial Completion</td>
<td>August 10, 2012</td>
</tr>
<tr>
<td>Final Completion</td>
<td>August 24, 2012</td>
</tr>
</tbody>
</table>

00110 - BID SECURITY

1. Submittal: Bids shall be accompanied by a Bid Security in the form of a certified check, cashier's check, bank draft or acceptable Bid Bond in favor of “Northeastern Illinois University”. Failure to submit the Bid Security in full amount shown will result in rejection of the Bid. Bid Bonds shall be signed by the Contractor, Attorney-in-Fact, and Resident Agent.

2. Exchange: After the Bid opening, Bidders may replace other forms of Bid Security with an acceptable Bid Bond.

3. Default: If for any reason the Bidder withdraws his bid within ninety (90) calendar days after the Bid opening, or fails to comply with all post award requirements, such defaulting Bidder and Surety shall pay NEIU all costs incurred by NEIU for procuring the performance of the work required by the Bidding Documents which exceed the amount of his Bid. Such costs shall include, but not be limited to, the additional Contract price paid for the work and additional costs for advertising, Architect/Engineer and construction management services. If such costs are less than the Bid Security, the defaulting Bidder shall be entitled to the excess of his Bid Security. If the defaulting Bidder is the sole Bidder and after an attempt to secure other Bids by re-advertising none can be obtained, NEIU shall be entitled to the full amount of the Bid Security as liquidated damages.

4. Bid Security: NEIU reserves its rights in and to the Bid Securities of all Bidders until the lowest responsive Bidder has complied with all post award requirements at which time the Bid Securities other than the Bid Bonds will be returned to all Bidders.
00111 - PRODUCT SUBSTITUTION

All Bids shall be based on providing all products exactly as required by the Bidding Documents. Substitutions may be permitted in accordance with this Section. NEIU reserves the right to reject any proposed substitution.

The Specifications provides the names of manufacturers of product which meet project specifications. The use of these names in this solicitation is for the purpose of describing the standard of quality, performance and characteristics desired and is not intended to limit or restrict competition. Substantially equivalent products to those cited may be considered for award, and the University encourages bidders to include these in their submittal, in accordance with this section.

For products specified only by reference or performance standards, select any product which meets or exceeds standards, by any manufacturer, subject to NEIU’s approval. For products specified by naming several products or manufacturers, select any product and manufacturer named. Only those products or manufacturers named shall be acceptable except as provided below.

1. **Prior to Bid Opening:** The Director of Purchasing will consider written requests by prospective Bidders to amend the Bidding Documents to add products not specified. Such requests must be received at least ten (10) calendar days prior to Bid opening and include complete technical data and references for evaluation. If a request is approved, an Addendum will be issued no later than seventy-two (72) business hours prior to Bid opening.

2. **With Bid:** A Bidder may propose substitutions with a Bid by completing the Product Substitution Form included in the Project Manual, subject to the provisions stated thereon. Accepted substitutions will be so stated in the Contract. NEIU will review the Product Substitutions proposed by the low Bidder prior to award of Contract.

3. **Substitutions by Change Order:** After Notice of Award, substitutions may only be approved by written Change Order under one (1) of the following conditions:
   
   A. Substitutions required for compliance with final interpretations of code requirements or insurance regulations.
   
   B. Unavailability of specified products, through no fault of Contractor.
   
   C. Subsequent information discloses inability of specified product to perform poorly or fit in designated space.
   
   D. Manufacturer/fabricator refusal to certify or guarantee performance of specified product as specified.
   
   E. When a substitution would be substantially to NEIU's best interests.

4. **Procedure:** Submit complete data substantiating compliance of proposed substitutions with Contract Documents:
   
   A. An itemized comparison of proposed substitution with product or method specified.
   
   B. Data relating to changes in construction schedule, coordination, other contract affected.
C. Accurate cost data on proposed substitution in comparison with product or method specified.

5. In making request for substitution, Bidder/Contractor represents that the proposed product is equal or superior to that specified; and,

A. Will provide an equal or superior guarantee for the substitution as was specified; and,

B. Will coordinate installation of accepted substitutions into work, making all changes for work to be complete; and,

C. Will pay all additional costs and expenses for NEIU and other contractors affected.

6. Substitutions will not be considered by Shop Drawing, informal request, or when acceptance will require substantial revision of Contract Documents.

00112 - SIGNING BID SUBMITTAL

1. Original signatures on Bid Form & Bid Security are required. Rubber stamped or photo copied signatures are unacceptable.

2. All Bid Documents shall be signed by a person authorized to bind the business entity to a contract. The legal name of the business entity (sole proprietorship, corporation, partnership, joint venture, etc.) shall be stated. The name and title of the individual signing the documents shall be typed or printed below their signature.

A. The Owner shall sign for a sole proprietorship.

B. Corporations shall state the complete corporate name on the documents. The documents shall be signed by the president or vice-president, and the signature attested to by the corporate secretary, unless the corporation has, by written notice to NEIU, authorized representatives to sign the documents.

C. One of the authorized partners or joint venturers shall sign for a partnership, limited partnership or joint venture.

D. Individuals doing business under an assumed name shall sign in the name of the individual, “doing business as ...” (dba).

E. If signed by Attorney-in-Fact, there should be, attached to Bid, a Power of Attorney to sign Bid, dated same day as Bid and executed by authorized individuals.

End of Section 00100
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00200
ADDENDA

All changes in or interpretations of Bidding Documents prior to the Bid Opening will be made by written Addenda issued by NEIU to each recipient of Bidding Documents recorded by NEIU. All Addenda will be issued via the Illinois Public Higher Education Procurement Bulletin website: http://www.procure.stateuniv.state.il.us/ no later than three (3) business days prior to Bid Opening. When addenda are not timely issued, the bids will be returned unopened and the bid opening date will be extended. Failure to acknowledge all Addenda may result in Bid rejection.

End of Section 00200
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00300

BID FORM

BID TO: Northeastern Illinois University
Purchasing Department
5500 North St. Louis Avenue
Chicago, Illinois  60625

PERSONAL DELIVERY TO:
Northeastern Illinois University
Purchasing Department, Building C, 4th Floor
5500 North St. Louis Avenue
Chicago, Illinois  60625

BID FROM: __________________________________________________________________________________________

(Company)

____________________________________________________________________________________________

(Address)

_____________________________________________________________________________ _______________

(City, State, Zip Code)

Telephone:____________________  Fax: __________________________

BID FOR: Organic Chemistry Lab & Instrument Room

PROJECT NO.: 11-0226-0911

THE UNDERSIGNED:

1. Acknowledges receipt of:
   1.1 Project Manual and Drawings for: Organic Chemistry Lab & Instrument Room
   1.2 Addenda: Note: If no Addenda have been received, write NONE

   ADDENDUM NUMBER   DATE
   ____________________  ______________
   ____________________  ______________

2. Has examined the site and all bidding documents. He/she shall be responsible for performing all work specifically required of him/her by all parts of the bidding documents, including all drawings and specifications for the entire project even though such work may be included as related requirements specified in other Divisions or Sections.
3. Agrees:

3.1 To hold this bid open for ninety (90) calendar days after the opening date.
3.2 To accept the provisions of the Instructions to Bidders regarding disposition of bid security.
3.3 To enter into and execute a contract with NEIU, if awarded on the basis of his/her bid, and in connection therewith to:

3.3.1 Furnish all bonds and insurance required by the bidding documents.
3.3.2 Accomplish the work in accordance with the Contract.
3.3.3 Complete the work within the Contract Time herein specified.

CONTRACT TIME:

The Contractor cannot commence work until receipt of Purchase Order and must provide Substantial Completion by August 10, 2012 and Final Completion by August 24, 2012.

BASE BID GENERAL WORK:

THE BIDDER AGREES TO PERFORM ALL BASE BID DEMOLITION WORK, EXCLUSIVE OF ALTERNATE BIDS, FOR THE SUM OF:

________________________________________________________________________ DOLLARS ($______________)

(Write Out Sum In Full)

ALTERNATE WORK:

Not applicable

BID SECURITY ENCLOSED:

$__________________________ Type: ____________________

BIDDER’S NAME: __________________________________________________________

COMPANY: _______________________________________________________________

BASE BID PLUMBING WORK:

THE BIDDER AGREES TO PERFORM ALL BASE BID DEMOLITION WORK, EXCLUSIVE OF ALTERNATE BIDS, FOR THE SUM OF:

________________________________________________________________________ DOLLARS ($______________)

(Write Out Sum In Full)

ALTERNATE WORK:

Not applicable
BID SECURITY ENCLOSED:
$______________________________ Type: __________________

BIDDER’S NAME: ____________________________________________
COMPANY: ____________________________________________________

BASE BID HVAC WORK:
THE BIDDER AGREES TO PERFORM ALL BASE BID DEMOLITION WORK, EXCLUSIVE OF
ALTERNATE BIDS, FOR THE SUM OF:
______________________________ DOLLARS ($__________)
(Write Out Sum In Full)

ALTERNATE WORK:
Not applicable

BID SECURITY ENCLOSED:
$______________________________ Type: __________________

BIDDER’S NAME: ____________________________________________
COMPANY: ____________________________________________________

BASE BID ELECTRICAL WORK:
THE BIDDER AGREES TO PERFORM ALL BASE BID DEMOLITION WORK, EXCLUSIVE OF
ALTERNATE BIDS, FOR THE SUM OF:
______________________________ DOLLARS ($__________)
(Write Out Sum In Full)

ALTERNATE WORK:
Not applicable

BID SECURITY ENCLOSED:
$______________________________ Type: __________________

BIDDER’S NAME: ____________________________________________
COMPANY: ____________________________________________________
PROPOSED PRODUCT SUBSTITUTION LIST:
The Base Bid and Alternate Bid(s) are to include only those products which are specified in the bidding documents. Following is a list of substitute products which the Bidder proposes to furnish on this project. If accepted by NEIU, the difference in price will be added to or deducted from the Base Bid or Alternate Bid(s).

Bidder understands that acceptance of any proposed substitution is at NEIU's option. Approval or rejection by NEIU of any substitution listed below will be indicated prior to executing the contract.

<table>
<thead>
<tr>
<th>MANUFACTURER’S NAME AND PRODUCT</th>
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EVALUATION of Contract award will be made in accordance with "Instructions to Bidders". Only the successful Bidder's proposed product substitution list will be evaluated.

AFFIDAVIT OF AVAILABILITY

SUBMITTED FOR:

I, being duly sworn, do hereby declare that the following is a true and correct statement relating to all uncompleted contracts of the undersigned for Federal, State, County, City, and private work, including all subcontract work and all pending low bids not yet awarded or rejected (add sheets as necessary):

<table>
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<tr>
<th>LOCATION OF WORK</th>
<th>UNDER CONTRACT WITH</th>
<th>CONTRACT AMOUNT</th>
<th>DOLLAR VOLUME TO BE COMPLETED</th>
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AWARDS PENDING

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

____________________________________________________________________________

TOTALS:

____________________________________________________________________________

WORK HISTORY REQUIREMENT:

The following is a reference history to be completed by the Contractor. List a minimum of three (3) references of contracted work on similar projects with a construction value greater than _____________ within the last two (2) years where your company was the Contractor. All references will be reviewed prior to award of contract. Work history/reference checks/performance record will be an evaluation factor used in the determination of award.

<table>
<thead>
<tr>
<th>Contract Holder &amp; Phone Number</th>
<th>Type of Work</th>
<th>Year Completed</th>
<th>Contract Amount</th>
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</table>

FAILURE TO SUBMIT CURRENT FACTUAL INFORMATION WILL RESULT IN NON-CONSIDERATION OF BID PROPOSAL.

__________________________  ______________________
Bidder's Name (Print)      Signature

__________________________  ______________________
COMPANY       Address

Subscribed and sworn to before me this ________ day of ________, 20____.

Notary Public: ________________________________ SEAL:

End of Section 00300
Bidder Application Form

Illinois Public Higher Education (IPHE)  This requested information is required to accomplish the statutory purpose of the Illinois Procurement Code [30 ILCS 500].

Instructions: Please type or print. You must respond to all questions, sign the form, and submit it to the appropriate university. If your answer is “same,” “not applicable,” or “none,” please write this to indicate no questions have been overlooked. It is your responsibility to notify the issuing university if the information in this application changes.

Today’s date______________ This application is:  ☐ Initial application  ☐ Revision of previously submitted application

Submit this completed form to the university closest to you or the university with whom you intend to do the most business. Check that university below:

☐ Director of Purchases
  Chicago State University
  9501 King Drive
  Chicago, IL  60628-1598

☐ Director of Purchases
  Eastern Illinois University
  Room 113 Old Main
  Charleston, IL  61920-3099

☐ Purchasing Office
  Governors State University
  University Park, IL  60466-0975

☐ Director of Purchases
  1220 Illinois State University
  Normal, IL  61790-1220

☐ Director of Purchasing
  Purchasing Department
  Northeastern Illinois University
  5500 North St. Louis Avenue
  Chicago, IL  60625-4699

☐ Director of Procurement Services
  Northern Illinois University
  B-113 Gilbert Hall
  DeKalb, IL  60115-2870

☐ Director of Purchasing
  Southern Illinois University
  Bldg 108 - Miles Hall
  Carbondale, IL  62901-6813

☐ Director of Purchasing
  Southern Illinois University
  Box 1012
  Edwardsville, IL  62026-1012

☐ Director of Procurement Services
  SIU Medical School
  P.O. Box 19605
  Springfield, IL  62794-9605

☐ Director of Purchases
  University of Illinois at Chicago
  Room 312 - M.A.B. (MC-560)
  809 South Marshfield Avenue
  Chicago, IL  60612-7203

☐ University of Illinois at Springfield
  Purchasing BSB 106
  PO Box 19243
  4900 Shepherd Road
  Springfield, IL  62794

☐ Director of Purchases
  University of Illinois at Urbana-Champaign
  Purchasing Division
  616 E. Green, Suite 212
  Champaign, IL  61820-5752

☐ Director of Purchases
  Western Illinois University
  One University Circle
  Room 227 Sherman Hall
  Macomb, IL  61455-1390

If you wish to be included on the bid list for other universities, copy this form and submit it to the other universities.

1. Legal name/address to which solicitations are to be mailed:  

2. Address to which purchase orders are to be mailed, if different:

3. Address to which payment is to be mailed, if different:

4. Contact person:  
   Phone number:  
   800 number:  
   FAX number:  
   E-mail:

5. If a division of a corporation, show name and address of parent company:  

   State of incorporation ________________________

6. Years in business  
   U.S. owned business:  ☐ Yes  ☐ No
7. Legal and tax status – I certify, under penalty of perjury, that I/we do business as a (check one only):

- [ ] Individual
- [ ] Sole Proprietorship
- [ ] Partnership
- [ ] Corporation
- [ ] Not-for-Profit Corporation
- [ ] Medical Health Care Services Provider Corp.
- [ ] Real Estate Agent
- [ ] Government Entity
- [ ] Tax Exempt Organizations (IRC 501 (a) only)
- [ ] Trust or Estate
- [ ] Limited Liability Corporation

8. Enter your Taxpayer Identification Number (use Social Security Number if individual or sole proprietorship):

- [ ] FEIN ______________________  [ ] SSN ______________________

9. Enter your Illinois Department of Human Rights (IDHR) number. Failure to do so will delay the processing of your application. If your IDHR number is 89999-00-0 or lower, you must re-register with the Illinois Department of Human Rights.

IDHR Contractor Registration Number ______________________  [ ] Exempt

If you employ 15 or more individuals and wish to bid on State of Illinois contracts, IDHR requires that you file an Employers Report Form - Form PC-1 before bid opening. You may obtain a PC-1 form through IDHR at (312) 814-2431, TDD (312) 263-1579, or www.state.il.us/cms/purchase/download. All persons (or firms) employing 14 or fewer individuals at all times during the past 365 days are exempt from the IDHR requirement and should check the "Exempt" box above.

10. Is your firm authorized to do business in the State of Illinois, as well as locally, with all necessary business licenses?

- [ ] Yes  [ ] No  If no, please explain

11. Net worth of business:

12. Bank reference - name and address:

13. Total sales and receipts (include amounts for all affiliated businesses) for most recent fiscal year:

The public higher education institutions of Illinois have various special programs that may be available to your company. Please check each category which applies, and complete the requested information. You may be requested to complete a more detailed form and provide additional documentation in order to ensure eligibility.

☐ (A) Small business. See 30 ILCS 500/45-45. To participate as a small business you must qualify under the following definition and criteria:

“Small business” means a business that is independently owned and operated and is not dominant in its field of operation (that is, it does not exercise a controlling or major influence in a kind of activity in which a number of business concerns are primarily engaged). To compute your size status, include your (and your affiliates’) annual sales and receipts, subject to the following limitations:

**Wholesale business** – annual sales for the most recently completed fiscal year cannot exceed $7,500,000
Submit a copy of the latest year’s Federal and State income tax return page(s) showing total annual gross sales for the company and an Illinois address. If both a wholesaler and retailer, the combined wholesale and retail annual sales for the latest year of tax filing shall not exceed $9 million. The retail component shall not exceed $1.5 million and the wholesale component shall not exceed $7.5 million. Businesses desiring to qualify under the combined status must also submit a notarized statement delineating the retail and wholesale dollar components.

**Retail business or business selling services** – annual sales and receipts cannot exceed $1,500,000
Submit a copy of the latest year’s Federal and State income tax return page(s) showing total annual gross sales for the company and an Illinois address. If both a wholesaler and retailer, the combined wholesale and retail annual sales for the latest year of tax filing shall not exceed $9 million. The retail component shall not exceed $1.5 million and the wholesale component shall not exceed $7.5 million. Businesses desiring to qualify under the combined status must also submit a notarized statement delineating the retail and wholesale dollar components.

**Manufacturing business** – cannot employ more than 250 persons
Submit a copy of the latest year’s Federal or State income tax return page(s) showing an Illinois address and the latest year’s form IL-W-3 (Illinois Annual Withholding Income Tax Return) showing the number of Forms W-2, W-2G, and 1099-R issued (denotes number of employees at the company). If a manufacturing business has been in existence for less than a full fiscal year, its average employment shall be calculated for the period through one month prior to the bid or proposal due date. In such cases, a notarized statement to that effect and proof of when the business came into existence shall be submitted.

**Construction business** – annual sales and receipts cannot exceed $10,000,000
Submit a copy of the latest year’s Federal and State income tax return page(s) showing total annual gross sales for the company and an Illinois address.

☐ (B) Minority, Female, Person with Disability. See 30 ILCS 575. To participate in this you must qualify under the following criteria and be certified by one of the following:

☐ DCMS (Department of Central Management Services) Business Enterprise Program
☐ CMBDC (Chicago Minority Business Development Council)
☐ IDOT (Illinois Department of Transportation)
☐ WBDC (Women’s Business Development Center)

The business must be at least 51% owned and controlled by one or more individuals who are minority, female, or a person with disabilities. A business owned and controlled at least 51% by any combination of minorities, females, and persons with disabilities should be checked as a business owned and controlled by the eligible group that has the largest percentage of ownership. If this block is checked, also check each of the following which are applicable:

☐ African American ☐ Female
☐ Hispanic ☐ Native American/Alaskan
☐ Person with disability (must be severe mental or physical disabilities which substantially limit major life activities) ☐ Asian American

☐ (C) Not-for-profit, U.S. tax exempt agency for the disabled. You must qualify under Section 501 of the Internal Revenue Code. See 30 ILCS 575/2A4.1.

☐ (D) State use – Not-for-profit agency for the severely handicapped. Must meet requirements of U.S. Department of Labor and the Illinois Department of Rehabilitation Services. See 30 ILCS 500/45-35.
15. In compliance with the Illinois Procurement Code, state the name of each person or company having a beneficial interest of more than 7½% in the bidding enterprise and each person or company, who, together with spouse or minor children, has a beneficial interest of more than 15% in the bidding enterprise (attach additional sheets if necessary):

<table>
<thead>
<tr>
<th>Name and Address</th>
<th>Percent Owned</th>
<th>Voting Percentage</th>
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If applicant is a corporation, please complete both columns:

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<tr>
<th>Names of Corporate Officers</th>
<th>Names of Corporate Directors</th>
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16. List equipment, supplies, and/or services you can provide. Include brand and manufacturer names or other information that will help buyers to categorize your capabilities. (Additional items may be submitted on an attached sheet.) If the issuing university has provided a separate listing of equipment, supplies, and/or services, provide requested information and return it with this form. If the services available from your firm include professional and/or artistic services (see Item #17 for listing), and you wish to be pre-qualified so you can receive direct notification of opportunities, complete Items #17-24 of this application.

 Fill out this section to pre-qualify as a provider of Professional and Artistic Services

If you do not offer such services, or do not wish to pre-qualify, proceed to Item #24.

Completing this section does not guarantee that you will be pre-qualified. Being pre-qualified does not guarantee that you will be awarded a contract. You do not need to be pre-qualified to respond to a solicitation (Illinois Procurement Code [30 ILCS 500/35-15]). Consult the universities’ solicitations to determine specific qualification requirements for individual solicitations.

Automatic notification – Once you have been pre-qualified you will be entitled to receive an automatic notification of Procurement Bulletin solicitations for services for which you have pre-qualified if you have listed a FAX number and/or e-mail address as requested in Item #4.

Do not use this section to pre-qualify for construction or construction-related professional services. Contact the university with whom you wish to do business for information regarding specific requirements for these categories.

17. Please check the professional and artistic services for which you are requesting pre-qualification. For each service you check, provide the information requested in Items #17-23 of this application.
18. Licenses and/or professional registration – List names of each key person of the firm. If a requested service requires a licensed/registered practitioner, you may be required to provide a copy of such license/registration to the university before an award can be made or work begun.

<table>
<thead>
<tr>
<th>Name</th>
<th>Capacity (Owner, Partner, Etc.)</th>
<th>Current Licenses/Registrations (Include Certificate # if Applicable)</th>
<th>License/Registration Exp. Date</th>
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19. Work experience – List contracts for similar services that have been completed within the last five years:

<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Type of Service</th>
<th>Total Amount of Contract</th>
<th>Start/Completion Dates</th>
<th>Name/Phone # of Owner or Other Reference</th>
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20. Resume’ of key personnel – Provide the requested information for key personnel who would be assigned to work on contracts awarded or who would, at a minimum, supervise such work.

<table>
<thead>
<tr>
<th>Name and Title</th>
<th>Primary Responsibilities</th>
<th>Years Experience (This Firm/Other Firms)</th>
<th>Education (Institutions, Years, Degrees, Certificates)</th>
<th>Other Relevant Experience and/or Qualifications</th>
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21. Judgments and claims – Are there any judgments, claims, or suits pending or outstanding against you or your organization that could affect the ability to complete any contract awarded?

- [ ] Yes  - [ ] No  If yes, please explain:

22. Receivership – Have you or your organization filed for bankruptcy, receivership, or reorganization within the last five years?

- [ ] Yes  - [ ] No  If yes, please provide details:
23. Statutory qualifications – Are you or your organization disqualified, ineligible, suspended, or otherwise barred from receiving solicitations and/or awards from any State of Illinois university or agency or any agency of the Federal Government?

☐ Yes  ☐ No  If yes, please provide details:

24. I understand that:

Information provided in this application may be audited by any State university or verified by other means.

Provision of information in this application does not relieve me from providing the same or additional information as required in a response to a solicitation.

Submittal of this application does not guarantee pre-qualification. Pre-qualification will be given only if I meet all statutory or regulatory requirements, including any that may not be listed in this application.

I must update significant information changes within a reasonable amount of time. Significant changes include, but are not limited to, change of legal status, TIN, ownership, name, address, as well as loss of licensure or registration, filing of bankruptcy, or suspension or debarment by any Federal, state, or local governmental agency.

Failure to provide accurate and reliable information required by this form may, in accordance with any and all applicable laws, result in penalties including, but not limited to, suspension or debarment from doing business with any university and termination of contracts, and loss of profits in appropriate cases.

Under penalty of perjury, I swear or affirm that:

The information provided in this application is true and correct as of the time of signing.

I have not been barred from contracting with a unit of State or local government as a result of a violation of Section 33-E or 33E-4 of the Criminal Code of 1961.

I, along with other officers and employees, have not been convicted of bribery nor attempted bribery of an officer or employee of the State of Illinois, nor have made an admission of guilt of such conduct that is a matter or record.

I am an equal opportunity employer and in compliance with the equal opportunity requirements of applicable state and federal laws.

______________________________  ______________________________
Signature  Name (type or print)

______________________________  ______________________________
Date  Title

08/13/03

End of Section 00310
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00311
FINANCIAL DISCLOSURES AND POTENTIAL CONFLICTS OF INTEREST

Instructions: Vendor shall disclose financial interests, potential conflicts of interest and contract information identified in Sections 1, 2 and 3 below as a condition of receiving an award or contract (30 ILCS 500/50-13 and 50-35). Failure to fully disclose shall render the contract, bid, proposal, subcontract, or relationship voidable by the chief procurement officer if s/he deems it in the best interest of the State of Illinois and may be cause for barring from future contracts, bids, proposals, subcontracts, or relationships with the State.

- There are five sections to this form and each must be completed to meet full disclosure requirements.
- Note: The requested disclosures are a continuing obligation and must be promptly supplemented for accuracy throughout the process and throughout the term of the resultant contract if the bid/offer is awarded. As required by 30 ILCS 500/50-2, for multi-year contracts vendors must submit these disclosures on an annual basis.

A publicly traded entity may submit its 10K disclosure in satisfaction of the disclosure requirements set forth in Section 1 below. HOWEVER, if a vendor submits a 10K, they must still must complete Sections 2, 3, 4 and 5 and submit the disclosure form.

If the Vendor is a wholly owned subsidiary of a parent organization, separate disclosures must be made by the Vendor and the parent. For purposes of this form, a parent organization is any entity that owns 100% of the Vendor.

This disclosure information is submitted on behalf of (show official name of Vendor, and if applicable, D/B/A and parent):

Name of Vendor:__________________________________________

D/B/A (if used):__________________________________________

Name of any Parent Organization:___________________________

Section 1 - Section 50-35 Disclosure of Financial Interest in the Vendor. (All Vendors must complete this section)

Vendors must complete subsection (a), (b) or (c) below. Please read the following subsections and complete the information requested.

A. If vendor is a Publicly traded corporation subject to SEC reporting requirements

Vendor shall submit their 10K disclosure (include proxy if referenced in 10k) in satisfaction of the financial and conflict of interest disclosure requirements set forth in subsections 50-35 (a) and (b) of the Procurement Code. The SEC 20f or 40f, supplemented with the names of those owning in excess of 5% and up to the ownership percentages disclosed in those submissions, may be accepted as being substantially equivalent to 10K.

Check here if submitting a 10k[ ] , 20f[ ], or 40f[ ] .
Proceed to Section 2.
B. If vendor is a privately held corporation with more than 400 shareholders

These Vendors may submit the information identified in 17 CFR 229.401 and list the names of any person or entity holding any ownership share in excess of 5% in satisfaction of the financial and conflict of interest disclosure requirements set forth in subsections 50-35 a and b of the Illinois Procurement Code.

OR

C. If Vendor is an individual, sole proprietorship, partnership or any other not qualified to use subsections (A) or (B), complete (i) and (ii) below as appropriate.

For each individual having any of the following financial interests in the Vendor (or its parent), please mark each that apply and show the applicable name and address. Use a separate form for each individual.

1. Do you have an ownership share of greater than 5% of the offering entity or parent entity?
   □ Yes □ No

2. Do you have an ownership share of less than 5%, but which has a value greater than $106,447.20?
   □ Yes □ No

3. Do you receive more than $106,447.20 of the offering entity’s or parent entity’s distributive income? (Note: Distributive income is, for these purposes, any type of distribution of profits. An annual salary is not distributive income.)
   □ Yes □ No

4. Do you receive greater than 5% of the offering entity’s or parent entity’s total distributive income, but which is less than $106,447.20?
   □ Yes □ No

5. If you responded yes to any of questions 1 – 4 above, please provide either the percentage or dollar amount of your ownership or distributive share of income: ____________
   For partnerships with more than 50 partners, the percentage share of ownership of each individual identified above may be shown in the following ranges (dollar value fields must also be completed when applicable):
   0.5% or less >0.5 to 1.0% >1.0 to 2.0% >2.0 to 3.0 % >3.0 to 4.0% >4.0 to 5.0% and in additional 1% increments as appropriate _________%

6. If you responded yes to any of the questions 1-4 above, please check the appropriate type of ownership/distributable income share:
   Sole Proprietorship □ Stock □ Partnership □ Other (explain)________

Name: __________________________________________________________
Address: ________________________________________________________
In relation to individuals identified above, indicate whether any of the following potential conflict of interest relationships apply. If "Yes," please describe each situation (label with appropriate letter) using the space at the end of this Section (attach additional pages as necessary). If no individual has been identified above, mark not applicable ("N/A") here.

Section 2 - Section 50-13 Conflicts of Interest (All Vendors must complete this section)

A. Prohibition. It is unlawful for any person holding an elective office in this State, holding a seat in the General Assembly, or appointed to or employed in any of the offices or agencies of State government and who receives compensation for such employment in excess of 60% of the salary of the Governor of the State of Illinois [$106,447.20], or who is an officer or employee of the Capital Development Board or the Illinois Toll Highway Authority, or who is the spouse or minor child of any such person to have or acquire any contract, or any direct pecuniary interest in any contract therein, whether for stationery, printing, paper, or any services, materials, or supplies, that will be wholly or partially satisfied by the payment of funds appropriated by the General Assembly of the State of Illinois or in any contract of the Capital Development Board or the Illinois Toll Highway Authority.

B. Interests. It is unlawful for any firm, partnership, association, or corporation, in which any person listed in subsection (a) is entitled to receive (i) more than 7 1/2% of the total distributable income or

(a) State employment, currently or in the previous 3 years, including contractual employment of services directly with the individuals identified in Section 1 in their individual capacity unrelated to the Vendor's contract.

(b) State employment of spouse, father, mother, son, or daughter, including contractual employment for services in the previous 2 years.

(c) Elective status; the holding of elective office of the State of Illinois, the government of the United States, any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois currently or in the previous 3 years.

(d) Relationship to anyone holding elective office currently or in the previous 2 years; spouse, father, mother, son, or daughter.

(e) Appointive office; the holding of any appointive government office of the State of Illinois, the United States of America, or any unit of local government authorized by the Constitution of the State of Illinois or the statutes of the State of Illinois, which office entitles the holder to compensation in excess of expenses incurred in the discharge of that office currently or in the previous 3 years.

(f) Relationship to anyone holding appointive office currently or in the previous 2 years; spouse, father, mother, son, or daughter.

(g) Employment, currently or in the previous 3 years, as or by any registered lobbyist of the State government.

(h) Relationship to anyone who is or was a registered lobbyist in the previous 2 years; spouse, father, mother, son, or daughter.

(i) Compensated employment, currently or in the previous 3 years, by any registered election or re-election committee registered with the Secretary of State or any county clerk in the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections.

(j) Relationship to anyone; spouse, father, mother, son, or daughter; who is or was a compensated employee in the last 2 years of any registered election or reelection committee registered with the Secretary of State or any county clerk in the State of Illinois, or any political action committee registered with either the Secretary of State or the Federal Board of Elections.
(ii) an amount in excess of the salary of the Governor ($177,412.00], to have or acquire any such contract or direct pecuniary interest therein.

C. Combined interests. It is unlawful for any firm, partnership, association, or corporation, in which any person listed in subsection (a) together with his or her spouse or minor children is entitled to receive (i) more than 15%, in the aggregate, of the total distributable income or (ii) an amount in excess of 2 times the salary of the Governor [$354,824.00], to have or acquire any such contract or direct pecuniary interest therein.

Check One:

☐ No Conflicts Of Interest

☐ Potential Conflict of Interest (If checked, name each conflicted individual, the nature of the conflict, and the name of the State agency that is associated directly or indirectly with the conflicted individual.)

Section 3 - Debarment/Legal Proceeding Disclosure *(All Vendors must complete this section)*.

Each of the persons identified in Sections 1, 2 and 3 must each identify any of the following that occurred within the previous 10 years:

- Debarment from contracting with any governmental entity
- Professional licensure discipline
- Bankruptcies
- Adverse civil judgments and administrative findings
- Criminal felony convictions

If any of the above is checked yes, please identify with descriptive information the nature of the debarment and legal proceeding. The State reserves the right to request more information, should the information need further clarification.

____________________________________________________________________________________
____________________________________________________________________________________

Section 4 - Current and Pending Contracts *(All Vendors must complete this section)*.

Does the vendor have any contracts pending contracts, bids, proposals or other ongoing procurement relationships with units of State of Illinois government?  

Yes ☐ No ☐

If yes, please identify each contract, pending contract, bid, proposal and other ongoing procurement relationship it has with units of State of Illinois government by showing agency name and other descriptive information such as bid number, project title, purchase order number or contract reference number.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
Section 5 - Representative Lobbyist/Other Agent (All Vendors must complete this section).

Is the vendor represented by or employ a lobbyist or other agent who is not identified under Sections 1 and 2 and who has communicated, is communicating, or may communicate with any State officer or employee concerning the bid, offer or contract?

[ ] Yes  [ ] No

If yes, please identify each agent / lobbyist, including name and address.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Costs/Fees/Compensation/Reimbursements related to assistance to obtain contract (describe):
____________________________________________________________________________________

Vendor certifies that none of these costs will be billed to the State in the event of contract award. Vendor must file this information with the Secretary of State.

By signing this form, Vendor certifies that the above information is accurate and complete:

Company name: _____________________________________________________________
Address: _____________________________________________________________
Telephone number: _____________________________________________________________
FTIN: _____________________________________________________________
(Do NOT provide Social Security number)

Project Name/#: _____________________________________________________________
Signature: _____________________________________________________________
Printed name/Title: _____________________________________________________________
Date: _____________________________________________________________

END OF SECTION 00311
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00312
STATE BOARD OF ELECTIONS CERTIFICATION INSTRUCTIONS AND CERTIFICATION

Compliance with Public Act 095-0971 (Registration with State Board of Elections)

If you have not already reviewed Public Act 095-0971, which went into effect on January 1, 2009, we strongly recommend that you do so immediately. The Act is available at http://www.ilga.gov/legislation/publicacts/fulltext.asp?Name=095-0971.


If you wish to submit a bid or proposal in response to this solicitation you must certify your compliance with the registration requirements of the Act by checking the appropriate box on the form below. Furthermore, if you are required to register with the State Board of Elections, you must also provide a copy of your certificate of registration with your bid or proposal.

If you do not certify your compliance with the Act and provide a copy of the registration certificate issued to you by the State Board of Elections if you are required to register, your bid or proposal cannot be accepted by the University. You must be registered with the Board of Elections prior to bid opening. THERE IS NO GRACE PERIOD ALLOWING FOR REGISTRATION WITH THE BOARD OF ELECTIONS AFTER BID OPENING.

Note: vendors who registered with the State Board of Elections by mail or e-mail prior to August 1, 2009 must re-register on-line at https:BEREP.elections.il.gov.

Vendor Certification of Compliance with Public Act 095-0971 (Registration with State Board of Elections)

Please read all of the following explanatory notes before completing the certification:

- If you are a for-profit vendor submitting a bid or proposal exceeding $50,000, you must check Box #2, register with the State Board of Elections, AND SUBMIT A COPY OF THE REGISTRATION CERTIFICATE ISSUED TO YOU BY THE BOARD OF ELECTIONS WITH YOUR BID OR PROPOSAL.

- If you are a for-profit vendor submitting a bid or proposal for less than $50,000 but the annual total value of all of your contracts and offers with all State agencies (including all current State contracts, the bid or proposal you are submitting, any other pending offers, and offers you previously submitted this year where you were not awarded a contract) exceeds $50,000, you must check Box #2, register with the State Board of Elections, AND SUBMIT A COPY OF THE REGISTRATION CERTIFICATE ISSUED TO YOU BY THE BOARD OF ELECTIONS WITH YOUR BID OR PROPOSAL.

- If you are a for-profit vendor submitting a bid or proposal for less than $50,000, and the annual total value of all of your contracts and offers with all State agencies is also less than $50,000, you may check Box #1 indicating that you are not required to register.
- If you are a not-for-profit organization or governmental entity, you may check Box #1 indicating that you are not required to register regardless of the amount of your bid or proposal or the annual total value of all of your contracts and offers with all State agencies.

- There are no exceptions to the registration requirements for out-of-state or non-U.S. vendors.

Certify your compliance with the Act by checking the appropriate box. If you fail to check any box, the University cannot accept your bid or proposal.

1. □ The bidder/proposer certifies that they are not required to register as a business entity with the State Board of Elections pursuant to the Procurement Code (30 ILCS 500/20-160). Further, the bidder/proposer acknowledges that all contracts between State agencies and a business entity that do not comply with this Section shall be voidable under Section 50-60 of the Procurement Code (30 ILCS 500/50-60).

(or)

2. □ The bidder/proposer certifies that they have registered as a business entity with the State Board of Elections and acknowledges a continuing duty to update the registration pursuant to the Procurement Code (30 ILCS 500/20-160). Further, the bidder/proposer acknowledges that all contracts between State agencies and a business entity that do not comply with this Section shall be voidable under Section 50-60 of the Procurement Code (30 ILCS 500/50-60).

If you need to register with the State Board of Elections, please visit its website for specific information on the registration process: https://BEREP.elections.il.gov.

ATTACH BOARD OF ELECTIONS REGISTRATION CERTIFICATE TO THIS PAGE.

If you are not required to register, check here □
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00313
CERTIFICATIONS AND STATUTORY REQUIREMENTS

GENERAL TERMS:

- "Vendor" is defined as any entity that is contractually obligated to perform work on behalf of or related to the Owner, regardless of whether the entity has a contract directly with the Owner. Certain provisions contained herein are only applicable to "Subcontractor(s)". A Subcontractor is defined as a Vendor that has a contractual obligation with a prime vendor rather than directly with the Owner. "Owner" and "University" are used interchangeably within this document.

- Vendor will include these terms in any subcontract and acknowledges that this Contract may be declared void without penalty or obligation to pay additional compensation if Vendor or Subcontractors fail to fully and truthfully comply with the requirements of this Attachment or if this Contract has been made in violation of the Procurement Code or any other law.

- Vendor acknowledges that this Contract may be voided if any of the certifications made herein by the Vendor are false.

- Vendor certifies it is not legally barred from contracting with the State of Illinois and has no known conflicts of interest.

- In the event of a conflict between these contract certifications and a purchase order these contract certifications shall control.

THE FOLLOWING CERTIFICATIONS AND STATUTORY REQUIREMENTS ARE APPLICABLE FOR ALL ENTITIES EXCEPT WHERE SPECIFICALLY NOTED:

1. Vendor agrees that, if this is a multi-year contract, Vendor shall confirm compliance by July 1 of each year that this contract remains in effect. Vendor shall obtain from all Subcontractors a statement of compliance with these provisions. Should vendor or its subcontractor(s) fail to be or remain in compliance, the contract may be void by operation of law or the contract may be voidable at the option of the Owner without additional compensation. Violation of certain provisions may also be a civil or criminal offense.

2. Vendor, its employees and subcontractors will comply with applicable provisions of the U.S. Civil Rights Act, Section 504 of the Federal Rehabilitation Act, the Americans with Disabilities Act (42 U.S.C. § 12101 et seq.) and applicable rules in performance under this Contract.

3. This applies to individuals, sole proprietorships, partnerships and LLCs, but is not otherwise applicable. Vendor is not in default on an educational loan (5 ILCS 385/3).

4. Vendor has not been convicted of bribing or attempting to bribe an officer or employee of the State of Illinois or any other State, nor has Vendor made an admission of guilt of such conduct that is a matter of record (30 ILCS 500/50-5).

5. If Vendor has been convicted of a felony, at least five years have passed after the date of completion of the sentence for such felony, unless no person held responsible by a prosecutor's office for the facts upon which the conviction was based continues to have any involvement with the business (30 ILCS 500/50-10).

6. If Vendor, or any officer, director, partner, or other managerial agent of Vendor, has been convicted of a felony under the Sarbanes-Oxley Act of 2002, or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953, at least five years have passed since the date of the conviction. Vendor further certifies that it is not barred from being awarded a contract and acknowledges that the State shall declare the Contract void if this certification is false (30 ILCS 500/50-10.5).

7. Vendor and its affiliates are not delinquent in the payment of any debt to the State (or if delinquent has entered into a deferred payment plan to pay the debt), and Vendor and its affiliates
acknowledge the State may declare the Contract void if this certification is false (30 ILCS 500/50-11) or if Vendor or an affiliate later becomes delinquent and has not entered into a deferred payment plan to pay off the debt (30 ILCS 500/50-60).

8. Vendor and all affiliates shall collect and remit Illinois Use Tax on all sales of tangible personal property into the State of Illinois in accordance with provisions of the Illinois Use Tax Act (30 ILCS 500/50-12) and acknowledges that failure to comply can result in the Contract being declared void.

9. Vendor certifies that it has not committed a willful or knowing violation of the Environmental Protection Act (relating to Civil Penalties under the Environmental Protection Act) within the last five years, and is therefore not barred from being awarded a contract. If the State later determines that this certification was falsely made by the Vendor, the Vendor acknowledges that the State may declare the Contract void (30 ILCS 500/50-14).

10. Vendor has not paid any money or valuable thing to induce any person to refrain from bidding on a State contract, nor has Vendor accepted any money or other valuable thing, or acted upon the promise of same, for not bidding on a State contract (30 ILCS 500/50-25).


12. Vendor will report to the Illinois Attorney General and the Chief Procurement Officer any suspected collusion or other anti-competitive practice among any bidders, offerors, contractors, proposers or employees of the State (30 ILCS 500/50-40, 50-45, 50-50).

13. In accordance with the Steel Products Procurement Act, steel products used or supplied in the performance of a contract for public works shall be manufactured or produced in the United States, unless the executive head of the procuring agency grants an exception (30 ILCS 565).

14. If Vendor employs 25 or more employees and this Contract is worth more than $5,000, Vendor certifies that it will provide a drug free workplace in accordance with the requirements of the Illinois Drug-Free Workplace Act (30 ILCS 580).

15. If Vendor is an individual and this Contract is worth more than $5,000, Vendor shall not engage in the unlawful manufacture, distribution, dispensation, possession or use of a controlled substance during the performance of the Contract. (30 ILCS 580).

16. Neither Vendor nor any substantially owned affiliate is participating or shall participate in an international boycott in violation of the U.S. Export Administration Act of 1979 or the applicable regulations of the U.S. Department of Commerce. This certification applies to contracts that exceed $10,000 (30 ILCS 582).

17. Vendor has not been convicted of the offense of bid rigging or bid rotating or any similar offense of any state or of the United States (720 ILCS 5/33 E-3, E-4).

18. Vendor complies with the Illinois Department of Human Rights Act, 775 ILCS 5/2-105 (2010), and rules applicable to public contracts, including equal employment opportunity, refraining from unlawful discrimination, and having written sexual harassment policies.

Responsibility for Subcontractors’ Compliance: The Vendor shall be responsible for compliance with applicable provisions of the Act by all Subcontractors employed by the Vendor in connection with this contract and will promptly notify both the Owner and the Illinois Department of Human Rights in the event any Subcontractor fails or refuses to comply therewith. In addition, the Vendor shall not utilize any Subcontractor declared by the Illinois Human Rights Commission to be ineligible for contracts or subcontracts with the State of Illinois or any of its political subdivisions.
Penalties for Noncompliance: In the event of the Vendor’s noncompliance with any provision of the Illinois Human Rights Act or the Illinois Department of Human Rights’ Rules and Regulations for Public Contracts, the Vendor may be declared ineligible for future contracts or subcontracts with the State of Illinois or any of its political subdivisions. In addition, this contract may be canceled or voided in whole or in part and such other sanctions, penalties, or remedies may be imposed as provided by statute or regulation.

Illinois Department of Human Rights (DHR) Public Contracts Number: If Vendor has (a) employed fifteen (15) or more full-time persons at the time of application for this contract; (b) employed 15 or more persons at any time during the 365-day period prior to the date of applying for this contract; or (c) is directed to file by a contracting agency of the State of Illinois, any political subdivision, or a municipal corporation, then Vendor must have a current Public Contract Number or have proof of having submitted a completed application. Please complete the appropriate sections below.

Name of Company (and D/B/A): ____________________________________________
DHR Public Contracts Number: ____________________________________________
Date of Expiration: ____________________________________________
____ (check if applicable) The number is not required as the company has employed 14 or less full-time employees during the 365-day period immediately preceding the renewal period.

19. Vendor does not pay dues to, or reimburse or subsidize payments by its employees for any dues or fees to any “discriminatory club” (775 ILCS 25/2).

20. Vendor complies with the State Prohibition of Goods from Forced Labor Act, and certifies that no foreign-made equipment, materials, or supplies furnished to the State under the Contract have been or will be produced in whole or in part by forced labor, or indentured labor under penal sanction (30 ILCS 583).

21. Vendor certifies that no foreign-made equipment, materials, or supplies furnished to the State under the Contract have been produced in whole or in part by the labor or any child under the age of 12 (30 ILCS 584).

22. Vendor certifies that it has not committed a willful or knowing violation of the Lead Poisoning Prevention Act (410 ILCS 45) and acknowledges that it is prohibited from doing business with the State until the violation is mitigated. (30 ILCS 500/50-14.5).

23. Vendor (as “business entity” under 30 ILCS 500/50-37), certifies that it will not make a prohibited political contribution.

24. Vendor is required under 30 ILCS 500/20-65 to maintain, for a period of three (3) years after the later of the date of completion of this Contract or the date of final payment under the Contract, all books and records relating to the performance of the Contract and necessary to support amounts charged to the Owner under the Contract. The Contract and all books and records related to the Contract shall be available for review and audit by the Owner and the Illinois Auditor General. If this Contract is funded from contract/grant funds provided by the U.S. Government, the Contract, books, and records shall be available for review and audit by the Comptroller General of the U.S. and/or the Inspector General of the federal sponsoring agency. The Contractor agrees to cooperate fully with any audit and to provide full access to all relevant materials. Failure to maintain the required books and records shall establish a presumption in favor of the Owner for the recovery of any funds paid by the Owner under this Contract for which adequate books and records are not available.
25. Vendor is an existing legal entity, and as applicable, has obtained an assumed name certificate from the appropriate authority, is registered to conduct business in Illinois, and is in good standing with the Illinois Secretary of State. (30 ILCS 500/1.15.80)

26. Subcontractor certifies that it has not retained a person or entity to attempt to influence the outcome of a procurement decision for compensation contingent in whole or in part upon the decision or procurement. Subcontractor further certifies that it has not and will not, pursuant to this subcontract or otherwise, bill or otherwise cause the State of Illinois to pay for any of the lobbyist’s costs, fees, compensation, reimbursement or other remuneration (30 ILCS 500/50-38).

27. Vendor has disclosed if required, on forms provided by the State, and agrees it is under a continuing obligation to disclose to the State, financial or other interests (public or private, direct or indirect) that may be a potential conflict of interest or that would prohibit Vendor from having or continuing the Contract. This includes, but is not limited to conflicts under the “Infrastructure Task Force Fee Prohibition” section of the State Finance Act (30 ILCS 105/8.40), Article 50 of the Illinois Procurement Code (30 ILCS 500/50), or those which may conflict in any manner with the Vendor’s obligation under this Contract. Vendor shall not employ any person with a conflict to perform under this Contract. If any elected or appointed State officer or employee, or the spouse or minor child of same has any ownership or financial interest in the Vendor or the Contract, Vendor certifies it has disclosed that information to the State if required, on forms provided by the State, and any waiver of the conflict has been issued in accordance with applicable law and rule. A waiver is required if:

   a) the person intending to contract with the State, his/her spouse or child: (i) holds an elective office in Illinois; (ii) holds a seat in the Illinois General Assembly; (iii) is an officer or employee of the Capital Development Board or the Illinois Toll Highway Authority; or holds an appointed position or is employed in any of the offices or agencies of the State government and who receives compensation for such employment in excess of 60% of the salary of the Governor (currently $106,447.20). (The conflict of interest threshold of 60% of the Governor's salary set forth in Section 50-13 does not apply to elective office holders, legislators, and officers or employees of the Capital Development Board or the Illinois Toll Highway Authority.);

   b) the contract is with a firm, partnership, association or corporation in which a person referenced in a) above receives more than 7.5% of the total distributable income or an amount in excess of the salary of the Governor (currently $177,412.00).

   c) the contract is with a firm, partnership, association or corporation in which a person referenced in b) above, together with their spouse or minor child, receives more than 15% in the aggregate of the total distributable income or an amount in excess of 2 times the salary of the Governor (currently $354,824.00) from the firm, partnership, association or corporation.

28. Vendor shall pay all current and applicable city, county, State and Federal taxes, licenses, assessments, including Federal Excise Taxes, due on his work, including without thereby limiting the foregoing, those required by the Federal Insurance Contributions Act and the Federal and State Unemployment Tax Acts.

Vendor shall accept exclusive liability for, and pay, all taxes, license fees, assessments, and excises, levied, assessed or imposed upon or on account of the execution of the contract or on the materials therefor, or on the manufacture, storage, sale, receipts from sale, transportation or delivery of the materials therefor, under any Federal, State, or local law or laws, and in the event said taxes, license fees, assessments and excises, or any part thereof, are in the first instance charged to the Owner, the Vendor shall, at the demand of the Owner, pay the Owner the amount thereof, plus any and all penalties which may have accrued thereon.
The Owner is exempted by Section 3-5 of the Illinois Use Tax Act (35 ILCS 105/3-5 (2000)) from paying any of the taxes imposed by that Act, and sales to Owner are exempt by Section 2-5 of the Illinois Retailer's Occupation Tax Act (35 ILCS 120/2-5 (2000)) from any of the taxes imposed by that Act. The Department of Revenue of the State of Illinois under Rule No. 15, issued August 9, 1961, has declared that sales of materials to construction contractors for conversion into real estate for schools, governmental bodies, agencies and instrumentalities, are not taxable retail sales.

29. This applies to information technology contracts and is otherwise not applicable. Vendor acknowledges that all information technology, including electronic information, software, systems and equipment, developed or provided under this Contract must be accessible to individuals with disabilities to the greatest extent possible, in accordance with the Illinois Information Technology Accessibility Act Standards published at [website link].

30. This applies to service contracts and is otherwise not applicable. Vendor certifies (i) that it will offer to assume the collective bargaining obligations of the prior employer, including any existing collective bargaining agreement with the bargaining representative of any existing collective bargaining unit or units performing substantially similar work to the services covered by the contract subject to its bid or offer, and (ii) that it shall offer employment to all employees currently employed in any existing bargaining unit performing substantially similar work that will be performed under this contract (30 ILCS 500/25-80). This certification does not apply to heating and air-conditioning, plumbing and electrical service contracts.

31. The following certification is applicable for prime vendors only. In accordance with 30 ILCS 500/20-160, Vendor certifies that either:

- Vendor is not required to register as a business entity with the State Board of Elections.
- Vendor has registered as a business entity with the State Board of Elections and acknowledges a continuing duty to update the registration as required by the Act. A copy of the official certificate of registration as issued by the State Board of Elections is attached.

32. The following certification is applicable for prime vendors only. Disclosure of Business in Iran: You must respond to the following request for information. Failure to respond will disqualify your firm from consideration in this solicitation.

Within the 24 months before submission of the renewal offer the vendor, or any of its corporate parents or subsidiaries, has had business operations that involved contracts with or provision of supplies or services to:

- the Government of Iran;
- companies in which the Government of Iran has any direct or indirect equity share;
- consortiums or projects commissioned by the Government of Iran; or
- companies involved in consortiums or projects commissioned by the Government of Iran;

AND

- more than 10% of the company's revenues produced in, or assets located in, Iran involve oil-related activities or mineral-extraction activities; less than 75% of the company's revenues produced in, or assets located in, Iran involve contracts with or provision of oil-related or mineral-extraction products or services to the Government of Iran or a project or consortium created exclusively by that government; and the company has failed to take substantial action;

OR

- the company has, on or after August 5, 1996, made an investment of $20 million or more, or any combination of investments of at least $10 million each that in the
aggregate equals or exceeds $20 million in any 12-month period, that directly or significantly contributes to the enhancement of Iran’s ability to develop petroleum resources of Iran.

☐ NO, the above information does NOT apply to our firm.

☐ YES, the above information DOES apply to our firm. We understand that the participating Owner is required to notify the State Comptroller of this disclosure.

33. The Vendor certifies that it has complied with the Substance Abuse Prevention on Public Works Projects Act (820 ILCS 265) including the requirement to file with respective Owner a written program that meets or exceeds the requirements of the Act. The Vendor shall require this certification provision to be included in all sub-agreements.

34. The following certification is applicable for professional services consultants and subcontractors only. The Vendor certifies in addition to all applicable certifications and statutory requirements listed previously in said document that it is authorized to practice those specified professional services in contractual agreement under the applicable Illinois licensing and registration statutes.

35. The following certification is applicable for professional services consultants and subcontractors only. Vendor shall comply with the Copeland “Anti-Kickback” Act, as codified in 18 USC 874 (2010) and 40 USC 3145 (2010), and comply with the payment provisions and obligations detailed by the Office of the Secretary of Labor in 29 CFR, Part 3 (2010).

36. The following certification is applicable for professional services consultants and subcontractors only. Vendor shall refrain from discrimination and engage in affirmative steps to ensure that applicants and employees receive equal employment opportunity regardless of race, color, religion, sex, and/or national origin, in compliance with Federal Executive Orders 11246 (September 24, 1965), 11375 (October 17, 1967), and 11478 (August 8, 1969), as amended. Contractor shall also comply with all relevant rules, regulations and orders of the U.S. Secretary of Labor.

37. The following certification is applicable for contractors and subcontractors only. The Vendor certifies that it and its subcontractors are in compliance with the Illinois Procurement Code, 30 ILCS 500/30-22(6), Apprenticeship and Training Program requirement for each division of work bid. The program(s) must be in the same trade(s) in which the Vendor or its subcontractor(s) perform Work. For information on how to participate in or set up a program, Bidders may call the U.S. Department of Labor (312/596-5508) or check the USDOL website: www.doleta.gov/atels_bat/.

38. The following certification is applicable for contractors and subcontractors only. Pursuant to the Prevailing Wage Act, Vendor shall pay a wage of no less than the general prevailing hourly rate as paid for work of a similar character in the locality in which the work is performed, to all laborers, workers and mechanics, pursuant to definitions, guidelines and procedures set forth in 820 ILCS 130/0.01 et. seq. (2010).

The vendor shall submit monthly to Owner a certified copy of the records required under section 130/5(a)(1) of the Act. The certified payroll shall include records of all laborers, mechanics, and other workers employed by the vendor, including assigned subcontractors, for services performed. The records shall include each worker’s name, address, telephone number when available, social security number, classification or classifications, hourly wages paid in each pay period, number of hours worked each day, and the starting and ending times of each work day. The certified payroll shall be accompanied by a statement signed by the vendor and statements signed by each subcontractor where appropriate which aver that: (1) such records are true and accurate, (2) the hourly rate paid to each worker is not less than the general prevailing rate of hourly wages required under the Act; and (3) the vendor acknowledges that filing a certified payroll that he or she knows to be false is a Class B misdemeanor.
39. The following certification is applicable for contractors and subcontractors only. Pursuant to the Employment of Illinois Workers on Public Works Act, Vendor shall employ Illinois laborers on all public works projects or improvements or for the clean-up and on-site disposal of hazardous waste whenever there is a period of excessive unemployment in Illinois, pursuant to the guidelines and exceptions in 30 ILCS 570/0.01 et. seq. (2010)

40. The following certification is applicable for contractors and subcontractors only. Pursuant to the Veterans Preference Act, Vendor shall give preference to veterans of the United States military and naval service in appointments and employment upon public works by, or for the use of, the State or its political subdivisions, pursuant to the guidelines in 330 ILCS 55/0.01 et. seq. (2010)

41. The following certification is applicable for contractors and subcontractors only. Pursuant to the Public Works Employment Discrimination Act (775 ILCS 10/0.01 et. seq. (2010)), Vendor shall not refuse or deny employment to any person in any capacity on the ground of unlawful discrimination, nor subject any person to unlawful discrimination in any manner, in connection with the Agreement

42. The following certification is applicable for contractors and subcontractors only. Pursuant to the Health and Safety Act, Vendor shall provide reasonable protection to the lives, health and safety of its employees and provide such employees with employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm, pursuant to the guidelines set forth in 820 ILCS 225/0.01 et. seq. (2010).

43. Domestic Products Act: If applicable, please check the statement below that applies to the articles you are offering in this contract. For the purposes of this question, “manufactured in the United States” means in the case of assembled articles that final assembly occurred in the United States.

   ___ We certify that all offered articles were/will be manufactured in the United States. Contractor understands that, if it is awarded a contract based on a preference for US manufactured goods under the Procurement of Domestic Products Act (PA 93-0954), this certification will become part of the contract, and that if Contractor knowingly supplies non-US manufactured goods, it will be subject to penalties that include debarment for five years, voiding of the contract, and civil damages.

   ___ We are unable to certify that all offered articles were/will be manufactured in the United States.

By signing this form, Vendor certifies that the above information is accurate and complete:

Company name: ___________________________________________________________

Address: _________________________________________________________________

Telephone number: _________________________________________________________

FTIN: ____________________________
(Do NOT provide Social Security number)

Project Name/#: __________________________________________________________

Signature: ________________________

Printed name/Title: _______________________________________________________

Date: ____________________________
SUBCONTRACTORS: Vendor will or may use subcontractors  □ yes  □ No

1. Vendor shall identify in this section the names and addresses of all subcontractors to be utilized by Vendor in the performance of the Contract, together with the anticipated amount of money each subcontractor is expected to receive pursuant to the Contract. For purposes of this section, “subcontractors” are those specifically hired to provide to the Vendor or another subcontractor some or all of the goods, services, property, remuneration, or other forms of consideration that are the subject of this Contract, including sublessees from a lessee of a State agency.

2. A copy of each subcontract issued pursuant to the Contract shall be provided to the State Purchasing Officer or Chief Procurement Officer within 20 days after the execution of the Contract or after execution of the subcontract, whichever is later. It is preferred that the subcontract be provided in PDF format and be sent to:

   Buyer:  
   Address:  
   Phone:  
   Email:  

3. If at any time during the term of the Contract, Vendor adds or changes any subcontractors, Vendor will be required to promptly notify, by written amendment to the Contract, the State Purchasing Officer or the Chief Procurement Officer (care of the person identified in 2. Above) of the names and addresses and the expected amount of money that each new or replaced subcontractor will receive pursuant to the Contract.

4. Any subcontracts entered into prior to award of the Contract are done at the Vendor’s and subcontractor’s risk.

5. All subcontracts must include the Standard Qualifications, Certifications, & Disclosures Attachment, completed by the subcontractor. Contractors should copy these forms from this contract document and insure they are included and provided as part of all subcontracts.

6. List all subcontractor information including name, address, phone, email, and anticipated amount to be paid on the following page.
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End of Section 00314

NEIU # 11-0226-0911  00314-2  Subcontractor Attachment for Bids
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00315
MINORITY, FEMALE, AND PERSONS WITH DISABILITY STATUS SUBCONTRACTING
BUSINESS ENTERPRISE PROGRAM (BEP) UTILIZATION PLAN

The State of Illinois Business Enterprise Program Act for Minorities, Females and Persons with Disabilities (BEP) (30 ILCS 575) establishes a goal for contracting with businesses that have been certified as owned and controlled by persons who are minority, female or who have disabilities.

Contract Goal to be achieved by the Vendor: This contract includes a specific Business Enterprise Program (BEP) utilization goal of 20% based on the availability of certified vendors to perform the anticipated direct subcontracting opportunities of this contract. In addition to the other award criteria established for this contract, NEIU will award this contract to a Vendor that meets the goal or makes good faith efforts to meet the goal. This goal is also applicable to change orders and allowances within the scope of work provided by the certified vendor.

Following are guidelines for the Vendor’s response in the Utilization Plan. A format for the utilization plan is included in this section. Vendor should include any additional information that will add clarity to the Vendor’s proposed utilization of certified vendors to meet the targeted goal. The Utilization Plan must demonstrate that the Vendor has either met the contract goal or that it has made good faith efforts to do so.

At the time of proposal submission, the Certified Vendor may not yet be certified with CMS Business Enterprise Program; however, the Certified Vendor must meet the eligibility requirements and be fully certified in the BEP Program before contract award. Visit http://www.sell2.illinois.gov/bep/Business_Enterprise.htm for complete requirements and to apply for certification in the Business Enterprise Program.

If applicable, the Plan should include an executed joint venture agreement specifying the terms and conditions of the relationship between the partners and their relationship and responsibilities to the contract. The joint venture agreement must clearly evidence that the certified vendor will be responsible for a clearly defined portion of the work and that its responsibilities, risks, profits and contributions of capital and personnel are proportionate to its ownership percentage. It must include specific details related to the parties’ contributions of capital, personnel and equipment and share of the costs of insurance and other items; the scopes to be performed by the certified vendor’s own forces and under its supervision; and the commitment of management, supervisory personnel and operative personnel employed by the certified vendor to be dedicated to the performance of the contract. Each joint venture partner must execute the proposal to NEIU.

An agreement between a vendor and a certified vendor in which the certified vendor promises not to provide subcontracting quotations to other vendors is prohibited. NEIU may request additional information to demonstrate compliance. The Vendor agrees to cooperate promptly with the designated NEIU representative in submitting to interviews, allowing entry to places of business, providing further documentation, or soliciting the cooperation of a proposed certified vendor. Failure to cooperate may render the proposal non-responsive. The contract will not be finally awarded until the Vendor’s Utilization Plan is approved.
**Certified Vendor Locator References:** Vendors may consult CMS’ BEP Certified Vendor Directory at [www.sell2.illinois.gov/bep/Small_and_Diverse_Businesses.htm](http://www.sell2.illinois.gov/bep/Small_and_Diverse_Businesses.htm), as well as the directories of other certifying agencies but subcontracting vendors must be certified by CMS as BEP vendors before the time of contract award.

**Vendor Assurance:** The Vendor shall not discriminate on the basis of race, color, national origin, sexual orientation or sex in the performance of this contract. Failure by the Vendor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as NEIU deems appropriate. This assurance must be included in each subcontract that the Vendor signs with a subcontractor or supplier.

**Calculating Certified Vendor Participation:** The Utilization Plan documents work anticipated to be performed by all certified vendors and paid for upon satisfactory completion. Only the value of payments made for the work actually performed by certified BEP vendors is counted toward the contract goal. Counting guidelines are summarized below:

1) The value of the work actually performed by the certified vendor’s forces shall be counted towards the goal. The entire amount of that portion of the contract that is performed by the certified vendor’s forces, including supplies purchased or equipment leased by the BEP vendor shall be counted, except supplies purchased and equipment rented from the Vendor.

2) A joint venture shall count the portion of the total dollar value of the contract equal to the distinct, clearly defined portion of the work of the contract that the certified vendor performs with its forces toward the goal. A joint venture shall also count the dollar value of work subcontracted to other certified vendors. Work performed by the forces of a non-certified joint venture partner shall not be counted toward the goal.

3) When a certified vendor subcontracts part of the work of its contract to another firm, the value of the subcontracted work shall be counted toward the contract goal only if the certified vendor’s subcontractor is a certified vendor. Work that a certified vendor subcontracts to a non-certified vendor will not count towards the goal.

4) A Vendor shall count towards the goal 100% of its expenditures for materials and supplies required under the contract and obtained from a certified vendor manufacturer, regular dealer or supplier.

5) A Vendor shall count towards the goal the following expenditures to certified vendors that are not manufacturers, regular dealers or suppliers:

   (a) The fees or commissions charged for providing a bona fide service, such as professional, technical, consultant or managerial services and assistance in the procurement of essential personnel, facilities, equipment, materials or supplies required for performance of the contract, provided that the fee or commission is determined by NEIU to be reasonable and not excessive as compared with fees customarily allowed for similar services.

   (b) The fees charged for delivery of materials and supplies required by the contract (but not the cost of the materials and supplies themselves) when the hauler, trucker, or delivery service is not also the manufacturer of or a regular dealer in the materials and supplies, provided that the fee is determined by NEIU to be reasonable and not excessive as compared with fees customarily allowed for similar services. The certified vendor
A trucking firm must be responsible for the management and supervision of the entire trucking operation for which it is responsible on the contract, and must itself own and operate at least one fully licensed, insured and operational truck used on the contract.

(c) The fees or commissions charged for providing any bonds or insurance specifically required for the performance of the contract, provided that the fee or commission is determined by NEIU to be reasonable and not excessive as compared with fees customarily allowed for similar services.

6) A Vendor shall count towards the goal only expenditures to firms that perform a commercially useful function in the work of the contract.

(a) A firm is considered to perform a commercially useful function when it is responsible for execution of a distinct element of the work of a contract and carries out its responsibilities by actually performing, managing, and supervising the work involved. The certified vendor must also be responsible, with respect to materials or supplies used on the contract, for negotiating price, determining quality and quantity, ordering the materials or supplies, and installing the materials (where applicable) and paying for the material or supplies. To determine whether a firm is performing a commercially useful function, NEIU shall evaluate the amount of work subcontracted, whether the amount the firm is to be paid under the contract is commensurate with the work it is actually performing and the credit claimed for its performance of the work, industry practices, and other relevant factors.

(b) A certified vendor does not perform a commercially useful function if its role is limited to that of an extra participant in a transaction or contract through which funds are passed in order to obtain certified vendor participation. In determining whether a certified vendor is such an extra participant, NEIU shall examine similar transactions, particularly those in which certified vendors do not participate, and industry practices.

7) A Vendor shall not count towards the goal expenditures that are not direct, necessary and proximately related to the work of the contract. Only the amount of services or goods that are directly attributable to the performance of the contract shall be counted. Ineligible expenditures include general office overhead or other Vendor support activities.

Good Faith Effort Procedures: If the Vendor cannot meet the goal, the Vendor must document in the Utilization Plan its good faith efforts that could reasonably have been expected to meet the goal. NEIU will consider the quality, quantity, and intensity of the Vendor’s efforts.

1) The following is a list of types of action that NEIU will consider as evidence of the Vendor's good faith efforts to meet the goal. Other factors or efforts brought to the attention of NEIU may be relevant in appropriate cases.

(a) Soliciting through all reasonable and available means (e.g., attendance at pre-bid meetings, advertising and/or written notices) the interest of all certified vendors that have the capability to perform the work of the contract. The Vendor must solicit this interest within sufficient time to allow the certified vendors to respond to the solicitation. The Vendor must determine with certainty if the certified vendors are interested by taking appropriate steps to follow up initial solicitations and encourage them to bid. The Vendor must provide interested certified vendors with adequate information about the plans, specifications, and...
requirements of the contract in a timely manner to assist them in responding promptly to the solicitation.

(b) Selecting portions of the work to be performed by certified vendors in order to increase the likelihood that the goal will be achieved. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate certified vendor participation, even when the Vendor might otherwise prefer to perform these work items with its own forces.

(c) Making a portion of the work available to certified vendors and selecting those portions of the work or material needs consistent with their availability, so as to facilitate certified vendor participation.

(d) Negotiating in good faith with interested certified vendors. Evidence of such negotiation includes the names, addresses, and telephone numbers of certified vendors that were considered; a description of the information provided regarding the plans and specifications for the work selected for subcontracting and evidence as to why additional agreements could not be reached for certified vendors to perform the work. A Vendor using good business judgment will consider a number of factors in negotiating with certified vendors and will take a firm’s price and capabilities into consideration. The fact that there may be some additional costs involved in finding and using certified vendors is not in itself sufficient reason for a Vendor’s failure to meet the goal, as long as such costs are reasonable. Vendors are not required to accept higher quotes from certified vendors if the price difference is excessive or unreasonable.

(e) Thoroughly investigating the capabilities of certified vendors and not rejecting them as unqualified without sound reasons. The certified vendor’s memberships in specific groups, organizations, or associations and political or social affiliations are not legitimate causes for the rejection or non-solicitation of bids in the Vendor’s efforts to meet the goal.

(f) Making efforts to assist interested certified vendors in obtaining lines of credit or insurance as required by NEIU, the Vendor or to perform the scope of work.

(g) Making efforts to assist interested certified vendors in obtaining necessary equipment, supplies, materials, or related assistance or services.

(h) Effectively using the services of available minority/women community organizations; minority/women vendors’ groups; local, state, and federal minority/women business assistance offices; and other organizations that provide assistance in the recruitment and placement of certified vendors.

2) In evaluating the Vendor’s good faith efforts, the good faith efforts of other vendors to meet the goal on this solicitation or similar contracts may be considered.

3) If NEIU determines that the Vendor has made good faith efforts to meet the goal, NEIU will award the contract provided that the Vendor is otherwise eligible for award. If NEIU determines that the Vendor has not made good faith efforts, NEIU will notify the Vendor of that preliminary determination. The preliminary determination shall include a statement of reasons why good faith efforts have not been found, and may include additional good faith
efforts that the Vendor could take. The Vendor shall have 5 business days to make the suggested good faith efforts and any other additional good faith efforts to meet the goal. The Vendor shall submit an amended Utilization Plan if additional certified vendor commitments to meet the goal are secured. If additional certified vendor commitments sufficient to meet the goal are not secured, the Vendor shall report the final good faith efforts made in the time allotted. All additional efforts taken by the Vendor will be considered. If NEIU determines that good faith efforts have not been made, it will notify the Vendor in writing of the reasons for its determination within 5 business days of receipt of the final Utilization Plan.

**Contract Compliance:** Compliance with this section is an essential part of the contract. The following administrative procedures and remedies govern the Vendor’s compliance with the contractual obligations established by the Utilization Plan. After approval of the Plan and award of the contract, the Utilization Plan becomes part of the contract. If the Vendor did not succeed in obtaining enough certified vendor participation to achieve the goal, and the Utilization Plan was approved and contract awarded based upon a determination of good faith, the total dollar value of certified vendor work calculated in the approved Utilization Plan as a percentage of the awarded contract value shall become the contract goal.

1) The Utilization Plan may not be amended without the NEIU’s prior written approval.

2) The Vendor may not make changes to its contractual BEP certified vendor commitments or substitute BEP certified vendors without the prior written approval of NEIU. Unauthorized changes or substitutions, including performing the work designated for a certified vendor with the Vendor’s own forces, shall be a violation of the utilization plan and a breach of the contract, and shall be cause to terminate the contract, and/or seek other contract remedies or sanctions. The facts supporting the request for changes must not have been known nor reasonably should have been known by the parties prior to entering into the subcontract. The Vendor must negotiate with the certified vendor to resolve the problem. Where there has been a mistake or disagreement about the scope of work, the certified vendor can be substituted only where agreement cannot be reached for a reasonable price or schedule for the correct scope of work.

3) Substitutions of a certified vendor shall be permitted under the following circumstances:

   (a) Unavailability after receipt of reasonable notice to proceed;

   (b) Failure of performance;

   (c) Financial incapacity;

   (d) Refusal by the certified vendor to honor the bid or proposal price or scope;

   (e) Material mistake of fact or law about the elements of the scope of work of a solicitation where reasonable price cannot be agreed;

   (f) Failure of the certified vendor to meet insurance, licensing or bonding requirements;

   (g) The certified vendor’s withdrawal of its bid or proposal; or
(h) Decertification of the certified vendor.

4) If it becomes necessary to substitute a certified vendor or otherwise change the Utilization Plan, the Vendor must notify NEIU in writing of the request to substitute a certified vendor or otherwise change the Utilization Plan. The request must state specific reasons for the substitution or change. NEIU will approve or deny a request for substitution or other change in the Utilization Plan within 5 business days of receipt of the request.

5) Where the Vendor has established the basis for the substitution to NEIU’s satisfaction, it must make good faith efforts to meet the contract goal by substituting a certified vendor. Documentation of a replacement vendor, or of good faith efforts to replace the certified vendor, must meet the requirements of the initial Utilization Plan. If the goal cannot be reached and good faith efforts have been made, the Vendor may substitute with a non-certified vendor.

6) If a Vendor plans to hire a subcontractor for any scope of work that was not previously disclosed in the Utilization Plan, the Vendor must obtain the approval of NEIU to modify the Utilization Plan and must make good faith efforts to ensure that certified vendors have a fair opportunity to bid on the new scope of work.

7) A new subcontract must be executed and submitted to NEIU within 5 business days of the Vendor's receipt of NEIU's approval for the substitution or other change.

8) The Vendor shall maintain a record of all relevant data with respect to the utilization of certified vendors, including but without limitation, payroll records, invoices, canceled checks and books of account for a period of at least 5 years after the completion of the contract. Full access to these records shall be granted by the Vendor upon 48 hours written demand by NEIU to any duly authorized representative thereof, or to any municipal, state or federal authorities. NEIU shall have the right to obtain from the Vendor any additional data reasonably related or necessary to verify any representations by the Vendor. After the performance of the final item of work or delivery of material by a certified vendor and final payment to the certified vendor by the Vendor, but not later than 30 calendar days after such payment, the Vendor shall submit a statement confirming the final payment and the total payments made to the BEP vendor under the contract.

9) NEIU will periodically review the Vendor’s compliance with these provisions and the terms of its contract. Without limitation, the Vendor’s failure to comply with these provisions or its contractual commitments as contained in the Utilization Plan, failure to cooperate in providing information regarding its compliance with these provisions or its Utilization Plan, or provision of false or misleading information or statements concerning compliance, certification status or eligibility of certified vendors, good faith efforts or any other material fact or representation shall constitute a material breach of this contract and entitle NEIU to declare a default, terminate the contract, or exercise those remedies provided for in the contract or at law or in equity.

10) NEIU reserves the right to withhold payment to the Vendor to enforce these provisions and the Vendor’s contractual commitments. Final payment shall not be made on the contract until the Vendor submits sufficient documentation demonstrating compliance with its Utilization Plan.
UTILIZATION PLAN

___________________________ (the Vendor) submits the following Utilization Plan as part of our proposal in accordance with the requirements of the Minority, Female, Persons with Disability Status and Subcontracting section of the solicitation for _________. We understand that compliance with this section is an essential part of this contract and that the Utilization Plan will become a part of the contract, if awarded.

___________________________ (the Vendor) makes the following assurance and agrees to include the assurance in each subcontract with a subcontractor or supplier utilized on this contract: We shall not discriminate on the basis of race, color, national origin, sexual orientation or sex in the performance of this contract. Failure to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy, as the NEIU deems appropriate.

Vendor’s person responsible for compliance:

Name: ________________________________

Title: ________________________________

Telephone: (______) ____________________ extension ________

Email: ________________________________

We submit one (1) of the following statements:

☐ We are certified (or are eligible and have applied to be certified) with BEP and plan to fully meet the BEP utilization goal through self-performance.

☐ We attach Section I to demonstrate our Plan fully meets the BEP utilization goal of ______% through subcontracting.

☐ We attach Section I to detail that we do not fully meet the BEP utilization goal. We also attach Section II, Demonstration of Good Faith Efforts.
SECTION I

UTILIZATION OF CERTIFIED VENDORS

Please submit a separate Section I for each proposed certified vendor.

To achieve the BEP utilization goal through subcontracting, the following is proposed:

1) The proposed certified vendor’s company name, address and phone number:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

At the time of submission, the above certified vendor is:

☐ Certified with the CMS Business Enterprise Program (BEP)

☐ Meets the criteria and has submitted an application for certification with BEP
  (BEP certification must be completed before contract award)

☐ Certified as a disadvantaged, minority, or woman business enterprise with the
  following governmental agency or private organization (BEP certification must be
  completed before contract award):

________________________________________________________________________

________________________________________________________________________

2) A detailed description of the commercially useful work to be done by this certified vendor is
   as follows:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

3) The total estimated cost to NEIU for this contract is $______.

   The portion of the contract which will be subcontracted to this certified vendor is
$______________,
or ______% of the total cost of the contract.

4) A notarized signed letter of intent between _____________________________the Vendor)
and ______________________ (the certified vendor) detailing the work to be performed by the
certified vendor and the agreed upon rates or prices, conforming to the Utilization Plan is
included.

5) A joint venture agreement is not required, as the arrangement between

___________________________ and _____________________________ is that of
contractor/sub-contractor and not a joint venture.

or,

A joint venture agreement between ______________________ and ______________________
___________ is included in lieu of the letter of intent.

6) The Vendor has not prohibited or otherwise limited ______________________ (certified
vendor) from providing subcontractor quotes to other potential respondents/vendors.

We understand that NEIU may require additional information to verify our compliance and we agree
to cooperate immediately in submitting to interviews, allowing entry to any of our office locations,
providing further documentation, or soliciting the cooperation of our proposed certified vendor. We
will maintain appropriate records relating to our utilization of the certified vendor including: invoices,
cancelled checks, books of account, and time records.
SECTION II

DEMONSTRATION OF GOOD FAITH EFFORTS TO ACHIEVE BEP SUBCONTRACTING GOAL

If the BEP subcontracting goal was not achieved, the Good Faith Efforts checklist (Section II A) and contacts log (Section II B) must be submitted with the solicitation response (or as otherwise specified by NEIU). Failure to do so may render the Vendor’s solicitation response non-responsive and cause it to be rejected, or render the Vendor ineligible for contract award, at NEIU’s sole discretion. The Vendor will promptly provide evidence in support of its Good Faith Efforts to NEIU upon request.

Section II A --Good Faith Efforts Checklist

Insert on each line below the initials of the authorized Vendor representative who is certifying on behalf of the Vendor that the Vendor has completed the activities described below. If any of the items below were not completed, attach a detailed written explanation why each such item was not completed. If any other efforts were made to obtain BEP participation in addition to the items listed below, attach a detailed written explanation.

_____ Identified portions of the project work capable of performance by available BEP vendors, including, where appropriate, breaking out contract work items into economically feasible units to facilitate BEP participation even when the Vendor could perform those scopes with its own forces.

_____ Solicited through reasonable and available means (e.g., written notices, advertisements) BEP vendors to perform the types of work that could be subcontracted on this project, within sufficient time to allow them to respond.

_____ Provided timely and adequate information about the plans, specifications and requirements of the contract. Followed up initial solicitations to answer questions and encourage BEP vendors to submit proposals or bids.

_____ Negotiated in good faith with interested BEP vendors that submitted proposals or bids and thoroughly investigated their capabilities.

_____ Made efforts to assist interested BEP vendors in obtaining bonding, lines of credit, or insurance as may be required for performance of the contract (if applicable).
Utilized resources available to identify available certified vendors, including but not limited to BEP assistance staff; local, state and federal minority or women business assistance offices; and other organizations that provide assistance in the recruitment and placement of diverse businesses.

Section II B -- Good Faith Efforts Contacts Log for Soliciting

**BEP Sub-consultant, Subcontractor or Supplier Participation**

Use this form to document all contacts and responses (telephone, e-mail, fax, etc.) regarding the solicitation of BEP sub-consultants, subcontractors and suppliers. Duplicate as needed. (It is not necessary to show contacts with certified vendors with which the Vendor reached an agreement to participate on this project, as shown on Section I of this Plan.)

<table>
<thead>
<tr>
<th>Name of certified vendor firm</th>
<th>Date and method of contact</th>
<th>Scope of work solicited</th>
<th>Reason agreement was not reached</th>
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Letter of Intent (LOI)

Between Prime Vendor and Certified Vendor

Instructions: The respondent is required to submit this signed and notarized Letter of Intent from each certified vendor identified on the Utilization Plan. LOIs must be submitted with the proposal and must be notarized by both parties. Submit a separate LOI for each proposed certified vendor. The amount and scope of work indicated on each LOI shall be the actual amount indicated on the Utilization Plan submitted with the proposal and approved by the NEIU.

Changes to the Utilization Plan including substitution of certified vendors are permitted only after award of the contract and only with prior written approval of NEIU. A request for changes to the Utilization Plan must be submitted on the Request for Change of Utilization Plan Form for all levels of subcontracting. LOIs must be submitted for all additions of certified vendors to the Utilization Plan prior to the start of work.

Project Name ___________________________ Project/Solicitation Number: __________

Name of Prime Vendor: ____________________________

Address: __________________________________________

                     Street       City   State   Zip Code

Telephone: (____)________________ Fax: (_)________________ Email: __________________

Name of Certified Vendor: ____________________________

Address: __________________________________________

                     Street       City   State   Zip Code

Telephone: (____)________________ Fax: (_)________________ Email: __________________


Type of agreement: □ Services □ Supplies □ Both Services/Supplies

Type of payment: □ Lump Sum □ Hourly Rate □ Unit Price

Period of Performance: Proposed Subcontract Amount $ or Proposed % of Contract

Description of work to be performed by certified vendor:

List the governmental agency or private organization with whom the certified vendor is currently certified as a disadvantaged, minority, or woman business enterprise.
The prime vendor and the certified vendor above hereby agree that upon the execution of a contract for the above-named project between the prime vendor and the State of Illinois, the certified vendor will perform the scope of work for the price as indicated above.

**Prime Vendor** (Company Name and D/B/A):  
________________________________________
Signature
________________________________________
Printed Name
Title: __________ Date: __________

**Certified Vendor** (Company Name and D/B/A):  
________________________________________
Signature
________________________________________
Printed Name
Title: __________ Date: __________

Subscribed and sworn before me this ______ day of __________, 20___.
________________________________________
Notary Public
My Commission expires: __________

Subscribed and sworn before me this ______ day of __________, 20___.
________________________________________
Notary Public
My Commission expires: __________
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00400

BID OPENING AND AWARD

00410 - BID OPENING

1. At the time and address stated in the Advertisement for Bids, all Bids will be publicly opened and read. Noted errors, omissions and defects will be announced. All Bids received after that time will be returned unopened to the Bidder. Official time will be at NEIU.

2. **Time For Acceptance:** Bids shall be valid for 90 calendar days after Bid opening unless otherwise specified. NEIU and the Bidder may agree to extend the acceptance period beyond ninety (90) calendar days.

3. **Reading of Bids:** The public opening and reading of Bids is for informational purposes only, and is not to be construed as acceptance or rejection of any of the Bids submitted.

00420 - REJECTION OF BIDS

1. **Defective Bids:** Defects or causes which will result in rejection include, but are not limited to:
   
   A. Failure to be qualified in accordance with these documents.
   
   B. Submission of a late Bid and Bid prepared in pencil.
   
   C. Submission of a Bid that is not in substantial conformance with the Bidding Documents.
   
   D. Submission of Bid Security in less than the amount stated in the Bidding Documents.
   
   E. Failure to complete and sign the Bid Form.
   
   F. Failure to complete and submit all, Section 00300 thru 00315 Bidding and Contract Requirements Forms marked “REQUIRED BID SUBMITTAL FORM” in margin.
   
   G. All other errors, omissions and defects which are determined by NEIU to be technical deficiencies or acceptable irregularities may be waived by NEIU, including but not limited to the submission of Bid Security provided by a suspended Surety if, within five (5) business days after receipt of notification thereof, Bid Security acceptable to NEIU is supplied.

2. **Cancellation of Advertisement:** NEIU reserves the right to cancel all or any part of the Advertisement for Bids.

3. **NEIU’s Rights:** Whenever, in its opinion, it is in the best interest of the State and not inconsistent with the competitive bidding process, NEIU reserves the right to:
   
   A. Accept any Bid.
B. Reject any or all bids.
C. Waive technical deficiencies and irregularities.
D. Rescind any Notice of Award if NEIU determines that the Notice of Award was issued in error.
E. Rescind any Notice of Award for the convenience of the State per Subsection 00720.
F. Rebid any Contract.

00430 - AWARD

1. The issuance of a Notice of Award is based upon the expectation of the Contractor's timely compliance with all post award requirements.

2. The Contract will be awarded to the lowest responsible Bidder whose Bid produces the lowest combination of Base Bid and accepted Alternate Bids.

End of Section 00400
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00500
POST AWARD REQUIREMENTS

00501 - GENERAL REQUIREMENTS

1. **Submittals:** Within fifteen (15) business days after date of the Notice of Award, the Contractor shall furnish, on NEIU forms, an A.I.A. or other form acceptable to NEIU, the following:
   A. Contract executed by the Contractor.
   B. Performance Bond.
   C. Labor and Material Payment Bond.
   D. Certificates of Insurance.
   E. Schedule of Values
   F. List of All Sub-Contractors

   1. The Contractor shall provide the names and addresses of all authorized subcontractors to be utilized by the Contractor in the performance of this contract, together with a description of the work to be performed by the subcontractor and the anticipated amount of money that each subcontractor is expected to receive pursuant to this contract.

   2. The Contractor shall provide a copy of any subcontracts within 20 days of execution of this contract. All subcontracts must include the same certifications that vendor must make as a condition of this contract. The Contractor shall include in each subcontract the subcontractor certifications as shown on the Subcontractor Standard Certifications and Subcontractor Disclosures forms available from the State.

   3. The Contractor shall notify the State of any additional or substitute subcontractors hired during the term of this contract. The Contractor shall provide to the State a copy of all such subcontracts within 20 days of execution of the subcontract.

2. **Recertification:** If the contract extends over multiple years, contractor and its subcontractors shall confirm compliance by July 1 of each year that this contract remains in effect. Contractor shall obtain from all Subcontractors a statement of compliance with these provisions. Should the contractor or subcontractor(s) fail to be or remain in compliance, the contract may be void by operation of law or the contract may be voidable at the option of NEIU without additional compensation. Violation of certain provisions may also be a civil or criminal offense.

3. **Cancellation of Award:** All post award requirements are mandatory. Noncompliance shall be cause for NEIU to cancel the Notice of Award.

4. **Post Award Extensions:** NEIU may extend the time limitations for good cause. No extension shall operate as a waiver of post award requirements, nor shall it extend the contract completion time.

End of Section 00500
DIVISION 0 - BIDDING AND CONTRACT REQUIREMENTS

SECTION 00600
BONDS AND INSURANCE

00605 - GENERAL

1. **Bonds and Insurance Required:** The Contractor shall provide bonds and insurance specified in the Bidding Documents.

00607 - QUALIFICATIONS OF SURETY COMPANIES

1. **Bonds:** The Contractor shall furnish a Performance Bond and a Labor Material Payment Bond covering the faithful performance of the Contract and the payment of all obligations arising thereunder. Each bond shall be in the full amount of the contract sum and executed by a Surety acceptable to NEIU.

2. **Acceptability:** Surety companies shall be acceptable to NEIU in accord with these documents. Surety company shall:
   
   A. Be approved or listed in Treasury Circular 570; or
   
   B. Have a policy holders rating of B or better and a financial rating of Class V or higher in Bests' Key Rating Guide (current edition) are acceptable; and,
   
   C. Be duly licensed to transact business in Illinois; and,
   
   D. Not be found unacceptable by NEIU for reasons of non-performance.

3. **Signature Authority:** Attorneys-in-Fact who sign bonds shall file with each bond a certified and effectively dated copy of their Power of Attorney and jurat (Notary's statement authenticating signature).

4. The Director of Purchasing is authorized to waive insurer and Surety prequalification standards established above in cases where the Director of Procurement determines that the standards create an extreme hardship on a Contractor desirous of submitting a Bid or obtaining an Authorization to Proceed for a NEIU project.

00610 - PERFORMANCE BONDS

1. The Contractor and its Surety shall be bound by Sub-Section 00720 regarding NEIU's authority to carry out the work and terminate the Contract.

2. Surety shall waive notice of any changes in the Contract, including extensions of time for the performance thereof.

3. No right of actions shall accrue on the bond to or for the use of any person or corporation other than NEIU.

00620 - LABOR AND MATERIAL PAYMENT BOND

1. The bond shall cover material used in the performance of the Contract and the labor at the prevailing wages established by the Illinois Department of Labor.
2. The Surety shall waive notice of any changes in the Contract, including extensions of time for the performance thereof.

00650 - INSURANCE

1. Qualifications of Insurance Companies:
   A. An insurer's policy with a policy holders rating of B and a financial rating of Class V or higher in Bests' Key Rating Guide (current edition) are acceptable.
   B. Insurance policies written by Lloyds of London are acceptable where in compliance with 1987 Ill. Rev. Ch. 73, Par. 698 et seq.
   C. Policies from Risk Retention groups organized and operated under State or Federal laws will be acceptable in occurrence form only.
   D. Insurance company duly licensed to transact business in Illinois.

2. Certificates of Insurance:
   A. Contractor shall file with NEIU a Certificate of Insurance, showing complete coverage of all insurance required by this Section, signed by the insurance company's authorized agent.
   B. NEIU shall be included as an additional insured for Commercial/Comprehensive General Liability, umbrella, and Builders' Risk policies or certificates.
   C. Each policy, binder or certificate shall contain a provision that the policy will not be canceled, changed, or altered until at least thirty (30) calendar days prior written notice has been given to the named insured and NEIU.

3. Reconstruction: The prompt repair or reconstruction of the Work as a result of an insured loss or damage shall be the Contractor's responsibility and shall be accomplished at no additional cost to NEIU. The Contractor shall furnish proper assistance in the adjustment and settlement of all losses. Loss will be adjustable with and payable to the party purchasing the Builder's Risk Insurance, who shall be responsible for apportioning the loss proceeds to each and every entity involved in the loss to the extent of its interest.

4. Required Minimum Insurance Coverages:
   A. Comprehensive Automobile Liability:
      1. $ 500,000 Bodily Injury Per Person
      2. $1,000,000 Bodily Injury Per Occurrence
      3. $ 500,000 Property Damage Per Occurrence
      4. $1,000,000 Combined Single Limit Coverage for bodily injury and property damage per occurrence in the same aggregate limit will be accepted in lieu of the separate limits specified above.
   B. Workmen's Compensation: Statutory Limits
      1. Employer's Liability: $500,000 Bodily Injury Per Person
      2. The Contractor may use a Self-Insured Plan for Workmen's Compensation Insurance if the Plan is approved by the State of Illinois. For approval, the Contractor shall obtain a Certificate from
the Illinois Industrial Commission, Office of Self-Insurance Administration, and Springfield Office.

3. **Certification of Carrier**: The Worker's Compensation Insurance carrier, or self insurance service agency where applicable, shall certify that to the best if its knowledge, the contractor has properly reported wage and workforce data and made premium payments in compliance with Illinois rates and worker classifications.

C. **Commercial/Comprehensive General Liability (occurrence form)**. Include coverage for premises and operations, broad form property damage, products completed operations, independent contractor's personal injury liability, and contractual obligations. Coverage shall not be excluded because of the contractor's negligence. A Response Action Contractor may provide the Commercial Comprehensive General Liability Insurance on a claims made form. Where the hazard exists, the contractor shall purchase and maintain insurance to protect against claims due to explosion, collapse, or underground damage.

1. $1,000,000 Bodily Injury Per Person
2. $1,000,000 Bodily Injury Aggregate Limit
3. $500,000 Property Damage Per Occurrence
4. $1,000,000 Property Damage Aggregate Limit
5. $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.

D. **Umbrella or Excess of Loss Coverage**:

1. If the limits specified in Section 00650.4.A and C are not met, an Umbrella or Excess Liability policy of not less than $1,000,000 for any one occurrence and subject to the same aggregate over the Comprehensive Automobile Liability and Commercial/Comprehensive General Liability coverages are acceptable. Umbrella coverage is subject to NEIU's approval as to form and amount of self insured retention.

00655 - **BUILDER'S RISK INSURANCE**

1. Builder's Risk Insurance shall be purchased and maintained by Northeastern Illinois University. The policy can be made available for review by contacting the Director of Procurement.

**End of Section 00600**
DIVISION 0 - BIDDING AND CONTRACT DOCUMENTS

SECTION 00700
GENERAL CONDITIONS

00701 - DEFINITIONS

1. **Bidding Documents** include:
   A. This "Project Manual," All contents listed in table of contents
   B. Advertisement for Bids
   C. Bid Forms
   D. Bid Bond
   E. Tables, Charts, Drawings which are listed in Index of Drawings
   F. Addenda

2. **Contract Documents** include:
   A. The Bidding Documents
   B. Contractor's bid as accepted by NEIU
   C. Contract
   D. Approved IDHR forms
   E. Performance Bond
   F. Labor & Material Payment Bond
   G. Required Insurance
   H. Approved Change Orders

3. **Northeastern Illinois University** is a State agency created by the General Assembly in Illinois Revised Statutes, Ch. 144, par. 1151-1153, as amended, herein referred to as "NEIU".

4. **Owner** is the Board of Trustees of Northeastern Illinois University, a body politic and corporate of the State of Illinois, created and established under Illinois Revised Statutes, Ch. 144, Par. 1001, et seq., as amended, herein referred to as the "Board", acting by and through NEIU.

5. **Project** comprises the completed construction required by the contract documents and includes all labor necessary to produce such construction, and all materials and equipment incorporated or to be incorporated in such construction.

6. **NEIU** will designate a Project Manager for the project. The Project Manager shall act on its behalf. NEIU and its representatives shall at all times have access to the work. Orders and directions to Contractor shall be through the Project Manager.

7. **NEIU** will designate an Architect/Engineer to direct the work on its behalf in conjunction with the Project Manager.

8. **Contractor** is the individual partnership, firm, corporation, or other business entity entering into the contract with NEIU to perform the Work under the Contract Documents and is identified as such in the Contract.

9. **Substantial Completion** is a condition which occurs when NEIU accepts the certification of the Project Manager that construction is sufficiently complete in accordance with the Contract Documents so that the project or a designated portion thereof may be occupied or utilized for the use for which it is intended.
10. **Final Completion** is a condition which occurs when NEIU accepts the certification of the Project Manager that Contractor has complied with all requirements of the Contract including all punch list items, and that Contractor is authorized to receive final payment in full, including all retainage.

**00705 - CONTRACT DOCUMENTS**

1. **Documents on Site**: Contractor shall keep a complete copy of the Contract Documents on the site and shall at all times give NEIU and its representatives access thereto.

2. **Conflicting Requirements**: The Contract Documents are complementary and what is required by any one shall be binding as if required by all. Specifications shall generally govern quality of materials and workmanship. Drawings shall generally govern dimensions, details and location of the work. It is not intended to mention every item of work in the Project Manual which can be adequately shown on the drawings nor to show on the drawings all items of work described or required by the Project Manual even if they are of such nature that they could have been shown thereon.

3. **Interpretations and Clarification**: All requests for interpretation of the Contract Documents and clarification to facilitate proper execution of the work shall be directed in writing to the Project Manager, who with reasonable promptness will furnish interpretations and supplemental instructions by means of drawings or otherwise. All such interpretations and instructions which constitute changes, pursuant to Sub-Section 00760, shall promptly be brought to the attention of NEIU.

4. **Ownership of Drawings, Project Manuals, and Models**: All copies of drawings and Project Manuals are the property of NEIU. Such copies are not to be used on any other work or project whatsoever.

**00710 - MISCELLANEOUS**

1. **Governing Law**: This Contract shall be governed by the State of Illinois.

2. **Written Notice**: Written notice shall be deemed to have been duly given when delivered in person to the individual or member of the firm or to an officer of the corporation for whom it was intended, or when sent by certified mail to the last known business address of the addressee.

3. **Contractor Obligations Survive**: The obligations or duties imposed upon Contractor under the contract shall survive any termination of the Contract.

4. **Successors and Assigns**: NEIU and Contractor each binds itself, its partners, successors and assigns and legal representatives to other party hereto and the partners, successors, assigns and legal representatives of such other party in respect to all covenants, agreements and obligations contained in the Contract Documents.

5. **Building Codes**: Contractor shall perform all work in conformance with applicable building codes formally adopted by the unit of local government in which the Project is located; however, NEIU does not waive in any manner its exemption as a state agency from local laws or rules pertaining to the procurement of building permits. Contractor is responsible for investigating and determining which codes are in force at the project site and for designing and
specifying accordingly. Contractor may submit written requests to NEIU, with full
documentation, for deviations from the local codes, or the substitution of more
stringent codes, but shall not proceed with design or specifications based on
deviations or other codes until receiving written authorization from NEIU.

6. **Regulatory Requirements**: Contractor shall comply with all laws, rules, and
regulations, including those of the City of Chicago, applicable to installation of the
work.

7. **Statutory Requirements**: All applicable Federal and State laws and the rules
and regulations of all authorities 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 written therein in full. The following
Statutes among others govern the work:

A. **Laws of Illinois**:
   1. This contract shall be governed in all respects by the laws of the
      State of Illinois.
   2. The Contractor, subcontractors, etc. shall pay to all laborers,
      workmen, and mechanics performing work under the Contract,
      not less than the prevailing rate of wages as determined by the
      Illinois Department of Labor.
   3. Whenever there is a period of excessive unemployment in the
      the Contractor shall employ only Illinois laborers for this project.
   4. Certified Payroll. State law 820 ILCS 130/5 requires all
      contractors and sub-contractors working on University
      construction projects to submit certified payroll records to NEIU.
      Contractors must submit these records once a month or with
      their pay applications, which ever comes first.
   5. (30ILCS 500/20-65) requires that the Contractor shall maintain,
      for a minimum of 3 years after the completion of the contract,
      adequate books, records, and supporting documents to verify the
      amounts, recipients, and uses of all disbursements of funds
      passing in conjunction with the contract; the contact and all
      books, records, and supporting documents related to the
      contract shall be available for review and audit by the Auditor
      General; and the Contractor agrees to cooperate fully with any
      audit conducted by the Auditor General; and the Contractor
      agrees to cooperate fully with any audit conducted by the Auditor
      General and to provide full access to all relevant materials.
      Failure to maintain books, records, and supporting documents
      required by the Section shall establish a presumption in favor of
      the State for the recovery of any funds paid by the State under
      the contract for which adequate books, records, and supporting
      documentation are not available to support their purported
      disbursement.
   6. Contract Debt Certification: Contractor certifies that it, or any
      affiliate, is not barred from being awarded a contract under 30
      ILCS 500. Section 50-11 prohibits a person from entering into a
      contract with a State agency if it knows or should know that it, or
      any affiliate, is delinquent in the payment of any debt to the State
      as defined by the Debt Collection Board. Section 50-12 prohibits
      a person from entering into a contract with a State agency if it, or
      any affiliate, has failed to collect and remit Illinois Use Tax on all
      sales of tangible personal property into the State of Illinois in
accordance with the provisions of the Illinois Use Tax Act. The contractor further acknowledges that the contracting State agency may declare the contract void if this certification is false or if the contractor, or any affiliate, is determined to be delinquent in the payment of any debt during the term of the contract.

7. Domestic Products Act: Contractor certifies that all articles to be provided under this contract have been or will be manufactured in the United States. Contractor understands that, if it knowingly supplies non-US manufactured goods, it will be subject to penalties under the Procurement of Domestic Products Act (PA 93-0954) that include debarment for five years, voiding of the contract, and civil damages.

8. Lead Poisoning Prevention Act: Pursuant to P.A. 94-879, if Contractor is the owner of residential rental property in Illinois, Contractor certifies that it has not committed a willful or knowing violation of the Illinois Lead Poisoning Prevention Act that has not been mitigated.

9. Substance Abuse Prevention on Public Works Project Act: Pursuant to P.A. 095-0635, the contractor certifies that it is in compliance with the Substance Abuse Prevention on Public Works Project Act. Prior to commencing work, the Contractor shall file with the University a written program meeting or exceeding the program requirements.

B. Steel Products Procurement Act: It is understood and agreed by and between the Parties hereto that any contract for the construction, reconstruction, alteration, repair, improvement or maintenance contains the provision that steel products used or supplied in the performance of this contract or any subcontract thereto shall be manufactured or produced in the United States.

C. The Contractor certifies that neither it nor any substantially-owned affiliated company is participating or shall participate in an international boycott in violation of the provisions of the U.S. Export Administration Act of 1979 or the regulations of the U.S. Department of Commerce promulgated under that Act.

D. The Contractor certifies in accordance with Public Act 93-0307 that no foreign-made equipment, materials, or supplies furnished to the State under the contract have been produced in whole or in part by forced labor, convict labor, or indentured labor under penal sanction.

E. The Contractor certifies in accordance with 30 ILCS 500/50-10.5 that no officer, director, partner, or other managerial agent of the contracting business has been convicted of a felony under the Sarbanes-Oxley Act of 2002 or a Class 3 or Class 2 felony under the Illinois Securities Law of 1953 for period of five years prior to the date of the bid or contract. The Contractor acknowledges that the contracting agency shall declare the contract void if this certification is false.

F. Public Act 93-0575 adds Section 50-12 to the Illinois Procurement Code (30-ILCS 500/50-12). Section 50-12 prohibits the bidding or entering into contracts with the State of Illinois or a State agency by a person or business found by a court or the Pollution Control Board to have committed a willful or knowing violation of Section 42 of the Environmental Protection Act for a period of five years from the date of the order containing the finding or violation.
The Contractor certifies in accordance with 30 ILCS 500/50-12 that the bidder or contractor is not barred from being awarded a contract under this Section. The Contractor acknowledges that the contracting agency may declare the contract void if this certification is false.

G. Under penalties of perjury, the undersigned certifies:

1. Employment Status: The Contractor certifies that if any of its personnel are an employee of the State of Illinois, they have permission from their employer to perform the service.

2. Bribery Clause: The Contractor certifies it has not been convicted under the laws of Illinois or any other state of bribery or attempting to bribe an officer or employee of the State of Illinois or any other state in that officer’s or employee's official capacity nor has the Contractor made any admission of guilt of such conduct which is a matter of public record.

3. Loans: That is not in default on an educational loan as provided in Public Education Act 85-827 (105 ILCS 5/30-15. 12).

4. Barred from Contracting/Bid-Rigging Rotating Law: Contractor certifies that it is not barred from contract with a unit of State or local government as a result of a violation of Section 33E-3 or 33E-4 of the Criminal Code of 1961 of the laws of the State of Illinois. These violations concern the criminal offenses of bid rigging, bid rotating, or kickback in regard to public contracts.

5. Drug Free Workplace Act: Pursuant to the requirements of the Illinois Drug Free Workplace Act, the Contractor, if this agreement is in the amount of $5,000 or more, certifies as follows:
   a. That the Contractor, if an individual or sole proprietorship, will not engage in the unlawful manufacture, distribution, dispensation, possession or use of a controlled substance in the performance of this Agreement; or
   b. That the Contractor, if a corporation, partnership, or other business entity having twenty-five (25) or more employees at the time of letting this Agreement, will provide a drug-free workplace by taking certain steps prescribed in the Act.

H. The Illinois Steel Products Procurement Act, as amended (Ill. Rev. Stat., Ch. 48, Par. 1801 et seq.)

I. The Illinois Roofing Industry Licensing Act, as amended (Ill. Rev. Stat., Ch. 111, Par. 7501 et seq.)

J. The Illinois Asbestos Abatement Act, as amended (Ill. Rev. Stat., Ch. 122, Par. 1401 et seq.)

K. The Illinois Response Action Contractor Indemnification Act, as amended (Ill. Rev. Stat., Ch. 111 1/2, Par. 7201 et seq.) referred to in all documents as the "Indemnification Act."

L. When a project involves asbestos abatement in a public or private elementary or secondary school:
1. The Illinois Asbestos Abatement Act, as amended (Ill Rev. Stat, Ch122, Par. 1401 et seq.) referred to in all documents as the "Abatement Act."

2. Rules and Regulations for the Asbestos Abatement Act, as amended (77 Illinois Administrative Code, Sub ch. p. et seq.) referred to in all documents as the "Rules and Regulations."

M. Public Construction Bond Act (30 ILCS 550) requires each bond securing a contract between the University and any contractor shall be deemed to contain the following provisions whether such provisions are inserted in such bond or not:

"The principal and sureties on this bond agree that all the undertakings, covenants, terms, conditions and agreements of the contract or contracts entered into between the principal and the State or any political subdivision thereof will be performed and fulfilled and to pay all persons, firms and corporations having contracts with the principal or with subcontractors, all just claims due them under the provisions of such contracts for labor performed or materials furnished in the performance of the contract on account of which this bond is given, when such claims are not satisfied out of the contract price of the contract on account of which this bond is given, after final settlement between the officer, board, commission or agent of the State or of any political subdivision thereof and the principal has been made.

"Upon the default of the principal with respect to undertakings, covenants, terms, conditions, and agreements, the termination of the contractor's right to proceed with the work, and written notice of that default and termination by the State or any political subdivision to the surety ("Notice"), the surety shall promptly remedy the default by taking one of the following actions:

(1) The surety shall complete the work pursuant to a written takeover agreement, using a completing contractor political subdivision; or

(2) The surety shall pay a sum of money to the obligee, up to the penal sum of the bond, that represents the reasonable cost to complete the work that exceeds the unpaid balance of the contract sum.

The surety shall respond to the Notice within 15 working days of receipt indicating the course of action that it intends to take or advising that it requires more time to investigate the default and select a course of action. If the surety requires more than 15 working days to investigate the default and select a course of action or if the surety elects to complete the work with a completing contractor that is not prepared to commence performance within 15 working days after receipt of Notice, and if the State or any political subdivision determines it is in the best interest of the State to maintain the progress of the work, the State or any political subdivision may continue to work until the completing contractor is prepared to commence performance. Unless otherwise agreed to by the procuring agency, in no case may the surety take longer than 30 working days to advise the State or political subdivision on the course of action it intends to take. The surety shall be liable for reasonable costs incurred by the State or any political subdivision to maintain the progress to the extent the costs exceed the unpaid balance of the contract sum, subject to the penal sum of the bond."
N. State Board of Elections Registration (P.A. 95-971)). By acceptance of award, the contractor certifies that either (1) it is not required to register as a business entity with the State Board of Elections pursuant to Section 20-160 of the Procurement Code (30 ILCS 500/20-160); or (2) (a) it has registered as a business entity with the State Board of Elections, (b) it has submitted a copy of the Certificate of Registration to the Chief Procurement Officer for Higher Education as specified at the Illinois Public Higher Education Procurement Bulletin website (http://www.procur.e.stateuniv.state.il.us), and (c) it acknowledges a continuing duty to update the registration. Any contracts entered into with contractor by the University are voidable under the Procurement Code if contractor fails to comply with the requirements of Section 20-160.

8. **Non-Asbestos Hazardous Materials**: For projects involving response action work other than asbestos abatement, the regulatory requirements are specified in the respective specification section of the Project Manual.

9. **Permits and Fees**: Contractor is responsible for any construction permits or inspection fees which might be assessed upon NEIU by State or local government.

10. **Taxes**: Purchases of building materials for incorporation into the project are exempt from the Illinois Retailer's Occupation and Use Tax (Sales tax). The Bidder shall therefore exclude such taxes in preparing their bid. The tax exempt number is **E9990-0981-04**. An exemption may also apply in regard to certain Federal excise taxes on materials and equipment used in connection with the Project.

11. **Royalties and Patents**: Contractor shall pay all royalties and license fees. The approval of any method of construction, invention, appliance, process, article, device, material, or equipment of any kind by NEIU or the Project Manager, will only be an approval of its adequacy for the work, and will not be an approval of the use thereof by Contractor in violation of any patent or other rights of any third person. Contractor shall indemnify NEIU in accordance with Sub-section 00741 against all suits and claims that may be based on an infringement of a patent.

00715 - **DISPUTES**

1. Except as otherwise provided below, in the event of disputes or conflicts between the contracting parties, NEIU will solely resolve the matter and its decision will prevail unless otherwise removed to the Court of Claims.

2. **Not Cause for Delay**: NEIU shall have the authority to determine questions of fact that arise in relation to the interpretation of this Agreement and Contractor's performance hereunder. Unless the parties agree otherwise, such determinations procedures shall not be cause for delay of the work. Contractor shall proceed diligently with the performance of this Agreement and in accordance with NEIU's decision whether or not Contractor or anyone else has an active claim pending. Continuation of the work shall not be construed as a waiver of any rights accruing to Contractor.
1. **Authorized Representatives of NEIU**

   A. NEIU has the right to designate authorized representatives, including the Project Manager, to act on its behalf. NEIU and its representatives shall at all times have access to the work.

   B. NEIU will designate one or more Project Managers to act on its behalf. The extent of the Project Manager's authority will be defined in writing at the preconstruction meeting.

   C. NEIU may issue orders and directions to Contractor through the Project Manager.

2. **Right to Reject or Stop the Work:** NEIU may reject work which does not conform to the Contract Documents. If Contractor fails to correct defective work or fails to supply labor, materials or equipment in accordance with the contract, NEIU may order Contractor to stop work, or any portion thereof until the cause for such order has been eliminated. Notwithstanding the preceding, Contractor shall retain exclusive control over all duties and responsibilities imposed by the Structural Work Act.

3. **Right to Carry Out the Work:**

   A. If Contractor neglects or fails to carry out the work in accordance with the Contract or fails to perform any portion of the Contract, NEIU may make good such deficiencies after giving three (3) business days written notice to Contractor and its surety. This shall be without prejudice to any other remedy NEIU may have. NEIU may deduct from the payments then or thereafter due Contractor the cost of correcting such deficiencies, including, but not limited to, the cost of additional architectural/engineering services and construction management services made necessary by such neglect or failure. If the payments then or thereafter due to Contractor are not sufficient to cover such amount, Contractor shall be liable in such amount to NEIU.

   B. In case of emergencies (as determined by NEIU) involving public health or public safety or to protect against further loss or damage to State property or to prevent or minimize serious disruption of State services or to insure the integrity of State records, NEIU may cause such work to be performed without prior notice to Contractor or its surety.

4. **Right to Terminate the Contract:** If Contractor fails or refuses to prosecute the work with such diligence as to allow completion of performance in accordance with the current progress schedule or fails to complete the work at the time of completion in accordance with the documents or commits a breach of any other provision of the Contract Documents, NEIU may terminate Contractor's right to proceed with the work. In such case, NEIU will give Contractor and its Surety written notice of intention to terminate and the reason therefore and, unless within seven (7) business days the delay or violation shall cease or satisfactory arrangement of correction made, NEIU may issue a written termination notice for Contractor and its Surety. Thereupon, the Surety will be given opportunity to complete the work in accordance with the Contract Documents. Such completion may include, but not be limited to, the use of a completing contractor pursuant to a written takeover agreement, the payment of a sum of money required to allow NEIU to complete the work, or other arrangements agreed to by NEIU and Surety. If within seven (7) business days the surety fails to exercises its right to
undertake the work, NEIU may take over the work, exclude Contractor from the site and take possession of all Contractor's tools, appliances, construction equipment and machinery at the site and use the same to the full extent they could have been used by Contractor (without liability for trespass or conversion), incorporate into the work all materials and equipment stored at the site or for which NEIU has paid Contractor but which are stored elsewhere, and finish the work as NEIU may deem expedient by contract publicly advertised or otherwise. If NEIU's expenses in completing the work exceed the unpaid balance of the contract sum, Contractor shall pay the difference to NEIU.

5. **Right to Terminate the Contract for Convenience of the State**: The Contract may be terminated whenever NEIU determines that such termination is in the best interest of the State of Illinois. NEIU will give Contractor ten (10) days written notice of its intention to terminate the Contract. Upon the receipt of such notice, Contractor shall stop all work on the Contract except for work NEIU directs in writing to be completed. Contractor will be paid for all work completed under the Contract. In the event NEIU and Contractor cannot agree to the amount of payment due Contractor, Contractor will receive a percentage of the contract sum equal to the percentage of the work completed on the project prior to termination of the Contract.

6. **Termination for Funding**: NEIU's obligations hereunder shall cease immediately, without further payment being required, in any year for which the General Assembly of the State of Illinois or other legally applicable funding source fails to make an appropriation sufficient to pay such obligation. NEIU shall give Contractor notice of such termination for funding as soon as practicable after NEIU becomes aware of the failure of funding.

7. **Right to Order Acceleration**: If Contractor fails to prosecute the work in accordance with the Construction Schedule, as provided by Contractor pursuant to the terms of Division 1, NEIU may require Contractor to increase the number of shifts or overtime operations, days of work or the amount of construction plant or all of them, without additional compensation.

8. **Use and Possession Prior to Completion**: NEIU shall have the right to take possession or use any substantially completed part of the work upon the issuance of a Certificate of Substantial Completion in accordance with Sub-Section 00770. Such possession or use shall not be deemed acceptance of that part of the project being occupied except as stated in the Certificate and shall not constitute a waiver of existing claims by either party. Contractor will be relieved of responsibility for loss or damage to that portion of the work resulting from NEIU's use or possession.

00730 - ARCHITECT/ENGINEER - RIGHTS AND RESPONSIBILITIES

1. **Duties Responsibility and Authority**: The Architect/Engineer employed by NEIU has assisted NEIU in the preparation of the Project Manual and Drawings for the project. When authorized to act on behalf of NEIU, the duties, responsibility and authority of the Architect/Engineer are set forth herein. Nothing contained herein shall create any contractual relationship between the Architect/Engineer and Contractor or any subcontractor, sub-subcontractor or supplier.

2. **General**: The Architect/Engineer shall consult with and advise NEIU and act as NEIU's representative as provided in these Standard Documents for Construction. NEIU's instructions to Contractor will be issued through the
Architect/Engineer who shall have authority to act on behalf of NEIU in dealings with Contractor to the extent provided in the Standard Documents for Construction.

3. **Submittals**: The Architect/Engineer will review and monitor all required Contractor Submittals for conformance with the Contract Documents.

4. **Contractor's Payments**: The Architect/Engineer will review and certify Contractors' applications for payment; attend and assist in pay meetings; maintain records of payments, Contract balances, and all proposed and approved changes thereto. Review, reconcile, and maintain files for Contractor's Waivers of Liens and sworn statements.

5. **Interpretations**: The Architect/Engineer will provide, when requested, interpretation of Contract Documents; prepare and distribute supplementary Drawings, Specifications and instructions.

6. **Change Orders**: The Architect/Engineer will prepare "Requests for Proposals" for Contract changes; evaluate contractors' proposals; review and verify the cost of the change and recommend action.

7. **Observation of the Work**: The Architect/Engineer will observe the progress and quality of the work as is reasonably necessary to determine in general that it is proceeding in accordance with the Contract Documents. Monitor and acknowledge conformance of materials, finishes and workmanship to the quality standards established in the Contract Documents. Notify NEIU immediately if in the Architect/Engineer's opinion, work does not conform to the Contract Documents, requires special inspection or testing, or has been disapproved or rejected.

8. **Tests**: The Architect/Engineer will witness tests; review and evaluate test reports; notify NEIU and Contractor of deficiencies.

9. **Defective Work**: On the basis of tests and observations, the Architect/Engineer may disapprove of or reject Contractor's work while it is in progress. If the Architect/Engineer believes that such work will not produce a completed project that conforms generally to the Contract Documents or that it will prejudice the integrity of the design concept of the project as reflected in the Contract Documents.

10. **Systems Commissioning**: The Architect/Engineer will observe and assist in the refining and adjustment of any equipment or system.

11. **Closeout**: The Architect/Engineer shall certify that to the best of their knowledge, the reviewed work conforms to the requirements of the Contract Documents; conduct Substantial Completion and Final Completion inspections. Expedite and coordinate Substantial Completion, Final Completion, Contractors' Submittals, final payment and facility turnover in accordance with NEIU's procedures.

12. **Records**: The Architect/Engineer will maintain records, including correspondence, Submittals, Schedules, payment request, addresses of contractors, subcontractors, and major suppliers.

13. **Record Drawings**: The Architect/Engineer will observe Contractors' Record Drawings at intervals appropriate to the construction and notify NEIU and
Contractor of any apparent failure to maintain up-to-date records. Prepare and submit revised Contract Documents as Record Drawings to show all changes reported to the Architect/Engineer by Contractor and all Change Orders and Addenda made during construction, including the location of all concealed systems installed during construction.

14. **Construction Supervision**: The Architect/Engineer shall not be responsible for construction means, methods, techniques, sequences, procedures or supervision or for safety precautions and programs in connection with the Project or work thereon and nothing hereunder shall relieve Contractor from his responsibility to carry out the work in accordance with the Contract Documents.

15. **On-Site Representative**: When included in its agreement, the Architect/Engineer will provide one or more on-site representatives to assist in carrying out the Architect/Engineer's construction phase responsibilities.

16. **Response Action Project**: When a project involves response action work as defined in the Response Action Contractor Indemnification Act, the Architect/Engineer will have the properly trained personnel, approved by the State of Illinois, on the site at all times during the performance of the response action work.

17. **Claims and Disputes**: The Architect/Engineer will review the claim or dispute including documentation of any time, money, or other expenditure made in connection with it. While work is in progress, will observe, measure and verify costs incurred that are related to the dispute. Provide a written response, interpretation, and recommendation for resolution to the claimant and NEIU.

18. **Inspection**: After substantial completion, the Architect/Engineer will assist NEIU with an inspection of the project work. The Architect/Engineer will prepare a report of all observed defective material, equipment and workmanship which requires corrective work under the guarantees.

19. **Miscellaneous**: Other responsibilities and authority of the Architect/Engineer are set forth throughout the Contract Documents.

00740 - CONTRACTOR - RIGHTS AND RESPONSIBILITIES

1. **Review of Contract Documents**: Contractor shall carefully study and compare the Contract Documents including all addenda, and shall promptly report to the Project Manager all errors, inconsistencies, or omissions it may discover. Contractor shall review the Drawings and Specifications relating to work to be performed by other contractors in connection with the Project. All work under the Contract which Contractor discovers may be in conflict with the work of such other contractors shall be brought to the attention of the Project Manager before the work is performed. If after the discovery of such conflict, Contractor fails to promptly notify the Project Manager, Contractor shall, upon written direction, remove all such work or portion thereof so conflicting, and rebuild it as directed at no additional cost to NEIU. Contractor shall not perform any work without documents bearing Project Manager signature and dated "Issued for Construction" stamp.

2. **Verification of Dimensions and Existing Conditions**: All dimensions and existing conditions shall be verified by Contractor by actual measurement and observation. All discrepancies between the requirements of the Contract Documents and the existing conditions or dimensions shall be reported to the
Project Manager as soon as they are discovered. Failure to verify and report shall constitute Contractor’s acceptance of existing conditions as fit for the proper execution of his work.

3. **Changed Conditions:** Should Contractor encounter subsurface or latent physical conditions at the site which differ materially from those indicated in the Contract Documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract, Contractor shall give written notice to the Project Manager before any such condition is disturbed. No claim of Contractor under this provision will be allowed unless Contractor has given the required notice. The Project Manager will promptly investigate and, should the Project Manager determine that the conditions materially differ from those which should have been reasonably anticipated, will make such changes in the Contract Documents as may be necessary. If such conditions cause an increase or decrease in Contractor's cost or time of performance, the Contract Sum or Contract Time will be modified in accordance with Section 00700.

4. **Laying Out the Work:** Contractor shall be responsible for properly and accurately laying out the work, and for all lines, levels, elevations, and measurements for all the work under the contract.

5. **Supervision of the Work:**

   A. Contractor, using its best skill and judgment, shall efficiently supervise the work. Contractor shall be responsible for all site safety and for all construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the work under the Contract.

   B. Contractor shall furnish a competent and adequate staff as necessary for the proper administration, coordination, and supervision of the work; organize the procurement of all materials and equipment so that they will be available at the time they are needed for the work; and keep an adequate force of skilled work personnel on the job to complete the work in accordance with all requirements of the Contract.

   C. Contractor shall employ at the site, satisfactory to the Project Manager, a competent superintendent who shall be in attendance at the site throughout the active performance of the work and at such other times as may be reasonably necessary, and who shall be authorized to commit Contractor with regard to personnel schedule, coordination, and cooperation. The superintendent shall not have less than two years documented experience in responsible field supervision for projects of comparable size and complexity. Contractor shall not change the superintendent unless it has given NEIU a written request for change thirty (30) days in advance of its proposed change, and NEIU has given authorization to do so. In the event the superintendent fails to perform his duties under the Contract requirements, NEIU may, in writing, require Contractor to remove the superintendent from the project, and Contractor shall provide a competent replacement.

   D. When a project involves response action work as defined in the Response Action Contractor Indemnification Act, properly trained personnel, approved by the State of Illinois, shall be on the site at all times during the performance of the response action work.

6. **Responsibility for Damages:** Contractor shall be responsible for all loss or damage to the work, Project, site and improvements thereon and the work of other contractors caused by its operation during the performance of the Contract.
The work shall be entirely at Contractor's risk and NEIU assumes no responsibility whatever for damage or loss to any of the work, adjacent property, or Contractor's equipment. Watchmen, if required, shall be retained at the expense of Contractor.

7. **Work of Other Contractors:** NEIU reserves the right to execute other contracts in connection with the Project. Contractor shall afford other contractors reasonable opportunity and storage of their materials and for the execution of their work, and shall properly connect and coordinate its work with theirs. Contractor shall not commit or permit any act which will interfere with the performance of work by any other contractor or by NEIU.

8. **Assignment of Claims:** NEIU shall not be bound by any assignment by Contractor to third parties of moneys due or become due or of any other claims it may have under its contract except where NEIU consents in writing to be so bound.

9. **Claims and Disputes:** Contractor shall promptly notify the Project Manager in writing of any claims or disputes. Any work performed, where the payment for same is in dispute, must be observed by the Project Manager while in progress. Failure to notify the Project Manager in such instances may result in rejection of any claim with NEIU.

10. **Notification:** No claim for a contract adjustment pursuant to any written order, verbal order, instruction, interpretation, clarification or changed condition will be allowed unless Contractor, within (thirty (30) calendar days of such occurrence furnishes a written notice setting forth the general nature and estimated monetary extent of such claim.

11. **Miscellaneous:** Other rights and responsibilities of Contractor are set forth throughout these Contract Documents and are included under other titles, articles, sections and headings for convenience. It is the responsibility of Contractor to familiarize itself with all provisions of these Contract Documents in order to understand fully the entirety of its rights and responsibilities hereunder.

**00741 - INDEMNIFICATION**

1. **Duty to Indemnify:** Contractor shall defend, indemnify, keep, and save harmless the State of Illinois, Board, NEIU, the Project Manager, and their respective board members, representatives, agents and employees, in both individual and official capacities, against all suits, claims, damages, losses and expenses, including attorney's fees, caused by, growing out of, or incidental to, the performance of the work under the Contract by Contractor or its subcontractors to the full extent as allowed by the laws of the State of Illinois and not beyond any extent which would render these provisions void or unenforceable. This obligation includes but is not limited to: The Illinois laws regarding structural work (Ill. Rev. Stat. Ch. 48 par. et seq.) and regarding the protection of adjacent landowners (Ill. Rev. Stat. Ch. 111 1/2 par 3301 et seq.). In the event of any such injury (including death) or loss or damage, or claims therefore, Contractor shall give prompt notice to NEIU.

2. **Effect of Statutory Limitations:** In the event of any claim against the State of Illinois, Board, NEIU, or against any of their officials or employees, in either their personal or official capacities, made by any direct or indirect employee or agent of Contractor or of any subcontractor, Contractor's indemnification obligation shall not be affected by any limitation on the amount or type of damages,
compensation, or benefits payable to said employee or agent contained in any other type of employee benefit act.

3. **NEIU/Architect/Engineer's Liability**: The obligations of Contractor shall not extend to the liability of NEIU's agents or employees or the Architect/Engineer, or their agents or employees.

00742 - LABOR LEGISLATION

1. Contractor shall familiarize himself with all provisions of all Acts referred to in this paragraph and in addition shall make an investigation of labor conditions and all negotiated labor agreements which may exist or are contemplated at this time. Nothing in the Acts referred to in this paragraph shall be construed to prohibit the payment of more than the prevailing wage scale.

2. In the employment and use of labor, Contractor shall conform to all Illinois statutory requirements regarding labor, including but not limited to the following Acts:

   B. An Act to prohibit discrimination and intimidation on account of race, creed, color, sex or national origin in employment under contracts for public buildings or public works, as amended (Ill. Rev. Stat., Ch. 29, par. 17).
   C. An Act to prohibit unjust discrimination in employment because of age and providing penalties, as amended (Ill. Rev. Stat., ch. 68, par. 1-101 et seq.).
   D. An Act to create the Minority and Female Business Enterprise Act, and to amend an Act named therein, as amended (Ill. Rev. Stat., Ch. 127, par. 132.601).

3. When project is classified as a Public Work, it is subject to all the provisions of the Prevailing Wage Law of the State of Illinois. Contractors and subcontractors shall conform to Illinois statutory requirements regarding prevailing wages, as defined in Chapter 48, section 39S-1-et. seq. Ill. Rev. Stat. which provides in part that Contractor, subcontractors, etc., shall pay to all laborers, workmen, and mechanics performing work under the Contract, not less than the prevailing rate of wages as determined by the Illinois Department of Labor. Contractor shall prominently post the current Schedule of Prevailing Wages at the project site, and shall notify immediately in writing all of its subcontractors, etc., of all changes in the Schedule of Prevailing Wages. Any increases in costs to Contractor due to changes in the prevailing rate of wages or labor law during the term of any Contract shall be at the expense of Contractor and not at the expense of NEIU. However, Change Orders shall be computed using the prevailing wage rates applicable at the time the Change Order work is scheduled to be performed.

4. **Equal Employment Opportunity - Applicable Laws**: State of Illinois policy and law, set out in the Illinois Constitution, Article 1, Section 17, requires that employment opportunities be free from discrimination. The equal employment clause contained in Ch. 68, Par. 1-101 et seq. is incorporated into the Contract and is intended to insure compliance with the applicable laws and with the Illinois Department of Human Rights Rules and Regulations for Public Contracts. Contractor shall conform to all provisions of the Equal Employment Opportunity Clause (44 Illinois Administrative Code, Ch. X, Sec. 750, Appendix A), and shall include said clause, verbatim or by reference, in each of its subcontracts under
which any portion of the Contract obligations will be undertaken or assumed, so that the provisions of the clause will be binding upon all such subcontractors.

5. In no event shall minors be employed except as authorized under an Act to regulate the employment of children and to repeal an Act herein, named, as amended (Ill. Rev. Statutes, Ch. 48, Par. 31.1 et seq.).

6. In no event shall convict labor be employed except as authorized under unified Code of Corrections, as amended (Ill. Rev. Statutes, Ch. 38, Par. 1001-1-1 et seq.)

7. An Act requiring employment of Illinois Workers on public works project, as amended (Ill. Rev. Stat., Ch. 48, Par. 2201, et seq.).

8. The Worker’s Compensation Act, as amended (Ill. Rev. Stat., Ch. 48, Par. 138.1 et seq.).


10. The bidder and all bidder’s subcontractors must participate in applicable apprenticeship and training programs approved by and registered with the United States Department of Labor’s Bureau of Apprenticeship and Training (30ILCS 500/30-22).

00743 - RECORDS OF WAGES AND EXPENSES

1. Contractors and subcontractors shall keep or cause to be kept an accurate record of names, occupations and actual wages paid to each laborer, workman, and mechanic employed by it in connection with the Contract. The record shall be open at all reasonable hours for inspection by any representative of NEIU or the Illinois Department of Labor and must be preserved for four years following completion of the Contract.

2. Project Expenses: In accordance with Public Act 87-991 (effective 1 September 92), Contractor shall maintain for a minimum of five (5) years after the completion of the Contract, adequate books, records, and supporting documents to verify the amounts, receipts, and uses of all disbursements of funds passing in conjunction with the Contract. These records shall be available for review and audit by the Auditor General. Contractor agrees to cooperate fully with any such audit and shall provide full access to all relevant materials. Failure to maintain the records required by this provision shall establish a presumption in favor of the State for the recovery of any funds paid by the State under the contract for which adequate records are not available to support their purported disbursement.

00760 - CHANGES

1. NEIU may, at any time, without notice to the Sureties, order changes in the Contract Time or in work germane to the Contract. Contractor may initiate requests for changes. Upon issuance of a Change Order, Contractor shall promptly proceed with the work as changed. No work shall be changed without written approval of NEIU.

2. NEIU reserves the right not to proceed with a proposed change.
3. If a Change Order or an aggregate of Change Orders impact the critical items on the current construction schedule, Contractor may request a time extension. Time extensions requests will not be considered with the Change Order, but must be submitted separately. Time extension will be granted in accordance with Sub-section 01310.

4. **Value of Change:** If a change affects work covered by unit prices in the Contract, such unit prices shall be used as the basis for adjustments to the Contract Sum. Except as otherwise specified, in all other cases, adjustments to the Contract Sum shall be based on Contractor's direct costs, including costs of material, labor, Workmen's Compensation Insurance, equipment bonds and taxes as applicable, plus an amount of 15% for overhead and profit except that no overhead and profit shall be deducted from the price for changes deleting work. If the changed work is performed by a subcontractor, 15% shall be added to that subcontractor's costs for overhead and profit, an additional 7-1/2% shall be included for each intermediate subcontractor, if any, between Contractor and the subcontractor, performing the changed work.

00765 - **PAYMENT**

1. **Progress Payments:** NEIU will make payments for materials and work incorporated into the Project as determined by NEIU in consultation with the Architect/Engineer. NEIU may require payment to be made on form, A.I.A. Document, G703. Such payments will be based on the approved Schedule of Values submitted fifteen (15) days prior to the first payment request. Applications for progress payments shall include an affidavit itemizing the principal portions of the work performed, and invoice-voucher and lien waivers from subcontractors and suppliers.

2. **Stored Material:** Progress payments will be made for materials and equipment not incorporated in the Work provided that:

   A. Such materials and equipment have been delivered to and suitably stored at the site or some other location approved in writing by NEIU. Payment for materials/equipment stored off-site will be permitted only NEIU's prior written authorization.
   B. Contractor submits evidence of title to such materials and equipment.
   C. The care and custody of such materials and equipment and all costs incurred for movement and storage shall be the responsibility of Contractor.
   D. Such materials and equipment are suitably insured by Contractor. Contractor shall submit a Certificate of Insurance showing NEIU as an additional insured and showing the amount of the insurance coverage.

4. **Retention and Retention Trusts:**

   In making progress payments NEIU will retain 10% of each progress payment. After 50% of the work has been completed, if NEIU determines, upon the recommendation of the Project Manager, that the work is being performed in a satisfactory manner, NEIU will waive further retention.

5. **Lien Waivers:**

   A. **Partial Lien Waivers:**
      1. Contractor must submit lien waivers with each payment request.
2. Beginning with the second payment request, and with each succeeding payment request, Contractor shall submit to the Architect/Engineer partial lien waivers from them, each subcontractor, and supplier showing that the amount paid to date to each is at least equivalent to the total value of its work, less retainage, included on the previous month's invoice/voucher.

3. Lien waivers from Contractor and all subcontractors and suppliers shall accompany the first payment request if the amount of payment exceeds 50% of the total Contract sum.

B. **Final Lien Waivers:** Contractor's request for final payment shall include:

1. Contractor's final lien waivers which shall be for the full amount of its Contract including all change orders thereto.

2. Final lien waivers in the full amount of their contracts from all subcontractors and suppliers for which final lien waivers have not previously been submitted.

6. **Payments to Subcontractors and Suppliers:** Contractor shall pay each subcontractor and supplier, promptly upon receipt of payment from NEIU, an amount equal to the percentage of total contract completion allowed to Contractor on account of performance by the subcontractor or supplier, less the retainer and less amounts previously paid to the subcontractor or supplier. Contractor shall require that all subcontractors make similar payments to their subcontractors and suppliers. NEIU, the Project Manager may furnish to any subcontractor or supplier information regarding the percentage of work completed which was used as the basis for payment or the amount of payment on account of work by such subcontractors or suppliers.

7. **Title:** Title to all work, materials, and equipment covered by a progress payment shall pass to NEIU upon receipt of such payment by Contractor. This provision shall not relieve Contractor from sole responsibility under the Contract for all work materials and equipment upon which payments have been made or for the restoration of all damaged work or as waiving the right of NEIU to require fulfillment of all terms of the contract.

8. A. **Withholding of Payments:** NEIU may withhold payments, in whole or in part, if it reasonably determines:

1. Contractor's work is not progressing in accordance with the most current Construction Schedule.

2. Work is not being performed in accordance with the Contract Documents.

3. Contractor is failing to comply with any provisions of the Contract.

4. Contractor or a subcontractor is under investigation by the Illinois Department of Labor for possible failure to pay prevailing wage benefits in accordance with the Contract Documents.

B. NEIU will notify Contractor in writing when any such payments are withheld.

C. Whenever NEIU receives notice in writing of a claim of money due from Contractor to any subcontractor, supplier, workmen, or employees for performance of work, NEIU may withhold the amount of such claim from Contractor provided that such withholding shall not be construed as conferring any rights on such subcontractor, suppliers, workmen, or
employees nor as enlarging or altering the application or effect of existing lien laws.

D. In the event of any withholding, NEIU will promptly investigate the facts and will make payments when the grounds for withholding have been removed.

E. NEIU will notify Contractor in writing and in accordance with the Prompt Payment Act (if applicable) when any payments are withheld. In the event of any withholding, NEIU will promptly investigate the facts and will make payments when the grounds for withholding have been removed.

9. **Final Payment**: Upon acceptance of all work by NEIU the remaining balance of the Contract Sum, including retainage, will be paid upon presentation of:

   A. Final Invoice-Voucher
   B. Contractor's Final Declaration
   C. Final releases of Waivers of Liens for Contractor and all sub-contractors, suppliers, and others with lien rights against property of NEIU, together with complete list of those parties.
   D. Copy of Certification of Systems Training
   E. Final accounting statement, reflecting all adjustments to Contract Sum from Change Orders, unit prices, or liquidated damages.
   F. Copy of transmittal letters to Project Manager for As-Built Drawings and Operating and Maintenance Manuals.

### 00770 - INSPECTION AND ACCEPTANCE

1. **Inspection**: The work will be subject to inspection and testing by the Project Manager, at all reasonable times and at all places. All such inspections and testing will be conducted in such a manner as not to unreasonably delay the work or increase the cost of performance. Contractor shall provide, without additional compensation, all facilities, labor, and material reasonably necessary for such safe and convenient inspection and testing as is required.

2. **Notice**: When layouts of the building and site work are to be made or when the Contract, or Federal, or State laws require any work to be especially tested or approved, or if work not yet inspected is to be covered, Contractor shall give the Project Manager timely notice of the work's readiness for inspection. If inspection is to be made by an authority other than the Project Manager, Contractor shall promptly notify the Project Manager of the date and time fixed for such inspection.

3. **Uncovering of Work**: Work covered without consent of the Project Manager shall, upon their request, be uncovered for examination and re-covered at Contractor's expense. Work covered with the consent of the Project Manager shall, upon their request, be uncovered for examination. If such work is found to be in accordance with the Contract, the contract sum and the contract time will be increased in accordance with Section 00700. If such work is found not in accordance with the Contract, the uncovering and re-covering shall be at Contractor's expense.

4. **Correction of Work**: Contractor shall, without additional compensation, promptly correct all work rejected by the Project Manager as defective or failing to conform to the Contract Documents unless NEIU agrees to accept such work with an appropriate reduction in the Contract Sum. If Contractor does not
promptly correct rejected work, NEIU may repair or replace such work in accordance with Sub-section 00720.

5. **Acceptance**: When Contractor believes that the work or any part thereof is substantially complete, it shall give five (5) business days written notice to the Project Manager who will prepare a punch list of items remaining to be completed or corrected. When NEIU determines that the work is substantially complete, a Certificate of Substantial Completion will be submitted to Contractor for written acceptance. Such certificate will establish the date of Substantial Completion, state the responsibilities of NEIU and Contractor for security, maintenance, heat, utilities, and insurance and will fix the time within which Contractor shall complete or correct the items on the punch list. The Certificate of Substantial Completion will constitute acceptance of the Work except for items included on the punch list. Upon completion of punch list items, Contractor shall give five (5) business days written notice of final completion to the Project Manager who together with NEIU, will promptly inspect the work. When NEIU determines that all work, including all punch list items, is complete, a Certificate of Final Acceptance will be issued which will constitute acceptance of all work. Acceptance will not bar claims of NEIU under Sub-section 00780.

**00780 - WARRANTIES**

1. Contractor warrants that all materials and equipment furnished under the Contract will be new, unless otherwise specified, and that all work will be in conformance with the Contract and free from defects in workmanship, materials and equipment for a period of one (1) year or such longer period as may be specified in the Contract Documents. Warranty time periods shall commence with the date of NEIU acceptance of the Certificate of Substantial Completion of the whole or any part of the project. The warranty time period for any incomplete or uncorrected work at the time of substantial completion shall commence with the date of final completion.

2. Contractor shall, at his own expense and without cost to NEIU, at any time within the Statute of Limitations, make good any defects in materials or workmanship which may develop, and any damage to other work caused by such defects or the repairing of same. Repair and replacement includes all defective or nonconforming work resulting from latent defects, fraud, fraudulent concealment or gross negligence. NEIU will give timely notice of such defects.

3. Upon notice from NEIU of such defect or nonconformity, Contractor shall promptly visit the site in the company of NEIU's representative to determine the extent of all defects or nonconforming work, including all adjacent work not necessarily provided by Contractor but damaged as a result of such defect or nonconformity or as a result of remedying them. If Contractor does not promptly repair or replace defective or nonconforming work, NEIU may repair or replace such work and charge the cost thereof to Contractor. Work which is repaired or replaced by Contractor shall be inspected and accepted in accordance with this Section and shall be warranted by Contractor in accordance with Paragraph 1 of this Sub-section. The warranties set forth herein are in addition to all warranties or guarantees expressed or implied by operation of law, statute, or ordinance.

4. Contractor shall deliver all commercial warranties received from manufacturer to the Project Manager prior to final completion but this shall not reduce Contractor's obligations under this Section.

End of Section 00700
00825 - PREVAILING WAGES

1. Pursuant to Public Act 86-799, the Project Manual includes the Prevailing Rate of wages for the county where the Work is being performed and for each craft or type of worker needed to execute the Contract.

2. The Act regulates wages of laborers, mechanics, and other workmen employed in any public works by the State, county, city, or any public body or any political subdivision or by anyone under contract for public works, as amended (Ill. Rev. Stat., Ch. 48, Par. 39S-1 et seq.) which provides a part that Contractor, subcontractors, etc., shall pay to all laborers, workmen and mechanics performing work under the Contract, not less than the prevailing rate of wages as determined by the Illinois Department of Labor. Contractor shall prominently post the current Schedule of Prevailing Wages at the project site, and shall notify immediately in writing all its subcontractors, etc., of all changes in the Schedule of Prevailing Wages.

3. Prevailing wage rates, benefits and conditions will be those as provided in the Bid Documents. Any increase in costs to Contractor due to changes in the Prevailing Rate of wages or labor law during the term of any contract shall be at the expense of Contractor and not at the expense of NEIU.

4. Change Orders shall be computed using the prevailing wage rates applicable at the time the Change Order Work is scheduled to be performed.

5. Davis-Bacon Act

Any project authorized by the University and utilizing federal funding must follow the Davis-Bacon Act (the entire Act can be located within www.dol.gov). The requirements include the payment of prevailing wages and the submittal of certified payrolls to the Project Manager. Contractors must also post the scale of wages in a prominent and easily accessible place at the work site. Reports required by the University in order to ensure the payment of prevailing wage may be requested. No payment requests will be honored unless the certified payroll is attached. If any worker covered by the contract has been or is being paid a rate of wages less than the rate of wages required, the University may, by written notice to the contractor, terminate the work or such part of the work as to which there has been a failure to pay said required wages and to prosecute the work to completion by contract or otherwise, and the contractor and his/her sureties shall be liable to the University for any excess costs occasioned thereby.

End of Section 00800
PART 1 - GENERAL

1.1. Work Includes:

A. Work covered by contract documents:
   1. Organic Chemistry Lab:
      a. A 940 +/- s.f. renovation of an existing science lab including new laboratory casework, acoustical ceiling, fume hoods, plumbing fixtures and mechanical and electrical upgrades.
   2. Instrument Lab:
      a. A 453 +/- s.f. renovation of an existing instrument lab including new laboratory casework, acoustical ceiling, fume hoods, plumbing fixtures and mechanical and electrical upgrades.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01230 – Alternates
   2. Section 01310 - Coordination
   3. Section 01311 - Project Meetings
   4. Section 01500 - Temporary Facilities and Controls
   5. Section 01770 - Closeout Procedures

1.3. Definitions: The following terms are used throughout the contract documents. The work will be governed in accord with the definitions.

A. Fabricated: "Fabricated" pertains to items specifically assembled or made of selected materials or components to meet individual design requirements.

B. Manufactured: "Manufactured" means standard units, usually mass produced by an established manufacturer of the respective item.

C. Provide: "Provide" means furnish and install.

D. Shop fabricated or shop made: "Shop fabricated or shop made" refers to items made by the Contractor in his own shop.

1.4. Insurance: See the Conditions of the Contract.

1.5. Contract:

A. Construct project under separate work contracts, under the terms of which the Owner will assign the other contracts to the coordinating Contractor which will be identified as General Contractor in accordance with the conditions of the contract:
   1. General Construction
   2. Plumbing
   3. HVAC
   4. Electrical
1.6. Work by Others:

A. The Owner will award contracts which will commence as soon as possible. Work under these contracts includes:
   1. Technology Equipment
   2. Furnishings

B. Items noted "N.I.C" (Not-in-Contract) will be furnished and installed by the Owner.

C. The Owner will remove and retain possession of the following items prior to start of the work:
   1. Organic Chemistry Lab:
      a. Furniture
      b. Lab Equipment
      c. Fire Extinguishers
   2. Instrument Lab:
      a. Furniture
      b. Lab Equipment
      c. Fire Extinguishers

1.7. Products Furnished by Others:

A. Purchaser's Duties:
   1. Schedule delivery date with supplier in accord with approved construction schedule.
   2. Arrange for and deliver Owner reviewed shop drawings, product data, and samples to Contractor.
   3. Obtain installation drawings and instructions.
   4. Arrange and pay for product delivery to the site.
   5. Upon delivery, inspect products jointly with Contractor.
   6. Submit claims for transportation damages, and replace damaged, defective, or deficient items.
   7. Arrange guarantees, warranties, inspection, and service.

B. General Contractor's Duties:
   1. Designate specific delivery date for each product in approved construction schedule.
   2. Review Owner reviewed shop drawings, product data, and samples.
   3. Promptly inspect delivered products with owner; report damaged or defective items.
   4. Handle at site, including unloading, uncrating, and storage.
   5. Protect from exposure to elements and from damage.
   6. Repair or replace items damaged as result of Contractor's operations.
   7. Install, connect, and finish products as appropriate.

C. Products furnished to the site and paid for by the owner: N/A

1.8. Contractor use of Premises:

A. Contractor to prepare and submit Site Logistics Plan for Architect and Owner approval prior to start of Work. Refer to Section 01500 – Temporary Facilities and Controls.

B. Confine operations at site to areas permitted by:
1. Law
2. Permits
3. Contract
4. Drawings
5. Owner's representative
   a. Confer with Owner's representative and obtain full knowledge of all site rules and regulations affecting work.
   b. Conform to site rules and regulations while engaged in project construction.
   c. Site rules and regulations take precedence over others that may exist outside such jurisdiction.
   d. Employee list: The Owner's representative may examine Contractor's list of employees, including those of his subcontractors and their agents.
   e. Vehicle use: Rigidly enforce the following:
      1) Keep all vehicles, mechanized or motorized equipment locked at all times when parked and unattended on the Owner's premises.
      2) Parking: Permitted only in areas designated by Drawings.

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

D. Do not load structures with weight that will endanger structure.

E. Assume full responsibility for protection and safekeeping of products stored on premises.

F. Move all stored products or equipment which interfere with operations of the Owner.

G. Obtain and pay for use of additional storage or work area needed for operations.

H. Use of Site: Confine operations at site to areas as designated by Contract Documents.

I. Fire Protection:
   1. Fires: Contractor shall prohibit the lighting of fires about the premises and use due diligence to see that refuse and such not be burned at the construction site. Promptly remove all refuse and such from the site for legal disposal. Prevent the accumulation of combustibles on the site or within the building.
   2. Welding and cutting: It shall be the responsibility of each contractor to take precautionary measures to prevent fire.
   3. Flammables: Gasoline and other fuels shall be kept and handled in accord with NFPA and in UL listed and labeled safety cans, and shall be stored away from hazardous work areas.

J. Smoking inside of the existing building, including those areas associated with the work of this contract, will not be permitted. Smoking on the premises outside of the building will also not be permitted.

1.9. Hazardous Materials:

A. No asbestos containing materials, lead based paints, or other hazardous materials shall be furnished or installed in this work.
1.10. Work Sequence:

A. Construct work in phases to accommodate Owner's occupancy requirements during the construction period; coordinate construction schedule and operations with the owner:

1. Organic Chemistry Instrument Labs:
   a. General, Plumbing, HVAC, Electrical Construction to start on May 14, 2012.
   c. Achieve final completion on August 24, 2012.

1.11. Owner Occupancy:

A. The Owner intends to occupy the renovated portion of the project by August 27, 2012.

B. The Owner will occupy the premises during the construction.

C. Cooperate with the owner to minimize conflict, and to facilitate the Owner's operations.

D. Schedule the Work to accommodate these requirements.

End of Section 01100
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01040
COORDINATION

PART 1 - GENERAL

1.1 Related document:
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 Work includes:
A. This Section includes each Contractor’s administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
   1. General project coordination procedures.
   2. Conversation.
   3. Coordination Drawings
   4. Administrative and supervisory personnel.
   5. Cleaning and protection.

1.3 Related Work:
A. Specified elsewhere:
   1. Section 01320 – Project Meeting: Progress meetings and coordination meetings.
   2. Section 01300 – Submittals

1.4 Coordination:
A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operation included under different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different maintenance, service, and repair.
   3. Make provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings. Prepare similar memoranda for the Owner and separate contractors where coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules
   2. Installation and removal of temporary facilities
3. Delivery and processing of Submittals
4. Project closeout activities

D. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials. Salvage materials and equipment involved in performance of, but not actually incorporated, the Work.

1.5 Submittals:

A. Coordination Drawings: Prepare coordination drawing where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.
   1. Show the relationship of components shown on separate Shop Drawings.
   2. Indicate required installation sequences.
   3. Comply with requirements contained in Section “Submittals.”

B. Staff Names: Within 15 days of commencement of construction operations, each contractor shall submit a list of Contractor’s principal staff assignments, including superintendent and other personnel in attendance at Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers. Post copies of the list the Project meeting room, the temporary field office, and each temporary telephone.

PART 2 – PRODUCTS

No relevant text

PART 3 – EXECUTION

3.1 Coordination Provisions:

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.2 Cleaning and Protection:

A. Cleaning and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging affects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction completed, or in progress, is subject to harmful, dangerous, damaging,
or otherwise deleterious exposure during the construction period. Where applicable, such exposure includes, but are not limited to, the following:

1. Excessive static or dynamic loading
2. Excessive internal or external pressures
3. Excessive high or low temperatures
4. Thermal shock
5. Excessively high or low humidity
6. Air contamination or pollution
7. Water or ice
8. Solvents
9. Chemicals
10. Light
11. Radiation
12. Puncture
13. Abrasion
14. Heavy traffic
15. Soiling, staining, and corrosion
16. Bacteria
17. Rodent and insect infestation
18. Combustion
19. Electrical current
20. High-speed operation
21. Improper lubrication
22. Unusual wear or other misuse
23. Contact between incompatible materials
24. Destructive testing
25. Misalignment
26. Excessive
27. Unprotected storage
28. Improper shipping or handling
29. Theft
30. Vandalism

End of Section 01040
PART I - GENERAL

1.1 Related Documents:
A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 Work Includes:
A. General Contractor Provide:
   1. Coordinate work of assigned contractors.
   2. Enforce predetermined lines of authority and communications; conduct coordination meetings attended by:
      a. Contractors and subcontractors.
      b. Architect-Engineer
      c. Owner’s representatives.
   3. Construction Schedule:
      a. Develop and maintain project schedules.
      b. Coordinate schedules of the assigned contractors
      c. Monitor schedules as work progresses.
         1) Identify potential variances between schedules and probable completion date.
         2) Report to Owner and Architect-Engineer adjustment in schedule to meet approved completion date.
         3) Document all changes in schedule.
      d. Observe work of all contractors to monitor compliance with project schedule.
         1) Verify that each contractor's labor force and construction equipment are available and adequate for maintaining the project schedule.
         2) Verify the product deliveries are adequate to maintain project schedule.
         3) Report conditions which will adversely affect critical items on project schedule to Owner and Architect-Engineer with recommendations for corrective action.
   4. Temporary Utilities:
      a. Allocate use and location of temporary offices and storage sheds.
      b. Verify that adequate services are provided to comply with requirements of work and climatic conditions.
      c. Monitor use of temporary utilities.
      d. Verify proper maintenance and operation of temporary utilities
      e. Administer traffic and parking controls.
   5. Payments:
      a. Conduct monthly payment request meetings attended by:
         1) Architect-Engineer
         2) Owner’s representatives.
3) Assigned contractors.
   b. Review and approve assigned contractor's application for payment and waivers of lien.

6. Change Orders:
   a. Recommended necessary or desirable changes to Owner and the Architect-Engineer.
   b. Review assigned contractor's request for changes or substitutions; submit recommendations to Architect-Engineer.
   c. Review and process requests for proposal and assigned contractor's proposals and backup.

7. Permit and Fees:
   a. Assist in obtaining building permits from authorities having jurisdiction.
   b. The bidder/contractors are not responsible for any construction permit fees or inspection fees which might be assessed upon NEIU by state or local governments. When NEIU authorizes or directs in writing the acquisition of such permits or payments or such fees, NEIU will reimburse the Contractor for the amount paid (no mark-up will be allowed) and the contract sum will be modified accordingly by change order.

8. Coordinate and Process:
   a. Schedules
   b. Shop drawings, product data, and samples.
   c. Project record documents.
   d. Submittals
   e. Payment requests.
   f. Change orders.
   g. Tests
   h. Inspections
   i. Punch list.
   j. Record documents.

9. Maintain reports and records at job site:
   a. Daily log of progress of work available to the Architect-Engineer and Owner.
   b. Daily log of project manpower by craft, including equipment and activities. Separate minority participation by craft.
   c. Daily log of site activity.

B. Assigned Contractor’s Duties:
1. Co-ordinate work of employees and subcontractor under their contract.
2. Conduct work to assure compliance with schedules.
3. Transmit all submittals and notices to General Contractor.
4. Under the administration of the General Contractor coordinate work with that of other contractor.
5. Cooperate with General Contractor.

End of Section 01041
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01060
REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 Requirements Include:

A. Each Contractor Comply with all laws, rules and regulations governing the work.
   1. When Contractor observes that contract documents are at variance with specified codes, notify Architect/Engineer in writing immediately. Architect/Engineer will issue clarifications in accordance with General Conditions.
   2. When Contractor performs any work knowing or having reason to know that the work is contrary to such laws, rules and regulations and fails to so notify the Architect/Engineer, Contractor shall pay all costs arising there from. However, it will not be the Contractor’s primary responsibility to make certain that the contract documents are in accordance with such laws, rules and regulations.

1.2 Definitions and Abbreviations:

A. Definitions:
   1. Dates: Reference Codes, Regulations and Standards are the issue current at date of bidding documents unless otherwise specified.
   2. Codes: Codes are rules, regulations or statutory requirements of government agencies.
   3. Standards: Standards are requirements set by authorities, custom or general consent and established as accepted criteria.

B. Abbreviations:
   1. AAMA American Architectural Manufacturer’s Association
   2. ACI American Concrete Institute
   3. ADA American with Disabilities Act
   4. AGCI Associates General Contractors in Illinois
   5. AISC American Institute for Steel Construction
   6. ANSI American National Standards Institute
   7. ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
   8. ASTM American Society for Testing and Materials
   9. AWWA American Waterworks Association
   10. BIA Brick Institute of American
   11. Board Board of Trustees of NEIU
   12. CBC Chicago Building Code
   13. CDB Capital Development Board
   14. CPSC Consumer Product Safety Commission (Federal)
   15. SPSC Consumer Product Safety Commission (Federal)
   16. DHWE Department of Health, Education & Welfare (Federal)
   17. FED Federal Agencies
   18. FM Factory Mutual Engineering Corp.
   19. IBOT Illinois Board of Trustees
   20. IBOHE Illinois Board of Higher Education
   21. ICCB Illinois Community College Board
   22. IDOL Illinois Department of Labor
1.3 Quality Assurance:

A. Architect/Engineer has designed the project with full knowledge of code requirements and has copies of all specified codes available for Contractor’s inspection.

B. Contractor:
1. Ensure that copies of specified codes and standards are readily available to Contractor’s personnel. Copies are available at Contractor’s expense from source of publisher.
2. Ensure that Contractor’s personnel are familiar with workmanship and installation requirements of specific codes and standards.

1.4 Regulatory Requirements:

Source and requirement:
2. FED:
   b. DHEW: Department of Health, Education and Welfare
      i. Title V: Handicapped Accessibility
      ii. Title IX: Regulations Prohibiting Sex Discrimination in Education
   c. ADA: American with Disabilities Act
3. State of Illinois
   a. Illinois Steel Products Procurement Act, as amended (Illinois Revised Statutes, ch 48, par. 1801 et. seq.)
   b. Illinois Purchasing Act, as amended (Illinois revised Statutes, ch. 127, par. 132.1 et. seq)
4. IDOL: Safety Glazing Materials Act, as amended with interpretive statement (Illinois Revised Statutes, ch. 111 ½, par 3101 et. seq)
5. IDOT:
   a. Design Manual, including all supplements, current at date of bidding documents, unless otherwise specified.
   b. Standard Specifications for Road and Bridge Construction, including all supplements, IDOT 1 January 97 edition.
6. IDPR: Illinois Roofing Industry Licensing Act, as amended (Illinois Revised Statutes, ch 111, par 7501 et seq)
7. IEPA:
   a. Air Pollution Standards
   b. Noise Pollution Standard
   c. Water Pollution Standards
   d. Public Water/ Supplier
   e. Solid Waste Standards
   f. Illinois Recommended Standards for Sewage Work
8. IDPH: Illinois State Plumbing Code
9. OSFM:
   a. Boiler and Pressure Vessel Safety Act and Rules and Regulations (Illinois Revised Statutes, Ch., 127 ½, Par. 151 et seq.).
   b. Tactile Identification on Certain Elevators (Illinois Revised Statutes, Ch. 111 ½, Par. 3901 et seq.)
   c. Installation of Elevators (Illinois Revised Statutes, CH. 111 ½, Par. 4001 et seq.)
11. Standards:
   d. ASHRAE No. 62, Standard for Natural and Mechanical Ventilation (Except IDMH and ISBE).
   f. ASHRAE No. 15, Safety Code for Mechanical Refrigeration
   g. AWWA: Water and Sewer Main Construction
   h. NFPA: National Fire Codes (16 volume set. Specify as appropriate to the project.) (Except ISBE).
13. Chicago Building Code

B. The Architect/Engineer or CDB may reference other codes or standards throughout the Project Manual when deemed appropriate for proper compliance with regulatory requirements.

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

No related text

End of Section 01060
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01110
EXISTING FACILITIES REQUIREMENTS

PART I - GENERAL

1.1 Requirements Include:

A. The project will be constructed at an occupied facility. This Section governs the Contractor’s use of existing facilities. These requirements supplement the Standard Documents for Construction and the other sections of the Project Manual.

B. The Contractor is to provide the following:
   1. Scheduling
   2. Security and site regulations
   3. Entrances
   4. Construction Aids
   5. Temporary enclosures and barriers and pedestrian walks
   6. Fences
   7. Temporary utilities
   8. Pedestrian Sidewalks Access and Parking Areas
   9. Traffic regulation
   10. Construction cleaning
   11. Field offices
   12. Storage
   13. Closeout
   14. Porta-Potties (FOR EXTERIOR WORK ONLY)

1.2 Contractor’s Use of Premises:

A. Confine operations at site to areas permitted by Law, Permits, Contract and representatives. Obtain and observe all site regulations.

B. Keep all unattended vehicles and equipment locked at all times. Park in approved areas only.

C. Assume responsibility for protection and safekeeping of products stored on premises. Obtain and pay for use of additional storage or work area needed for operation. Move all stored products or equipment which interfere with the work.

D. Contractor and Project Manager may not interfere with lawfully conducted inspections or site visits by properly identified representatives of regulatory agencies or collective bargaining units. Notwithstanding the above, NEIU’s Public Safety Department regulations shall be observed.

E. All work personnel and visitors shall comply with personal protection regulations, including hard hats.

F. All visitors to hazardous waste or asbestos abatement projects must provide proof of OSHA respirator fit-testing, medical examination and proof of proper certification to enter contaminated areas. Disposable clothing will be provided and disposed of by the Abatement Contractor.
G. At occupied facilities, provide and maintain appropriate fences, barricades and/or security locking to limit resident access to excavations, construction areas, and construction storage field offices.

H. Preserve and protect existing trees and plants at sites which are designated to remain as well as those adjacent to site. Replace trees and plants damaged or destroyed due to construction operations.

PART 2 - PRODUCTS

No Related Text

PART 3 - EXECUTION

3.1 Scheduling:

A. Schedule the work to allow NEIU to remain fully operational during all phases of construction. Submit separate detailed schedule showing:
   1. Each stage of work, occupancy dates of areas.
   2. Date of Substantial Completion for each area of work.

B. Schedule noisy or hazardous work to avoid problems with NEIU operations as approved by NEIU prior to start of work.

C. Schedule fire alarm shutdowns with NEIU electricians for Hot Work Permit work and other activities requiring disarming of the fire alarm system a minimum of two (2) working days prior to each event.

3.2 Security and Site Regulations:

A. Initiate security program at project mobilization. Maintain security program throughout construction period until NEIU occupancy and/or acceptance precludes need for Contractor’s security.

B. Site rules and regulations take precedence over others that may exist outside such jurisdiction. Confer with NEIU representative and obtain full knowledge of all site rules and regulations affecting work.

C. NEIU may examine Contractor’s list of employees, including subcontractors and agents.

D. Provide control of all persons and vehicles entering and leaving project site. (Reasonable proof of identification and signature to the visitor’s log shall be required of the visitors by the Contractor’s site representative.)
   1. Workers are required to obtain and wear University badges from University Police on a daily basis.

E. Contractor shall protect work, stored materials and construction equipment from theft and vandalism. Protect premises from entry by unauthorized persons. At site, protect NEIU’s operations from theft, vandalism or damage from Contractor’s work or employees.
F. Keep all vehicles, mechanized or motorized equipment locked at all time when parked and unattended.

3.3 Entrances:
A. Access to the site shall be made as directed by NEIU.

3.4 Construction Aids:
A. Except as noted the Contractor provides and maintains construction aids and equipment for common use and to facilitate execution of the work.
B. Use of stairs, elevators and toilets shall not disrupt normal NEIU activities. Contractor shall maintain normal cleanliness of areas at all times.

3.5 Temporary Enclosures and Barriers:
A. Provide and maintain suitable barriers of materials appropriate for purpose, to comply with specified codes, to prevent unauthorized entry and to protect the work, existing facilities, and utilities from construction operations.
B. The Contractor shall provide and maintain required barricades in good condition until the completion of the part of the work requiring such protection and then remove same. The Contractor shall be responsible for all acts and operations of his employees or subcontractors including the neglect or failure to take proper safety precautions, and for all damages to persons or property consequence of neglect or failure to take the necessary or required regulations.
C. All barriers shall comply with federal, state and local laws and regulations.
D. Remove when no longer needed, at completion of the work or as directed.

3.6 Temporary Utilities:
A. NEIU will authorize Contractor use of existing facilities or services:
   1. Electrical power service.
   2. Water service.
B. Make written arrangements with NEIU representative.
C. Prevent interference with NEIU normal use of system.
D. Modify, supplement and extend systems to meet temporary utility requirements for project, subject to approval of NEIU. Modifications shall be at Contractor's expense.
E. Contractor requiring facilities or services beyond those available from NEIU shall provide and pay for extension or modification of services to perform the work and for restoration of services of completion of work.

3.7 Pedestrian Sideways, Access and Parking Areas:
A. Temporary Access: Contractor shall provide and/or maintain access to site and within site. Maintain facilities to provide uninterrupted access to mobilization, work, storage areas and/or other areas required for execution of the Contract. Locate as specified or as approved by the Project Manager.
B. **Existing Pavements.** Existing streets, drives and parking areas may be used for construction traffic, only if specified or approved in writing by NEIU. Maintain existing construction. Do not allow heavy vehicles or construction equipment in parking areas. Repair or replace all portions damaged during construction work progress. Restore to original or specified condition prior to Final Acceptance.

C. **Traffic Control.** Contractor shall provide and maintain traffic control signs, personnel and protective devices to expedite the work and maintain required pedestrian and vehicular traffic as required for university programs.

D. **Maintenance.** Maintain roads, walk and parking areas in a sound, clean condition and restore to original condition upon completion prior to Final Acceptance.

E. **Parking:**

1. Contractors, including their sub-contractors and suppliers, are responsible to comply with all “Northeastern Illinois Parking Rules and Regulations” at all times. No exceptions. Copies of the regulations are available in the Public Safety Office, and in the Parking Office located at the Parking Facility, west of our main campus.

2. Contractors and sub-contractors planning on parking their car must purchase a parking permit. A daily parking permit can be purchased at the automated parking permit machine located at the south end of the main parking lot or in the Parking Facility, 1st level. Daily, semester, and annual permits may be purchased in the Parking Office located at the Parking Facility.

3.8 **Temporary Environment Controls**

A. Contractor shall provide controls over environmental conditions at the construction site. Maintain until Substantial Completion.

1. **Dust Control.** Provide dust control materials to minimize dust from construction operations.

2. **Water Control.** Control surface water to prevent ponding or damage to the work, the site, or adjoining properties. Provide operator and maintain pumps as required.

3. **Pollution Control.** Prevent discharge of noxious substances from construction operations. Provide equipment and personnel to perform emergency measures to contain spillage and to remove contaminated soils or liquids. Take measures necessary to prevent pollutants from entering public waters.

4. **Erosion Control.** Plan and execute construction and earthwork in a manner to control surface drainage from cuts and fills and from borrow and waste disposal areas, to prevent erosion and sedimentation. Provide measures to prevent silting or runoff of silt or sediment from site.

5. **NPDES Permits.** When applicable, cooperate with Project Manager in obtain and compliance with National Pollutant Discharge Elimination System permit.

6. **Noise Control.** The Contractors is required to limit constant resonating noise, such as cutting or jack hammering, to closed hours, or carefully schedule such work at non critical normal hours.

3.9 **Fire Safety:**

A. Do not burn debris and waste on site. Open flame heaters shall not be used.

B. **Hot Work Permit**
1. Contractors, including their sub-contractors, are responsible to comply with Northeastern Illinois University Hot Work Permit Program at all times. No exceptions. Copies of the program are available in the Facilities’ Management Office. This program details the process required by contractors and NEIU employees to obtain and complete a Hot Work Permit to perform hot work (welding, burning, and cutting) activities at all Northeastern Illinois University owned and leased properties. Any process, including grinding, which produces sparks or flames capable of igniting combustible or flammable materials or transmits heat to the work material from a hot gas requires a Hot Work Permit.

2. Contractor shall request a Hot Work Permit a minimum of three (3) working days prior to any operation involving open flames or producing heat and/or sparks. This includes, but is not limited to: welding, brazing, cutting, grinding, soldering, torch-applied roofing, and thawing pipe. Contractor must obtain a signed Hot Work Permit before proceeding with work as described above. An approved Hot Work Permit must be posted at the job site at all times the job is in progress.

3.10 Storage and Protection:
   A. Unless otherwise specified in the Project Manual, Contractor shall provide and maintain storage, protection and security for stored materials and equipment on and off site. Contractor shall comply with manufacturer’s recommendations. Storage shall be where authorized by Project Manager.

3.11 Construction Cleaning:
   A. Contractor shall provide regular cleaning and disposal of construction waste from the project site to the level of broom clean. Provide covered containers for disposal of waste and debris.
   B. Remove waste and debris from exterior of building, floor by floor progressively, and remove all waste and debris from grounds and landscaping around building site prior to each operation.
   C. During handling and installation, clean and protect existing and new construction and adjoining materials in space. Apply protective covering where required to ensure protection from damage or deterioration prior to Substantial Completion.
   D. Perform construction cleaning
      1. Clean NEIU-occupied areas daily if work causes unclean condition.
      2. Clean all spillage and heavy dust collections in occupied areas immediately.
      3. Contractor shall be responsible for immediately cleaning any dust or debris outside the work area resulting from construction activities.
   E. At completion of work of each craft, clean and make surfaces ready for work of successive crafts.

3.12 Closeout:
   A. Upon completion of need to use existing provided facilities, restore each to original or specified condition.
C. Upon completion of work in each area, provide final cleaning, including floors, walls, windows, etc. that are soiled as a result of the construction activities and return the space to a condition suitable for use.

End of Section 01110
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01120
PROJECT PROCEDURES

PART I - GENERAL

1.1 Requirements Include:

A. Contractor
   1. Coordinate work of employees and subcontractors
   2. Schedule elements of renovation work to expedite completion
   3. Schedule noisy or hazardous work to avoid problems with NEIU’s operations:
   4. Patch, repair, and refinish existing items to remain to the specified condition for each material with a neat transition to adjacent existing construction

1.2 Related requirement:

A. Specified elsewhere:
   1. 01710 - Final Cleaning
   2. 03300 - Cast-in-Place Concrete

1.3 Sequence and Schedules:

A. Submit separate detailed sub schedule for work, coordinated with Construction Schedule. Show:
   1. Each stage of work
   2. Date of Substantial Completion for each area of work
   3. Crafts and subcontractors employed in each stage

1.4 Alterations, Cutting and Protection:

A. Cut finish surfaces such as concrete by methods to terminate surfaces in a straight one at a natural point of division.

B. Protect existing and new work from weather and temperature extremes
   1. Maintain existing interior work above 60 degrees F.
   2. Provide weather protection and waterproofing, control to prevent damage to remaining existing work and to new work.

C. Provide temporary enclosures specified in 01525, to separate work areas from existing building and from areas occupied by NEIU, and to provide weather protection.

PART 2 - PRODUCTS

2.1 Materials for Patching, Extending and Matching:

A. Ensure that work is complete. Provide same materials or types of construction as that in existing structure, to patch, extend or match existing work.
PART 3 - EXECUTION

3.1 Remove Existing Construction:
   A. Remove and dispose of:
      1. Existing faulty concrete
      2. Existing coatings and membranes on all concrete eyebrow/folded plates and struts, fascia beams and concrete columns

3.2 Performance:
   A. Patch and extend existing work using skilled craftsmen capable of matching existing quality of workmanship. For patched or extended work, provide quality equal to that specified for new work.

3.3 Damaged Surfaces:
   A. Patch and replace all portions of existing finished surfaces found to be damaged, lifted, discolored or showing other imperfections with matching material.
      1. Provide adequate support prior to patching the finishing.
      2. Finish patched portions of concrete sources in a manner to produce uniform color and texture over entire surface
      3. When existing surface cannot be matched, refinish entire surface

3.4 Cleaning:
   A. Perform construction cleaning as specified in 01561
      1. Clean NEIU-occupied areas daily if work causes unclean condition
      2. Clean all spillage, over spray and heavy dust collections in NEIU occupied areas immediately

   B. At completion of work of each craft, clean and make surfaces ready for work of successive crafts.

   C. At completion of work in each area, provide final cleaning in accord with 01170 and return space to a condition suitable for use of NEIU.

End of Section 01120
PART 1 - GENERAL

1.1 Schedule and Contract Time

A. Construction Schedules:
   1. The Contractor shall submit a projected construction schedule to NEIU within five (5) business days after the pre-construction meeting.
   2. Form: Horizontal bar chart, unless otherwise specified in the Project Manual. A critical path schedule may be required for certain projects.
   3. Content: Submittals, delivery dates, dates for beginning and completion of each element of construction.
   4. Revisions: Review and update monthly (on original schedule). Note problem areas; current and anticipated delay factors and their impact; corrective action taken; effect of change in schedule; activities modified since previous submission.

B. Contract Time:
   1. The Contractor, recognizing that the contract time is of the essence, shall perform the work in such manner and with such sufficient equipment and forces to complete the work by the date specified in the contract.
   2. Extensions of the contract time will be made for delays which affect critical items on the Construction Schedule arising from unforeseeable causes beyond the control and without the fault or negligence of the Contractor or of its subcontractors or suppliers, including, but not restricted to:
      a. Acts of God
      b. Acts of Project Manager
      c. Acts of other contractors in the performance of a contract with NEIU, except when other contracts are assigned to the Contractor.
      d. Fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather or other perils causing damage to the Project.
   3. Requests for an extension of time will not be considered unless made in writing to the Project Manager within 15 (fifteen) calendar days after the cause of delay. In the case of a continuing cause of delay, only one (1) request is necessary. Extensions of the contract time may be made by NEIU either during performance of the work or at the end of the contract time. The grant of an extension of time to the Contractor shall not impair or prejudice the rights of NEIU hereunder.

C. The Contractor shall not be entitled to payment or compensation of any kind from NEIU for any alleged damages, costs or expenses whatsoever, including but not limited to costs of acceleration, arising in any manner because of hindrance or delay from any cause whatsoever, whether such hindrances or delays be reasonable, foreseeable or avoidable. The Contractor shall not be entitled to recover from NEIU, and hereby waives all rights which it, or its subcontractors or any other person may otherwise have to recover any costs, expenses and damages of any nature which it, or its subcontractors or any other person, may suffer by reason of delay in the performance of the work or any portion thereof, the extension of contract time granted herein being the Contractor's sole and exclusive remedy.
1.2 Shop Drawings, Product Data and Samples:

A. Do not begin any work which requires submittals without the Project Manager's approval. Substitution of materials or equipment may not be made except by Change Order.

B. Contractor shall provide Submittals as specified in other sections, to Project Manager.
   1. Include schedule for all submittals with Project Schedule.
   2. Submit four (4) copies to Project Manager. Include one (1) copy which will be maintained on the project site and submitted at close-out showing actual conditions. At Contractor's option, submit reproducible copy to Project Manager which will be returned with Project Manager's note and stamp.
   4. Shop Drawings shall be prepared by qualified personnel. Maximum sheet size shall be 36 inch x 24 inch. Clearly indicate dimensions, clearances and tolerances.
   5. Manufacturer's product data shall be clearly marked to show specific features and models that apply to the work.
   6. Samples shall be sized to illustrate materials, color and workmanship. See specific sections for size format or other requirements related to a particular item.
   7. Field samples and mock-ups shall be erected at project site as specified by Project Manager. Protect, maintain and remove when directed.

C. Submittals shall include:
   1. Date and revision dates
   2. Project Number and Title
   3. Name, as applicable, of Project Manager, Contractor, Subcontractor, Supplier, Manufacturer, Detailer
   4. Identification of product or material
   5. Relation to adjacent structure or material
   6. Field dimensions, clearly identified
   7. Specification page and number
   8. Specified standards, such as ASTM or ANSI
   9. Blank space for Project Managers stamp
   10. Identification of previously approved deviation from Contract Documents
   11. Contractor's stamp, initialed or signed, certifying to review and submittal, verification of field measurements and compliance with Contract
   12. Space for Architect/Engineer's approval stamp, when applicable.

1.3 Contractor's Use of Architect's Electronic Files:

A. General: At Contractor's written request, copies of Architect's electronic files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. Contractors and subcontractors may purchase electronic media files of the contract drawings and/or copies of the specifications.
   2. The cost to generate these documents will be $100 per drawing or $500 per set and $0.10 per page of specification to be reimbursed to BLDD. Specifications will be in PDF format.
   3. Upon request to purchase electronic media, the Contractor shall complete the “Electronic File Transfer” form provided by BLDD and return the signed for with a check for the proper amount.
4. Construction drawings for this project have been prepared utilizing Autodesk Architectural Desktop 2007. We make no representation as to the compatibility of these files with your hardware or your software beyond the specified release of the referenced specifications.

5. If the information requested includes electronic drawings prepared by others, the Contractor will be responsible for obtaining approval from the appropriate Design Professional for use of that part of the document.

6. The electronic contract documents can be used for preparation of shop drawings and as-built drawings only. The information may not be used in whole or in part for any other project.

7. The drawings prepared by BLDD for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.

8. The use of these CAD documents by the Contractor does not relieve them from their duty to fully comply with the contract documents, including, and without limitation, the need to check, confirm and coordinate all dimensions and details, take field measurements, verify field conditions and coordinate your work with that of the other contractors for the project.

9. The information is provided to expedite the project and assist the Contractor with no guarantee by BLDD as to the accuracy or correctness of the information provided. BLDD accepts no responsibility or liability for the Contractor’s use of these documents.

1.4 Contractor License

A. Upon request, submit to the Project Manager, copies of all contractor licenses applicable to the work and which are required by all applicable local, City and State laws and the Project Manual.

1.5 Schedule of Values

A. An approved Schedule of Values shall be the only basis for application for payment. Submit the Schedule of Values to Project Manager 15 (fifteen) business days prior to first Application for Payment. Payment for materials stored on or off site will be limited to those materials listed in the Schedule of Values.

1. Itemize overhead and profit, bonds, insurance, general requirements, mobilization.

2. Itemize by separate line item the cost for work specified in each section of the Project Manual. Identify the work of Contractor’s own labor forces, subcontractors and major suppliers of products and equipment. List quantities of materials specified under unit prices.

3. Break down installed costs into delivered cost of product with applicable taxes paid and labor cost, excluding overhead and profit.

4. The sum of all items listed in the Schedule should equal contract amount.

5. Itemize by name and amount all subcontractors and suppliers whose subcontracts will exceed $500 unless otherwise approved by Project Manager.

B. Revise to indicate changes in subcontractors or suppliers (not for Change Orders).

1.6 Electronic Submittal Procedures:

B. The following types of submittals may be transmitted electronically as outlined in this Section:

1. Shop drawings.
2. Product data.
3. Manufacturer’s installation instructions.
4. Schedule of Values.
5. Construction Schedule.
6. Draft pay applications.
7. RFI’s.
8. RFP response.

C. Electronically transmit each submittal to the Architect as follows:
   1. Transmit submittals as attachments to emails.
   2. Send submittal emails to the following designated person’s email addresses:
      a. Architect.
      b. The designated representative of the Owner.
   3. Submittals shall include an electronic letter of transmittal.
      a. Samples: Samples shall be delivered to the Architect with a letter of transmittal. An electronic copy of the transmittal shall be emailed to the Architect.
   4. Format: Electronic submittals shall be made in PDF or DWF format.
      a. Scanned copies in PDF format of paper originals are acceptable; scanned copies that are not legible will be rejected.
      b. Electronic submittals will be reviewed and returned in PDF or DWF format.
      c. All sheets shall be oriented to a “ready to read” orientation.
   5. File Names: Electronic submittal file names shall be easily understood and shall include the relevant specification section number.
   6. File Size: Electronic file size shall be limited to a maximum of 5MB. No emailed submittal shall exceed 5MB.
      a. Larger files shall be divided into files sized 2MB or smaller and clearly labeled, such as “1 of 2”, “2 of 2”, etc.
   7. File Security: Do not set any permissions on the file; protected/secured documents will be rejected.
   8. Large Format Submittals: All electronic submittals that are larger than 8 ½” x 11” shall have one full size printed set submitted to the Architect and the Owner’s Project Manager. The printed set is for reference only and will not be returned.

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

1.2. Contractor Responsibilities:

   A. Review shop drawings, product data, and samples prior to submission to Architect. Contractor to indicate approval of submittal prior to sending to Architect for review by stamping item “Approved” with Contractor’s name and date.

   B. Verify:
      1. Field dimensions.
      2. Field construction criteria.
      3. Catalog numbers and similar data.

   C. Coordinate each submittal with requirements of:
1. The work.
2. The contract documents.
3. The work of other contractors and Subcontractors.

D. Contractor's responsibility for errors and omissions in submittals is not relieved by Architect's review of submittals.

E. Prior to submission, notify Architect in writing of all proposed deviations in submittals from contract requirements.

F. Do not begin any work which requires submittals without having Architect's stamp and initials or signature.

G. After Architect's review, make response indicated by the Architect's stamp. Distribute copies of reviewed submittals to concerned parties.
   1. Instruct parties to promptly report any inability to comply with provisions.

H. Coordinate all subcontractor's submittals:
   1. Subcontractors make submittals to Contractor.
   2. Contractor review and initial submittal for compliance with scope, coordination and integration with the work of all other subcontractors.
   3. Contractor shall transmit reviewed copies of subcontractors' submittals to Architect.
   4. Contractor shall retain copy of submittals after review by Architect and distribute copies to submitting subcontractor and to other subcontractors for coordination and integration.
   5. Contractor shall enforce re-submittal requirements.

1.3. Architect's Duties:

A. Review submittals within 20 business days, unless notice is otherwise given to the Contractor.

B. Review for:
   1. Consistency with design concept of project.
   2. Compliance with Contract Documents.

C. Review all requests for proposed deviations.

D. Review of separate item does not constitute review of assembly in which item functions.

E. Affix stamp, data and initials or signature certifying to review of submittal, and with indications for Contractor response.

F. Return submittals to Contractor for response or distribution. The Architect will return the reviewed and stamped reproducible to the Contractor. The Architect will retain all prints submitted with the reproducible. If only prints are submitted (only with Architect's prior permission), the Architect will retain four copies of same, and will return all additional copies.

1.4. Resubmission Requirements:

A. Shop drawings:
1. Revise initial drawings as indicated and resubmit in accordance with submittal procedures.
2. Indicate on drawings all changes which have been made in addition to those requested by Architect.

B. Product data and samples: Submit new data and samples as specified for initial submittal.

C. Make all re-submittals within 10 business days after date of Architect's previous review.

D. Assign alphabetic suffix to original submittal number for each re-submittals.

1.5. Distribution of Submittals After Review:

A. Architect will review copies of shop drawings and product data, apply the Architect's stamp and inform the Contractor that the mark-up is available for viewing on the website:

B. General Contractor will distribute copies of shop drawings and product data which carry Architect's stamp to:
   2. Job site file.
   3. Record Documents file.
   4. Other Contractors.
   5. Subcontractors.
   7. Fabricators.

C. General Contractor will distribute samples in accordance with contract documents.

D. General Contractor shall print one copy of all "Reviewed" and "Reviewed as Noted" submittals and submit to Owner at completion of project.

End of Section 01300
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01310
PROJECT SCHEDULES

PART 1 - GENERAL

1.1 Requirement Includes:
   A. Contractor: Submit schedule to Architect/Engineer within ten (10) business days after preconstruction meeting. Maintain, coordinate and distribute schedule.

1.2 Related Requirements:
   A. Specified elsewhere:
      1. 01010 - Project Summary
      2. 01320 - Project Meetings
      3. 01340 - Shop Drawings, Product Data & Samples
      4. 01370 - Schedule of Values

1.3 Form of Schedules:
   A. Prepare a standard horizontal bar chart:
      1. Provide separate horizontal bar column for each class of work, activity or long-lead equipment item

1.4 Content of Schedules:
   A. Indicate complete sequence of removal and recoating by activity.
      1. Shop drawings, product data and samples: In accordance with 01340.
         a. Submittal dates
         b. Dates when reviewed copies will be required.
      2. Decision dates for: Selection of finishes
      3. Product procurement date, application time and delivery dates
      4. Dates for beginning and completion of, each element of cleaning, repairing and recoating.
   B. Identify work on separate floors or separate phases.

1.5 Updating:
   A. Update monthly. Indicate:
      1. Progress of each activity since previous submission
      2. Projected completion dates for all activities
      3. Activities modified since previous submission.

1.6 Submittal:
   A. Submit initial schedules within ten (10) business days after date of preconstruction meeting.
      1. Architect/Engineer will review schedules and return reviewed copy within ten (10) business days after receipt
      2. When directed, resubmit within five (5) business days after return of reviewed copy.
B. Submit monthly updated schedules accurately depicting progress to first day of each month.

1.7 Distribution:

A. Distribute copies of approved schedules to:
   1. Job site file
   2. Contractor
   3. Subcontractors and suppliers on as-needed basis
   4. Architect/Engineer
   5. NEIU

**PART 2 - PRODUCTS**

No related text

**PART 3 - EXECUTION**

No related text

End of Section 01310
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01320
PROJECT MEETINGS

PART I - GENERAL

1.1 Requirements Include:

A. Contractor
   1. Attend specified meetings
   2. Ensure attendance of subcontractors and suppliers when specified or directed.

1.2 Related Requirement:

A. Specified elsewhere:
   1. 01310 - Project Schedule
   2. 01370 - Schedule of Values
   3. 01700 - Project Closeout
   4. 01720 - Project Record Documents
   5. 01730 - Operating & Maintenance Data

1.3 Preconstruction Meeting:

A. NEIU will schedule within five (5) business days after Notice of Award. Contractor is to coordinate with specified date of submittal of construction schedule (01310) and other initial Submittals.

B. Attendance
   1. Architect/Engineer
   2. Contractor
   3. NEIU
   4. Major subcontractors
   5. Safety representative

C. Minimum Agenda:
   1. Project Directory:
      Major subcontractors, etc.
   2. Designation of responsible personnel
   3. Establish chain of authority
   4. Interrelation and coordination of contractors
   5. Critical work sequencing, scheduling (see Section 01310)
   6. Processing of field decisions and change orders
   7. Adequacy of distribution of contract documents
   8. Submittals: See Section 01340
      a. Schedules
      b. Shop drawings, product data and samples
      c. Test reports
      d. Manufacturer's certification of products
      e. Schedule of Values
   9. Major equipment deliveries and priorities
   10. Procedures for maintaining record documents
   11. Use of premises
      a. Office and storage areas
b. Access
  c. NEIU’s requirements
12. Safety and first aid procedures
13. Pay meetings, including dates, time and location
14. Architect/Engineer Observation
15. Barrier (see Section 01530)
16. Construction Aids

1.4 Payment and Progress Meetings

A. NEIU will schedule and administer payment and progress meeting. Architect/Engineer will:
   1. Prepare agenda
   2. Distribute written notice and agenda of regular and called meeting five (5) business days in advance of meeting date
   3. Make physical arrangements for meeting
   4. Record minutes, include significant proceedings and decisions
   5. Distribute copies of minutes to participants within four (4) business days after meeting

B. Attendance
   1. NEIU
   2. Architect/Engineer
   3. Contractor
   4. Subcontractors and suppliers

C. Minimum Agenda
   1. Review, approve minutes of previous meeting
   2. Review work progress since last meeting, review schedule
   3. Review applications for payment

End of Section 01320
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01340
SHOP DRAWINGS, PRODUCT DATA & SAMPLES

PART 1 - GENERAL

1.1 Requirement Includes:

A. Contractor:
   1. Shall make submittals to Project Manager for approval.
   2. Contractor shall also maintain a master list of submittals.

1.2 Related Requirements

A. Specified elsewhere:
   1. 01230 - Alternates
   2. 01310 - Project Schedules
   3. 01300 - Submittals
   4. Division 15 & 16

1.3 Definitions

A. Shop drawings: Shop drawings are original drawings prepared by Contractor, subcontractor, supplier or distributor, which illustrates some portion of the work, showing fabrication, layout, setting or erection details.
   1. Prepared by qualified detailer
   2. Identify details by reference to sheet and detail numbers shown on contract drawings
   3. Maximum sheet size (36 inches x 24 inches)
   4. Reproductions for submittals: Reproducible on Copier machine.
   5. Submit three (3) copies.

B. Product data
   1. Manufacturer’s standard schematic drawings, edited to fit this project
   2. Manufacturer’s catalog, sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data
      a. Clearly mark each copy to identify pertinent materials, product or models
      b. Show dimensions and clearances.
      c. Collect in three-ring notebook.
      d. Submit three (3) copies.

1.4 Resubmission Requirements

A. Contractor
   1. Resubmit all shop drawings, product data and samples as requested by the Project Manager.

1.5 Responsibilities

A. Review shop drawings, product data and samples prior to submission to Project Manager.

B. Verify:
1. Field dimensions
2. Field construction criteria
3. Catalog numbers and similar data

C. Coordinate each submittal with requirements of:
   1. The scope of work.
   2. The contract documents.

D. Contractor's responsibility for errors, omissions or deviation from contract documents in submittal is not relieved by Project Manager’s review of Submittals.

E. Prior to submission, notify Project Manager in writing of all proposed deviations in Submittals from contract requirements.

F. Do not begin any work which requires Submittals without Project Manager’s approval.

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

No related text

End of Section 01340
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01370
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 Requirements Include:

A. Contractor:
   1. Submit Schedule of Values to Architect/Engineer at least ten (10) business
      days prior to submitting first application for payment
   2. Support values given with data to substantiate their correctness
   3. Submit quantities of designated materials
   4. List quantities of materials specified under unit prices
   5. Use approved Schedule of Values as only basis for application for payment
      cleaning and disposal of waste materials, debris and rubbish during
      construction

B. Payment for materials stored on or off site will be limited to those materials listed in
   Schedule of Values.

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 01010 - Project Summary
   2. 01320 - Project Meetings
   3. 01700 - Project Closeout

1.3 Form of Submittal

A. Submit typewritten Schedule of Values

B. Use Project Manual Table of contents as basis of format for listing costs of all
   work.

C. Identify each line item with number and title listed in Project Manual table of contents

1.4 Preparation

A. Itemize separate line item cost for each of following cost items:
   1. Overhead and profit
   2. Bonds
   3. Insurance
   4. General Requirements
      Break down general requirements to temporary facilities. Show initial
      installation and maintenance and fuel consumption

B. Itemize work of:
   1. Contractor's own labor forces
   2. All subcontractors
   3. All major suppliers of product or equipment
C. Break down installed costs into:
   1. Delivered cost of product, with taxes paid
   2. Labor cost, excluding overhead and profit

D. For each line item which has installed value of more than ten (10) percent of Contract Value. Provide separate entry including general contractor, subcontractor, supplier, specification section number, description of work or material, quantity, unit price, schedule value and percentage of contract.

E. Round off figures as appropriate to project size.

1.5 Review and Resubmittal
   A. After review by Architect/Engineer, revised and resubmit Schedule as directed

1.6 Distribution
   A. After approving Schedule of Values, Architect/Engineer will distribute copies to the contractor.

1.7 Update
   A. Update Schedule of Values when change of subcontractor, supplier, product or equipment occurs.

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

No related text

End of Section 01370
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01400
GENERAL REQUIREMENTS FOR ALL TRADES

PART 1 - GENERAL

1.1 Furnish and install all labor, material and equipment as required to complete the Work as shown on the Drawings and as specified in the Specifications and herein to provide complete and operational systems.

1.2 The completed Work shall consist of complete and operational systems constructed in strict accordance with the Drawings and Specifications. Any labor, material or equipment which is not indicated on the Drawings or mentioned herein, but is necessary or incidental to completing the entire Work, as shown and intended, shall be implied and must be furnished in place at no additional cost.

1.3 Contractor, prior to preparing a proposal, shall visit the site and fully acquaint himself with the conditions as they exist and the character of the operation to be carried out. Contractor shall also familiarize himself with the Drawings, Specifications and the operations and equipment required to complete the Work. By submitting a proposal, Contractor agrees that he has carefully examined the Drawings, Specifications and the site, and that from his own investigations has satisfied himself as to the nature and the location of the Work, the general conditions surrounding the Work and all matters which may in any way affect the Work or its performance, and that as a result of such examination and investigation fully understands the Drawings and Specifications and the conditions of bidding.

1.4 The Drawings indicate the general location of existing construction, new construction, equipment, accessories, specialties, mechanical, plumbing, and electrical systems, and other related conditions. Contractor shall carefully investigate the site and conditions, verify dimensions by actual measurement, coordinate his work accordingly. Contractor shall be responsible for the accuracy of all such measurements and the precise fitting and assembly of the finished construction.

1.5 Contractor shall obtain and pay for all necessary licenses, permits and inspections as required by all applicable laws, ordinances, codes and rules. Where required, Contractor shall request such inspections and furnish NEIU with all certificates of final inspection where applicable.

PART 2 - QUALITY ASSURANCE

2.1 All work shall be done in a thoroughly first-class and workmanlike manner, executed with the best practice of the trade involved, installations made secure, plumb, true and square and shall conform to all applicable laws and shall be completed in accordance with the Drawings and Specifications. All Work shall be executed in a timely and efficient manner.

2.2 All materials shall be new and the best of their respective kind. In no case shall substitutions for materials, methods or equipment be made from that which is specified without the written consent of the Architect. Any changes in the Work necessitated by the substitution of materials, methods or equipment from that which is shown on the Drawings or specified in the Specifications made by Contractor, shall be the responsibility Contractor and shall be completed at no additional cost.

2.3 All work and materials shall be in accordance with the laws, codes, regulations and ordinances as required or adopted by the City of Chicago and all other applicable bodies
having jurisdiction with the Work. Compliance with the requirements of applicable laws, codes, regulations and ordinances shall not be construed as waiving any part of the Drawings or Specifications which may be in excess of the requirements set forth. If, in the opinion of the Contractor any part of the Drawings or Specifications does not comply with the above mentioned laws, codes, regulations, and ordinances, the matter shall be referred to the attention of the Architect for a decision before proceeding with that portion of the Work. There shall be no changes in the Drawings or Specifications without the written approval of the Architect.

2.4 Furnish and install all specified materials and assemblies in accordance with the manufacturer’s current printed directions, specifications and recommendations. All materials shall be delivered in their original unopened packages or containers and stored in an enclosed area providing adequate protection from damage. Damaged or deteriorated materials shall be removed from the property immediately. All colors shall be selected by the Architect from samples to be provided by Contractor upon request.

PART 3 - EXECUTION

3.1 Contractor shall confer with all other contractors as may be also working on the Project, regarding the location and size of all equipment, other construction, pipes, openings, switches, etc., in order that there may be no interferences between the installation or the progress of any contractor and any changes required to comply with the Drawings or Specifications shall be made at no additional cost in order to accommodate the work of others.

3.2 Where cutting is required to facilitate construction, Contractors shall cut such construction at their own expense. Patching and the repair of all such openings shall be performed by the applicable trade for the material to be patched or repaired, leaving all existing construction which is to remain in its original state. In no case shall structural work be cut or modified without the written approval of the Architect.

3.3 Contractor shall take all necessary precautions and provide and maintain all necessary protection and enclosures to insure that dust and debris created as a result of the Work does not get out of the construction area and into other parts of the building during the course of the Work. Contractor shall provide and maintain suitable barriers to regulate access, to assure public safety, and to protect the Work in progress. Contractor shall be responsible for any damages to any other construction or furnishings as a result of his work.

3.4 Contractor at all times shall keep the premises free from the accumulation of waste materials or rubbish caused by his operations. At the completion of the Work, Contractor shall remove all waste materials and rubbish from and about the site as well as all tools, construction equipment and surplus materials and leave all areas broom clean. All rubbish and debris resulting from the Work shall be suitably and legally disposed of off of NEIU’s property.

3.5 Contractor shall guarantee all of the work to be performed and materials to be furnished under this Contract against defects in materials and workmanship for a period of one (1) year from the date of Substantial Completion of Work by NEIU. Contractor shall at his own expense and without cost to NEIU, within a reasonable time after receiving written notice thereof, make good any defects in materials or workmanship which may develop and any damage to other work caused by such defects or the repairing of same. Contractor will provide typewritten operating or maintenance instructions and coating warranties.

End of Section 01400
PART 1 - GENERAL

1.1. Work Includes:
   A. The Owner will employ and pay for an independent testing laboratory to perform specified services.
   B. A visual Inspection is required for:
      1. Section 05120 - Structural Steel - Bolts
   C. Employment of testing agency does not relieve Contractor's obligations to perform work in accord with the Contract.
   D. Contractor shall contact testing agency when the periodic visual inspections are needed. Owner's Representative will determine testing frequency.

1.2. Related Work:
   A. Specified Elsewhere:
      1. Section 05120 – Metal Fabrications.

1.3. Testing Agency Duties – Limits of Authority:
   A. Cooperate with Architect and each Contractor; provide qualified personnel promptly on notice.
   B. Acquaint Architect's personnel with the visual inspection procedures and with all special conditions encountered at the site.
   C. Perform specified inspections and construction methods:
      1. Comply with specified standards, ASTM, other recognized authorities.
      2. Ascertain compliance with contract requirements.
      3. Obtain written acknowledgment of each inspection made from Contractor whose work is being tested or from his superintendent.
   D. Promptly notify Architect and Contractor, of irregularities or deficiencies of work which are observed during performance of services.
   E. Testing Agency will promptly submit copies of reports of inspections directly to Owner's Representative, Architect and Contractor including:
      1. Date issued.
      2. Project title and number.
      3. Name and signature of inspector.
      4. Date of inspection.
      5. Record of temperature and weather.
      6. Identification of product and specification section.
      7. Location of project.
      8. Type of inspection.
   F. Perform additional services requested by Architect.
1.4. Contractor’s Responsibilities:

A. Cooperate with testing agency personnel, provide access to work, to manufacturer's operations.

B. Furnish copies of mill test reports.

C. Furnish verification of compliance with contract requirements for materials and equipment.

D. Furnish casual labor and facilities:
   1. To provide access to work to be tested.
   2. To facilitate inspections.

E. Contractor shall be responsible for determining all tests required by the Contract Documents and scheduling their occurrences so not to delay the project schedule.

F. Correct work which is defective or which fails to conform to the contract documents. Corrective work shall not delay the project schedule or the work of other Contractors.

G. Pay all costs of retesting when test results indicate non-compliance with contract requirements.

H. Patch all surfaces and areas disturbed by inspection operations.

End of Section 01450
DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01460
WELDING QUALIFICATIONS

PART 1 - GENERAL

1.1. SECTION INCLUDES

A. Welding requirements

B. Performance qualifications

C. Performance qualification

D. Submittals

1.2. WELDING REQUIREMENTS

A. Welding shall be performed by qualified welding operators using procedures, which have been qualified in accordance with applicable codes and standards:*specified*.

1. ANSI B31 Code for Pressure Piping

2. AWS D1.1 Structural Welding Code

B. Welding screens must be used while working inside the building and protect roof with plywood when working on roof.

1.3. PROCEDURE QUALIFICATION

A. CONTRACTOR, subcontractor, or fabricator performing welding under jurisdiction of referenced codes shall be responsible for obtaining and qualifying welding procedures. Structural welding procedures conforming to AWS D1.1 are prequalified as defined in AWS D1.1, Chapter 5 and Appendix E.

B. CONTRACTOR shall maintain records, and make available to *ENGINEER* OWNER when requested, certifying successful completion of procedure qualification tests.

1.4. PERFORMANCE QUALIFICATION

A. CONTRACTOR, Subcontractor, or fabricator performing welding under jurisdiction of referenced codes shall be responsible for testing and qualifying its welding operators in accordance with applicable codes, using qualified procedures. *Welding to structural steel shall be performed by state-certified welders*.

B. Unless welding operators have been previously qualified by CONTRACTOR within last 6 months and have been continuously employed as welders by CONTRACTOR following qualification, prequalification tests must be performed.

C. ENGINEER reserves right to require any welder to retake tests when, in opinion of ENGINEER, work of welder creates reasonable doubt as to welder’s proficiency; ENGINEER reserves right to witness any required retesting; conduct such tests at no additional expense to ENGINEER.
1.5. SUBMITTALS

A. Except for procedures exempted to AWS D1.1 Section 5.1, submit 1 copy of each welding procedure to ENGINEER with certificate demonstrating successful qualification of welding procedures for each welding process performed in field: AWS D1.1 – Forms E-1, E-2, E-3, or ASME QW-483.

B. Prior to execution of any field welding, submit to ENGINEER 1 copy of welder qualification form for each individual performing field welding: AWS D1.1 Form E-4 or ASME QW-484.

End of Section 01460
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01510
TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 Requirements Include: Designated contractor provide and maintain specified temporary utilities during construction period.

A. Contractor Provide:
   1. Toilets
   2. Telephone service and telephones
   3. Payment of telephone bills
   4. All utilities required in excess of this specified or exceed capacity of existing or permanent system(s)
   5. Hoses and fittings from temporary standpipes or water service connection
   6. Drinking water for own forces

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 01010 - Project Summary

B. Furnished by Others:
   1. NEIU will authorize use of existing facilities or services for temporary use.
      a. Electrical power service
      b. Water service
      c. Elevator for transportation of people only
   2. When requiring NEIU furnished services, the Contractor shall provide and pay for extension or modification of services to perform the work and for restoration of services at completion of work.

1.3 Description of Utility Systems:

A. Toilets:
   1. Provide temporary toilet facilities for use of all workmen and authorized parties throughout construction period.
   2. Provide a minimum number of enclosed combination toilet and urinal units for construction personnel.
      a. One (1) for every twenty (20) employees, or fraction thereof.

B. Temporary telephone service:

A. Provide telephone service as required throughout construction period, pay all charges for the installation, maintenance and removal of such service.

1.4 Requirements of Regulatory Agencies

A. Owner’s only on prior written authorization obtain:
   1. Permits and inspections required by City of Chicago
   2. Temporary easements required across property other than that of NEIU.
      (At Contractor’s expense).

1.5 Use of NEIU’s Existing Systems.
A. Make written arrangements with NEIU's representative

B. Modify, supplement and extend system to meet temporary utility requirements for project, subject to approval of Architect/Engineer and NEIU.

C. Limitations:
   1. Do not overload systems. When project requirements exceed system capacity, provide separate system to meet needs.
   2. Prevent interference with Owner’s normal use of system.

D. Maintain strict supervision of use of temporary facilities.
   1. Enforce conformance with Owner’s regulations
   2. Use only designate facilities, systems or portions thereof

E. Upon completion of need to use existing systems or when directed by Architect/Engineer restore existing systems to specified permanent condition

F. Existing Elevator
   1. The elevator and building entrance designated for use during the work is shown on Drawings A1, A2, A3 and A5. This elevator may be used at any time during the allowable working hours.
   2. Contractor is to provide padding for walls and any other protection needed inside existing elevator to protect all existing finishes.
   3. Contractor shall verify weight to be carried by elevator prior to loading to ensure it is within elevator’s capacity.
   4. Building elevator is to be used for the transportation of people only.

PART 2 - PRODUCTS

2.1 Material may be new or used, but shall be adequate for purposes used, shall not create unsafe or unsanitary conditions or violate applicable codes.

2.2 Materials: Materials must be new and suitable for purpose. Comply with specified codes.

2.3 Barriers: Materials at Contractor’s option, appropriate for purpose.

PART 3 - EXECUTION

3.1 Installation:
   A. Install facilities of a neat and uniform appearance.

End of Section 01510
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01530
BARRIERS

PART 1 - GENERAL

1.1 Requirements Include:

A. Contractor:
   1. Provide and maintain suitable barriers to prevent unauthorized entry and to protect the work, existing facilities and utilities, trees and plants from construction operations.
   2. The Contractor shall provide and maintain required barricades, protection and warning lights in good condition until the completion of the part of the work requiring such protection and then remove same. The Contractor shall be responsible for all acts and operations of his employees or subcontractors including the neglect or failure to take proper safety precautions, and for all damages to persons or property consequence of neglect or failure to take the necessary or required precautions.
   3. All barriers shall comply with federal, state and local laws and regulations.
   4. Remove when no longer needed, at completion of the work or as directed.

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 01010 - Project Summary
   2. 01320 - Project Meetings

PART 2 - PRODUCTS

2.1 Materials: Materials must be new and suitable for purpose. Comply with specified codes.

2.2 Barriers: Materials at Contractor’s option, appropriate for purpose.

PART 3 - EXECUTION

3.1 Installation:

A. Install facilities of a neat and uniform appearance.

End of Section 01530
PART 1 - GENERAL

1.1 Requirements Include:

A. Contractor Provide: Cleaning and disposal of waste materials, debris and rubbish during construction.

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 01120 - Project Procedures
   2. 01710 - Final Cleaning

PART 2 - PRODUCTS

2.1 Equipment

A. Provide covered containers for deposit of water materials, debris and rubbish.

PART 3 - EXECUTION

3.1 Cleaning

A. Maintain areas under Contractor’s control free of waste materials, debris or rubbish.
B. Control cleaning operations so that dust and other particulate will not adhere to wet or newly-coated surfaces.

3.2 Disposal

A. Regularly remove waste materials, debris and rubbish from site and legally dispose of off site.

End of Section 01561
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01620
STORAGE & PROTECTION

PART 1 - GENERAL

1.1 Requirements Include:

A. Make arrangements with NEIU’s Representative for storage of materials and equipment to be installed in reject. Protection and security for stored materials and equipment, on and off site is solely contractor’s responsibility.

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 01010 - Project Summary
   2. 01340 - Shop Drawings, Product Data & Samples

1.3 Off-Site Authorization. Payment for materials/equipment stored off-site will not be permitted.

PART 2 - PRODUCTS

2.1 Protective Materials

A. For duration of storage period, provide materials which will provide proper protection against the elements or other harmful environmental conditions.

PART 3 - EXECUTION

3.1 Location

A. Where shown on drawings (staging area, or where authorized by NEIU).

B. Contractor will resolve conflicts in storage requirements of all contractors.

3.2 Installation

A. Mount fire extinguishers in prominent locations with clear access to use.

B. Mount identifying signs adjacent to entrance doors, in conspicuous locations

3.3 Limitations

A. Material storage is limited to the staging area.

B. Materials are to be stored in such manner as to not interfere with safe entry and egress from all areas.

End of Section 01620
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01630
SUBSTITUTIONS & PRODUCT OPTIONS

PART 1 - GENERAL

1.1 Requirements Include:

A. Base all bids on providing all products exactly as specified.

B. For products specified only by reference or performance standards, select any product which meets or exceeds standards, by an manufacturers, subject to the Architect/Engineer's approval.

C. For products specified by naming several products or manufacturer's, select any product and manufacturer names. Only those products or manufacturers named shall be considered acceptable. Exception see 1.03 below.

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 00300 - Bid Form-Proposed Product Substitution List
   2. 01340 - Shop Drawings, Project Data & Samples
   3. 01370 - Schedule of Values

1.3 Substitutions Bidder/Contractor Options

A. Prior to Bid Opening: The Architect/Engineer will consider written requests to amend the bidding documents to add products not specified provided such requests are received at least days (10) calendar days prior to bid opening date. Requests received after that time will not be considered. When a request is approved, the Architect's/Engineer will issue an appropriate addendum not less than seven (7) days prior to bid opening dates.

B. With Bid: A bidder may propose substitutions with his bid by completing the Proposed Product Substitution List in the Bid Form, subject to the provisions stated thereon. Architect/Engineer will review Proposed Product Substitution List of low bidder and recommend approval or rejection by NEIU prior to award of contract.

C. After Award of Contract: No substitutions will be considered after Notice of Award except under one or more of the following conditions:
   1. Substitutions required for compliance with final interpretations of code requirements or insurance regulations
   2. Unavailability of specified products, through no fault of Contractor
   3. Subsequent information discloses inability of specified product to perform property or to fit in designated space
   4. Manufacturer/fabricator refusal to certify or guarantee performance of specified product as specified.

1.4 Substitution Requirements:
A. Submit three (3) copies of each request for substitution. Include in request:
   1. Complete data substantiating compliance of proposed substitution with contract documents
   2. For products:
      a. Product identification, including manufacturer’s name and address
      b. Manufacturer’s literature:
         1) Product description
         2) Performance and test data
         3) Reference standards
      c. Samples
      d. Names and address of similar project on which product was used and date of installation.
   3. For construction methods:
      a. Detailed description of proposed method
      b. Drawings illustrating methods
   4. Itemized comparison of proposed substitution with product or method specified
   5. Data relating to changes in construction schedule
   6. Identify
      a. Change or coordination required
      b. Other contracts affected
   7. Accurate cost data on proposed substitution in comparison with product or method specified.

B. In making request for substitution, bidder/contractor represents:
   1. It has personally investigated proposed product or method and determined that it is equal or superior in all respects to that specified
   2. It will provide the same guarantee for substitution as for product or method specified
   3. It will coordinate installation of accepted substitutions into work, making all changes for work to be complete in all respects
   4. Cost data is complete and includes all related costs under its contract but excludes:
      a. Architect/Engineer’s redesign
      b. Administrative costs of Architect/Engineer
   5. It will pay all additional costs and expenses for Architect/Engineer and other contractors.

C. Substitutions will not be considered when:
   1. They are indicated or implied on shop drawings or product data Submittals without formal request submitted in accordance with Paragraph 1.4
   2. Acceptance will require substantial revision of contract document.

PART 2 - PRODUCTS
No related text

PART 3 - EXECUTION
No related text

End of Section 01630
DIVISION 1 - GENERAL REQUIREMENTS

SECTIONS 01700
PROJECT CLOSEOUT

PART I - GENERAL

1.1 Commissioning and Substantial Completion

A. The Contractor shall complete all commissioning actions that include:
   1. Inspections and Testing
   2. O & M Manuals
   3. Training
   4. Turn over of Loose Items

B. Upon completion of all commissioning items the Contractor shall submit written declaration to the Architect/Engineer (A/E) that work, or designated portion thereof, is substantially complete. Include a Contractor prepared list of items to be completed or corrected along with all Submittals required for Substantial Completion. Upon A/E's approval, the A/E will schedule a Substantial Completion Inspection to be attended by A/E, NEIU and Contractor.

C. Following the inspection, A/E will prepare and process a Substantial Completion package containing the following:
   1. Certificate of Substantial Completion
   2. Date of Substantial Completion
   3. Punch List of items to be completed or corrected
   4. Time within which Punch List items shall be completed or corrected
   5. Date and time NEIU will take occupancy of the Project.
   6. Responsibilities of NEIU and Contractor for insurance; utility payments, operation and maintenance of mechanical, electrical and other systems, maintenance and cleaning, and security
   7. Signatures indicating approval of A/E, NEIU and Contractor.

D. Contractor shall complete all work listed for completion or correction within designated time and perform final cleaning. NEIU will occupy the Project or designated portions under provisions stated in Certificate of Substantial Completion.

1.2 Final Completion

A. Contractor shall submit written declaration to A/E that the work complies with all aspects of the Contract Documents and that all items on the Substantial Completion Punch List have been completed. All tools, construction equipment and surplus materials shall have been removed. Contractor shall also submit the following:
   1. Project Record Documents
   2. Certificates of inspection for systems which require local government inspection.

B. A/E will make Final Inspection with Contractor to verify completion. When A/E considers that all work is finally complete, Contract Closeout documents shall be prepared.
1.3 Final Cleaning
A. At completion of work or when directed by A/E, remove all waste, debris, rubbish, tools, construction aids, fences, barriers, temporary utilities, equipment, machinery and surplus materials.
B. Clean and repair all exposed surfaces; leave work clean and ready for occupancy. Repair, patch and touch-up marred surfaces to specified finish to match adjacent surfaces. Broom clean all exposed concrete and paved surfaces. Mop all hard flooring. Vacuum clean all carpet.

1.4 Project Record Documents
A. Maintain, protect and keep current one (1) copy of Contract Drawings, Project Manual, Addenda, approved Shop Drawings and product data, other modifications to Contract, field test results, all schedules and correspondence file at site.
B. Label each document "PROJECT RECORD DOCUMENTS". Legibly record actual construction, depths of foundations, horizontal and vertical location of underground utilities and appurtenances concealed in construction, field changes of dimension and detail, and changes made by Change Order.
C. Make documents available at all times for inspection by A/E.
D. At completion of Project, deliver Record Documents, including As-Built Drawings, to A/E. Accompany Submittal with transmittal letter. Include name and number of each Record Document. Obtain signed receipt.

1.5 Operating and Maintenance Manuals
A. Contractor shall compile product data related to the maintenance and operation of products and equipment provided under the Contract. Provide operating and maintenance information for products specified and specific work sections of the Project Manual.
B. Prepare a typewritten Table of Contents for each volume, arrange in the Project Manual order. Include for each product, the name, address and telephone number of subcontractor, maintenance contractor and parts vendor.
C. Include a copy of each warranty, bond and service contract.
D. Submit four (4) copies of each manual.
E. Materials and Finishes: Provide full information on products, including catalog number, size, composition, color and texture designations and information for reordering special manufactured products. Provide manufacturer's recommendations for cleaning agents/methods and recommended cleaning and maintenance schedule.
F. Equipment and Systems: Provide operating characteristics and limiting conditions, performance curves, engineering data and tests.
   1. Include operating procedures; normal operating instructions, maintenance procedures, servicing and lubrication schedule.
   2. Provide manufacturer's operating and maintenance instructions, manufacturer's parts list, illustrations, assembly drawings and diagrams for maintenance, predicted life of parts subject to wear, recommended spare parts.
1.6 Warranties and Bonds

A. Contractor shall assemble executed warranties and bonds. Submit one (1) original signed copy, bound with Table of Contents to A/E and transmittal to NEIU.

1.7 Final Payment

A. Contractor shall submit the following:
   1. Final Invoice/Voucher
   2. Contractor's CASS Form
   3. Separate releases of Waivers of Liens for all subcontractors, suppliers and others with lien rights against the property of NEIU, together with a complete list of those parties.
   4. Copy of transmittal letters to A/E for As-Built Drawings and Operating and Maintenance Manuals.
   5. Copy of Certification of Systems Training.
   6. Final accounting statement reflecting all adjustments to Contract Sum from Change Orders, Unit Prices or liquidated damages.

B. A/E will process final payment in accordance with the Contract.

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

3.1 Project Closeout Sequence

A. The contractor shall submit to the A/E for approval commissioning items as follows:
   1. Comprehensive plan of items or systems to be inspected and tested.
   2. All O&M manuals.
   3. Agendas for all training sessions to be provided
   4. List of all of the loose items to be turned over to NEIU (keys, special tools, materials, etc.)

B. Upon approval of the above items:
   1. Inspection and testing shall be completed and reports must be approved prior to training.
   2. Final O&M manuals must be received a minimum of 2 weeks prior to training.

C. Upon completion of all training, receipt of all loose items to be turned over to NEIU, and when the Contractor considers work substantially complete, the Contractor shall submit written declaration to the A/E that work, or designated portion thereof, is ready for final inspection.

D. A/E will make a preliminary inspection within seven (7) business days after receipt of Contractor's notice. If A/E determines that work is substantially complete, A/E will schedule a Substantial Completion Inspection to be attended by the Project Manager and Contractor.

End of Section 01700
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01710
FINAL CLEANING

PART 1 - GENERAL

1.1 Requirements Include:

A. Contractor: Provide final cleaning: At completion of work, or at such other times as directed by the Architect/Engineer or NEIU, remove all waste, debris, rubbish, tools, equipment, machinery and surplus materials. Clean all sight-exposed surfaces, leave work clean and ready for occupancy.

1.2 Related Requirements:

A. Specified Elsewhere:
   1. 01340 - Shop Drawings, Product Data & Samples
   2. 01561 - Construction Cleaning
   3. 01700 - Project Closeout

1.3 Safety Requirements:

A. All cleaning materials must have a MSDS sheet on file in field office in accordance with OSHA requirements.

PART 2 - PRODUCTS

See specification sections listed above in paragraph 1.2.A.

PART 3 - EXECUTION

3.1 Employ experienced workmen or professional cleaners for final cleaning

3.2 Remove grease, dust, dirt, stains, labels, fingerprints, protection and other foreign materials from sight-exposed interior and exterior finished surfaces, polish surfaces so designated to specified finish.

In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces and of concealed spaces to ensure performance.

3.3 Repair, patch and touch up marred surfaces to specified finish to match adjacent surfaces.

3.4 Contractor shall soft broom all exposed concrete surfaces clean; other paved areas with soft or stiff broom as directed. Rake clean other surfaces on grounds.

End of Section 01710
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 Requirements Include:

A. Contractor:
   1. At project site, maintain one copy of:
      a. Contract drawings, including separate volume(s) of details
      b. Proper manual
      c. Interpretations and supplemental instructions
      d. Addenda
      e. Reviewed, approved shop drawings and product data
      f. Other modifications to contract
      g. Field test records
      h. All schedules
      i. Correspondence file
   2. Store documents apart from documents used for field construction.
   3. Maintain documents in clean, dry, legible condition.
   4. Do not use record documents for field construction purposes.
   5. Make documents available at all times for inspection by Architect/Engineer and NEIU.

1.2 Required Requirement.

A. Specified elsewhere:
   1. 01340 - Shop Drawings, Product Data & Samples
   2. 01410 - Testing Laboratory Services
   3. 01700 - Project Closeout
   4. 01730 - Operating & Maintenance Data
   5. 01740 - Warranties & Bonds

1.3 Recording

A. Label each document "product record documents" in 2 inch high printed letters

B. Keep record documents current

C. Do not permanently conceal any work until specified information has been recorded.

D. Contractor drawings: legibly mark to record actual construction:
   1. Field changes or dimension and detail
   2. Changes made by change order
   3. Details not on original contract drawings

E. Specifications and addenda: Legibly markup each section to record:
   1. Manufacturer, trade name, catalog number and supplier of each product and item of equipment actually installed.
   2. Changes made by change order or field order.
   3. Other matters not originally specified.
F. Shop Drawings: Maintain as record documents, legible annotate drawings to record changes made after review.

1.4 Submittal

A. At completion of project, deliver record documents to Architect/Engineer.

B. Accompany submittal with transmittal letter, in duplicate, containing:
   1. Date
   2. Project title and number
   3. Contractor’s name and address
   4. Title and number of each record document
   5. Certification that each document submitted is complete and accurate
   6. Signature of general contractor or his authorized representative

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

No related text

End of Section 01720
PART 1 - GENERAL

1.1. Work Includes:

A. Requirements and limitations for cutting and patching of work.
   1. Execute cutting, filling, or patching of work, required to:
      a. Make several parts fit properly.
      b. Uncover work to provide for installation of ill-timed work.
      c. Remove and replace defective work.
      d. Remove and replace work not conforming to contract requirements.
      e. Install specified work in existing construction.
   2. In addition to contract requirements, upon written request of Architect:
      a. Uncover work to provide for observation of covered work.
      b. Remove samples of installed materials for testing.
      c. Remove work to provide for alteration of existing work.
   3. Do not endanger work by cutting or altering work or any part thereof.
   4. Do not cut or alter work of another contractor without written consent of Architect.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01100 - Project Summary
   2. Section 01330 - Submittal Procedures
   3. Individual Product Specification Sections:
      a. Cutting and patching incidental to work of the Sections.
      b. Advance notification to other Sections of openings required in work of those Sections.
      c. Limitations on cutting structural members.

1.3. Submittals:

A. Submit written request in advance of cutting or alteration which affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather-exposed or moisture-resistant element.
   3. Efficiency, maintenance, or safety of any operational element.

B. Include in request:
   1. Identification of Project.
   2. Location and description of affected work.
   3. Necessity for cutting or alterations.
   4. Description of proposed work, and Products to be used.
   5. Alternatives to cutting and patching.
   6. Date and time that work will be executed.

C. Prior to cutting and patching done on request of Architect, submit cost estimate.

D. Should conditions of work, or schedule, indicate change of materials or methods, submit recommendation to Architect, including:
   1. Condition indicating change.
2. Recommendation for alternative materials or methods.

E. Submit written notice to Architect designating time when work will be uncovered, to provide for observation.

1.4. Payment for Costs:

A. Costs caused by ill-timed or defective work, or work not conforming to contract documents, including costs for additional services of Architect: Party responsible for ill-timed, rejected, or non-conforming work.

B. Work done on request of Architect, in addition to the contract requirements, other than defective or non-conforming work: Owner.

C. Cutting and patching of all major holes in existing materials in remodeling work for the penetration of any contractor’s work shall be installed by the General Contractor. Cost of cutting and patching of these holes, as well as costs for lintels, sleeves, or other associated construction, shall be borne by the trade requiring the holes.

D. Cost of cutting of minor holes in existing materials in remodeling work, and cost of cutting of new materials installed in remodeling work shall be the responsibility of the trade requiring the cutting. Patching shall be done by the trade normally involved with that type of work at the cost of the trade requiring the cutting.

E. Major holes shall be defined as any opening 8" x 8" or 8" in diameter, or larger, in surface area by depth as required. Minor holes shall be defined as any opening smaller than a major hole.

PART 2 - PRODUCTS

2.1. Materials:

A. Primary Products: Those required for original installation.

B. Product Substitution: For any proposed change in materials, submit request for substitution under provisions of the Contract Documents.

PART 3 - EXECUTION

3.1. Examination:

A. Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.

B. After uncovering existing Work, inspect conditions affecting performance of work.

C. Beginning of cutting or patching means acceptance of existing conditions.

3.2. Preparation:

A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
B. Provide protection from elements for areas which may be exposed by uncovering work.

3.3. Cutting and Patching:

A. Execute cutting, fitting, and patching including excavation and fill to complete work.
B. Fit products together, to integrate with other work.
C. Uncover work to install ill-timed work.
D. Remove and replace defective or non-conforming work.
E. Provide openings in the Work for penetration of mechanical and electrical work.

3.4. Performance:

A. Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
B. Employ original installer to perform cutting and patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior acceptance.
D. Restore work with new products in accordance with requirements of Contract Documents.
E. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
F. At penetrations of fire-rated walls, completely seal voids with fire-rated, fire resistant material to full thickness of the penetrated element.
G. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

End of Section 01730
DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01731
OPERATING & MAINTENANCE DATA

PART 1 - GENERAL

1.1 Requirements Include:

A. Contractor:
   1. Compile product data and relate information appropriate for NEIU’s maintenance of products provided under the Contract
   2. Instruct NEIU’s personnel and maintenance of products and systems

1.2 Required Requirement.

A. Specified elsewhere:
   1. 01340 - Shop Drawings, Product Data & Samples
   2. 01700 - Project Closeout
   3. 01720 - Project Record Documents
   4. 01740 - Warranties & Bonds

1.3 Submittals

A. Form: Manufacturer’s standard product data of same type and form furnished to manufacturer’s personnel.

B. Provide sturdy manila or draft envelope, property labeled, of sufficient size to contain all Submittals.

1.4 Manual Content

A. Neatly typewritten table of contents for each volume, arranged in systematic order. Follow Project manual form.
   1. Contractor, name of responsible principal, address and telephone number
   2. List of each product specified to be included, indexed to volume content
   3. List with each product, the name, address and telephone number
      a. Subcontractor
      b. Maintenance contractor, as appropriate
      c. Identify area of responsibility of act
      d. Local supply source for parts and replacement

B. Product Data
   1. Include only sheets pertinent to specific products
   2. Annotate each to:
      a. Clearly identify specific product or parts installed
      b. Clearly identify data applicable to installation
      c. Delete references to inapplicable installation

C. Written text to supplement product data for particular installation:
   1. Organize in consistent format under separate headings for different procedures.
   2. Provide logical sequence of instruction for each procedure
D. Copy of each warranty, bond and service contract issued.
   1. Provide information sheet for NEIU’s personnel. Give:
      a. Proper procedures in event of failure
      b. Instances which might affect validity of warranties or bonds

1.5 Manual for Materials and Finishes

A. Submit two (2) copies of complete manual in final form.

B. Content for products, applied materials and finishes:
   1. Manufacturer’s data, giving full information on products.
      a. Catalog number, size, and composition
      b. Color and texture designations
      c. Information for reordering special-manufactured products.
   2. Instructions for care and maintenance
      a. Manufacturer’s recommendations for types of cleaning agents and methods.
      b. Cautions against cleaning agents and methods detrimental to product.
      c. Recommended cleaning and maintenance schedule

C. Content for moisture-protection and weather-exposed products
   1. Manufacturer’s data giving full product information
      a. Applicable standards
      b. Chemical composition
      c. Installation details
   2. Instructions for inspection, maintenance and repair.

D. Additional maintenance data requirements: Respective specifications sections

E. Provide complete information for products specified in:
   1. 03920 - Concrete Cleaning
   2. 03930 - Concrete Repairs
   3. 09980 - Concrete Protective Coating(s)

1.6 Submittal Schedule

A. Submit 2 copies of draft of proposed formats and outlines of contents prior to start of work.
   1. Architect/Engineer will review draft and return one (1) copy with comments.

B. Submit one (1) copy of completed data in final form fifteen (15) business days prior to final inspection or acceptance
   2. Copy will be returned after final inspection or acceptance with comments

C. Submit specified number of copies of approved data in final form ten (10) business days after final acceptance or approval

1.7 Instruction of NEIU’s Personnel

A. Prior to final inspection or acceptance, fully instruct NEIU’s designated operating and maintenance personnel in the operation, adjustment and maintenance of all products and systems.
B. Operating and maintenance manual shall consist of the basis of instructions.  
1. Review contents of manual with personnel in full detail to explain all aspects of operations and maintenance.

PART 2 - PRODUCTS

No related text

PART 3 - EXECUTION

No related text

End of Section 01730
DIVISION 02 – EXISTING CONDITIONS

SECTION 02222
SELECTIVE DEMOLITION FOR REMODELING

PART 1- GENERAL

1.1. Work Includes:
   A. Base Bid:
      1. General Contractor provide:
         a. Remove designated building equipment and fixtures.
         b. Remove designated partitions and components.
         c. Cap and identify utilities.
         d. Temporary partitions to allow building occupancy.
         e. Shoring at structural members and walls

1.2. Related Work:
   A. Specified Elsewhere:
      1. Section 01110 - Project Summary
      2. Section 01310 - Project Coordination
      3. Section 01330 - Submittal Procedures
      4. Section 01500 - Temporary Facilities and Controls
      5. Section 01730 - Cutting and Patching
      6. Section 03300 – Concrete
      7. Section 05500 - Metal Fabrications

1.3. Submittals:
   A. Submit in accordance with Section 01330:
      1. Provide a detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
      2. Include in schedule coordination for shut-off, capping of utilities, and disconnection of equipment as required.
   B. Submit in accordance with Section 01770:
      1. Submit record drawings under provisions of Section 01770 - Closeout Procedures. Provide photos of critical hidden work.

1.4. Existing Conditions:
   A. Maintain protected egress and access at all times.
   B. Provide, erect, and maintain temporary barriers and security devices.

1.5. Project Conditions:
   A. Salvageable Items:
      1. Items to be reused: Items shown to be reused in the remodeled building shall be removed by the General Contractor and properly stored until reinstallation.
      2. Items of value to Contractor: Other items of salvageable value to the contractor must be transported from the site as they are removed. Storage or sale of items salvaged by the contractor on the site will not be permitted.
B. Protect existing construction as required to prevent damage during demolition operations. Protection shall be by the General Contractor.

C. Extermination: The General Contractor shall employ a certified exterminator and maintain entire building in accordance with governing health regulations for rodent and insect control.

D. Coordination: The General Contractor shall coordinate the work of all contractors. The General Contractor shall determine the timing of demolition operations, use of existing facilities for temporary construction utilities and the location of storage for items salvaged for re-use.

E. Occupancy: The building will be occupied during demolition.

F. Condition of Structure: Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable.

G. Protection: Ensure the safety of persons working around the area of demolition. Conduct operations to prevent injury to adjacent construction to remain.

H. Damages: Promptly repair damages caused to adjacent work by demolition operations.

PART 2 - PRODUCTS

2.1. Reuse of Existing Materials:

A. Remove existing materials designated for reuse and refinish for relocation in new construction where shown on the drawings.

B. Provide storage of salvage materials for reuse or turn materials over to owner as scheduled.

PART 3 - EXECUTION

3.1. Preparation:

A. Erect and maintain weatherproof closures for exterior openings, as specified in Section 01500 - Temporary Facilities and Controls.

B. Erect and maintain temporary partitions to prevent spread of dust, fumes, noise, and smoke to provide for Owner occupancy.
   1. Dust Controls: Use temporary enclosures and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.
      a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
   2. Clean adjacent structures and improvements of dust, dirt, and debris caused by demolition operations, as directed by Architect or governing authorities. Return adjacent areas to condition existing prior to start of work.

C. Protect existing items which are not indicated to be altered.
1. Extent of removal is shown on the drawings. Any construction that is shown to remain that is inadvertently removed shall be replaced at the Contractor's expense.

   D. Disconnect, remove, and cap designated utility services within demolition areas.

   E. Mark location of disconnected utilities. Identify and indicate capping locations on Project Record Documents.

   F. Test all drains that are to remain. Provide protection of drains for the duration of the work.

3.2. Structural Shoring and Bracing:

   A. Demolish in an orderly and careful manner. Demolition work shall be closely coordinated with new structural members.

   B. Provide all shoring and temporary bracing required at partial removal of masonry walls and steel beams to maintain structural support of the remaining building sections.

3.3. Demolition of Construction

   A. Except where noted otherwise, immediately remove demolished materials from site.

   B. Remove and promptly dispose of contaminated, vermin infested, or dangerous materials encountered.

   C. Do not burn or bury materials on site.

   D. Remove demolished materials from site as work progresses. Upon completion of work, leave areas of work in clean condition.

   E. All hazardous materials have been removed from the project. Contractor to contact Owner/Architect immediately if any hazardous material is found.

3.4. PATCHING

   A. Patch all floors, walls, and ceilings where existing partitions are removed, new openings formed, or mechanical and electrical equipment is remodeled or installed. Existing surface shall be finished to match existing adjoining surfaces.

3.5. SCHEDULE OF SALVAGE ITEMS

   A. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect under provisions of Section 01600 - Product Requirements.

End of Section 02222
DIVISION 03 – CONCRETE

SECTION 03300
CONCRETE

PART 1 - GENERAL

1.1. Work Includes:
   A. Base Bid.
      1. General Contractor provide:
         1) Concrete work required to infill existing floor coring at
electrical, plumbing and mechanical penetrations.

1.2. Related Work:
   A. Specified Elsewhere:
      1. Section 01330 - Submittal Procedures
      2. Section 01400 – Quality Requirements
      3. Section 05500 - Metal Fabrications

1.3. References:
   A. Publication Dates: Comply with standards in effect as of the date of the Contract
      Documents unless otherwise indicated.
   B. ACI Standards:
      1. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and
         Placing Concrete.
      3. ACI 318 - Building Code Requirements for Reinforced Concrete.
      4. ACI 347 - Guide to Formwork for Concrete.
      5. ACI 315 - Details and Detailing of Concrete Reinforcement.
      6. ACI 117 - Standard Specifications for Tolerances for Concrete Construction
         and Materials.
      7. ACI 211.1 - Standard Practice for Selecting Proportions for Normal,
         Heavyweight, and Mass Concrete.
      8. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
   C. American Society for Testing and Materials (ASTM):
      1. ASTM A820 - Steel Fibers for Fiber-Reinforced Concrete
      2. ASTM C31 - Making and Curing Concrete Test Specimens in the Field.
      3. ASTM C33 - Concrete Aggregates.
      4. ASTM C39 - Test Method for Compressive Strength of Cylindrical Concrete
         Specimens.
      5. ASTM C94 - Ready-Mixed Concrete.
      7. ASTM C150 - Portland Cement.
      8. ASTM C171 - Sheet Materials for Curing Concrete.
      9. ASTM C231 - Test Method for Air Content of Freshly Mixed Concrete by the
         Pressure Method.
      10. ASTM C260 - Air Entraining Admixtures for Concrete
      11. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
      12. ASTM C494 - Chemical Admixtures for Concrete.
      13. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined
         Natural Pozzolan for Use in Concrete.
14. ASTM C1116 - Fiber Reinforced Concrete
15. ASTM C1315 - Liquid Membrane - Forming Compounds Having Special Properties for Curing and Sealing.
16. ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as used in Construction.

1.4. Submittals:

A. Submit in accordance with Section 01330:
   1. Manufacturer's Data: Submit manufacturer's specifications with application and installation instructions for proprietary materials and items, including reinforcement and forming accessories, admixture, patching compounds, joint systems, chemical floor hardeners, bonding compounds, curing compounds, non-shrink grouts, release agents and others as requested by the Architect.
   2. Contractor's Laboratory Test Reports on Concrete Mix Design and Materials: Submit six copies of laboratory test reports for concrete materials and mix design tests in accordance with ACI 301. Indicate amount of mix water to be withheld for later addition at the Project site.

1.5. Quality Assurance:

A. Perform work in accordance with ACI 301.
B. Correct concrete work which does not conform to the specified requirements, including strength, tolerance and finishes. Correct deficient concrete as directed by the Architect.

1.6. Regulatory Requirements:

A. Illinois Steel Products Procurement Act as amended (IL. Revised Statutes Chapter 48, Paragraph 1801).

PART 2 - PRODUCTS

2.1. Concrete Materials:

A. Portland Cement: ASTM C150, normal - Type 1 grey color; unless otherwise acceptable to Architect. Use only one brand of cement throughout the project.
B. Water: Clean and not detrimental to concrete.
   1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
   2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, frozen particles, cemented particles, or foreign matter as follows:
      a. Crushed stone, processed from natural rock or stone.
      b. Washed gravel, either natural or crushed. Use of pit or bankrun gravel is not permitted.
      c. Aggregate Size: 3/8” – 3/4”
2.2. Admixtures:
A. Air Entrainment Admixture: ASTM C260.
1. The Euclid Chemical Co.
2. Master Builders, Inc.

B. Water-Reducing Admixture: ASTM C494, containing no chlorides, fluorides, or nitrates. normal (Type A) shall be used unless set-accelerator (Type C or E), set-retarder (Type D), or superplasticizer (Type F) is accepted by Architect.
2. Master Builders, Inc.
3. The Euclid Chemical Co.

C. Calcium Chloride: Do not use calcium chloride in concrete.

2.3. Accessories:
A. Bonding Agent Product/Manufacturer: ASTM C1042, Type II
1. Euco Weld/The Euclid Chemical Co.
2. Everbond/L&M Construction Chemicals
3. Acrylic Additive/Sonneborn
4. Weld-Crete/Larsen Products Corporation
5. Sealight Intralock/W. R. Meadows

B. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water reducing and plasticizing agents; capable of minimum compressive strength of 7000 psi. at 28 days.

2.4. Curing, Sealing and Hardening Materials
A. Water: Clean and not detrimental to concrete.

B. Moisture-Retaining Cover: One of the following:
1. Waterproof Paper: ASTM C171, Type 1 or Type 2.
3. Polyethylene-coated burlap: bonded to prevent separation during use.

C. Evaporation Retarder:
1. Waterborne, monomolecular film forming, manufactured for application to fresh concrete awaiting finishing in hot, dry and/or windy conditions.
2. Acceptable Products/ Manufacturers:
   a. Eucobar/ Euclid Chemical Company
   b. Sure Film/ Dayton Superior Corporation
   c. Evapre/ W.R. Meadows
   d. E-Con/ L&M Construction Chemicals
3. Provide when placing concrete slabs when the atmospheric temperature is 80°F and above, or during other climatic conditions, such as days with high winds or low relative humidity, which will cause too rapid drying of the concrete surface.

D. Curing Compounds:
1. Clear, waterborne, membrane forming, dissipating curing compound; ASTM C 309, Type 1, Class B.
2. Acceptable Products/ Manufacturers:
   a. Kurex DR Vox/ Euclid Chemical Company
b. RX Cure WB/ Dayton Superior Corporation

c. 1100 Clear/ W.R. Meadows

d. L&M Cure R/ L&M Construction Chemicals

3. Provide curing compound to all interior concrete surfaces which will later receive a floor covering directly adhered to the concrete surface.

   a. Floors to receive additional coatings, sealing and coverings must be cleaned thoroughly prior to installation of the surfacing material to ensure complete removal of curing compound.

2.5. Proportioning and Design of Mixes:

   A. Prepare design mixes for each type of concrete. Use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing.

   B. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete specified, complying with ACI 211.1 for normal-weight concrete.

   C. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, subject to prior written approval by the Architect. Laboratory test data for revised mix designs and strength results shall be submitted to and reviewed by the Architect before using in the work.

   D. Fly ash: maximum 20% of cementitious materials by weight.

   E. Admixtures:

      1. Do not use admixtures which have not been incorporated and tested in the accepted design mixes, unless otherwise authorized in writing by the Architect.

      2. Use air-entraining admixture in all concrete which is to be exposed to the weather.

      3. Use water-reducing admixtures in strict compliance with the manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low-slump concrete, may be used at the Contractor's option subject to the Architect's acceptance.

      4. Use amounts of admixtures recommended by the manufacturer for climatic conditions prevailing at the time of placing. Adjust quantities of admixtures to maintain quality control.

2.6. Concrete Mixing:

   A. Ready-Mix Concrete: Comply with ASTM C94, and as herein specified. Delete the references for allowing the addition of water to the batch for material with insufficient slump. Addition of water to the batch after the truck leaves the batch plant will only be permitted with authorization by the Architect.

   B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be allowed.
1. When the air temperature is between 85°F and 90°F, reduce the mixing and delivery time from 90 minutes to 75 minutes, and when the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1. Placing Reinforcement:

A. Place, support, and secure reinforcement against displacement.

B. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute’s recommended practice for “Placing Reinforcing Bars”, for details and methods of reinforcement placement and supports, and as herein specified.

C. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolster, spacers, and hangers.

D. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in all slabs on grade in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.2. Installation of Embedded Items:

A. Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.

3.3. Concrete Placement:

A. Notify Architect minimum 24 hours prior to commencement of concreting operations.

B. Comply with ACI 304, and as herein specified.

C. Pre-Placement Inspection: Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit the installation of their work; cooperate with other contractors in setting such work. Thoroughly wet wood forms immediately before placing concrete where form coatings are not used.

D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. When a section cannot be placed continuously, provide construction joints as herein specified.
E. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Carry out at such a rate that the concrete is at all times plastic and flows readily into the space between the bars.

F. Concrete Placement Time: Ready-mixed concrete delivered to the job more than one hour before it is poured shall be rejected.

G. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Do not use vibrators to transport concrete inside of forms. Do not insert vibrators into lower layers of concrete that have begun to set.

H. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Bring slab surfaces to the correct level with a straightedge and strikeoff. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows.

3.4. Floor Slabs:

A. Installation – Curing Compound:
   1. Surface Preparation:
      a. Prepare concrete surfaces in accordance with manufacturers recommendations.
      b. Ensure concrete surfaces are clean and free of standing and bleed water.
   2. Application:
      a. Apply curing compound at uniform coverage to concrete surfaces in accordance with the manufacturer's recommendations.
      b. Apply as soon as possible after finishing and immediately after disappearance of surface moisture.
      c. Do not dilute curing compound unless specifically required by manufacturer.
      d. Protect surfaces from traffic until curing compound has set.
      e. Do not apply curing compound at temperatures lower than 40 degrees F.

B. Finish surfaces as scheduled herein.

3.5. Existing Work:

A. Dowel new concrete work to existing concrete when existing openings exceed 6" in any direction.

B. Prepare previously placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions.

3.6. Slab Finishes:

A. Trowel Finish:
   1. Apply trowel finish to monolithic slab surfaces that are to be exposed-to-view and slab surfaces that are to be covered with resilient flooring, carpet, paint or other thin film finish coating system.
2. Consolidate concrete surface by final hand-troweling operations, free of trowel marks, uniform in texture and appearance. Grind smooth and latex surface defects which would telegraph through applied floor covering system.

3.7. Concrete Curing and Protecting:

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for a period of time for hydration of cement and proper hardening.

B. Perform curing of concrete by moisture curing, by moisture-retaining cover curing, by membrane curing, or by combinations thereof, as herein specified.

C. Moisture Curing: Keep concrete surface continuously wet by covering with water, or by continuous water-fog spray, or by covering concrete surface with an approved absorptive cover, thoroughly saturating cover with water and keeping continuously wet.

D. Moisture-Retaining Cover Curing: Cover concrete surfaces with moisture-retaining cover placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair holes or tears during curing period using cover materials and waterproof tape.

E. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moisture curing with forms in place for full curing period or until forms are removed. When forms are removed, continue curing by methods specified above, as applicable.

F. Curing Unformed Surfaces: Initially cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moisture or membrane curing.

3.8. Miscellaneous Concrete Items:

A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other crafts, unless otherwise shown or directed, after work of other crafts is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown to complete the work.

3.9. Concrete Surface Repairs:

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to Architect.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces when defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning.

C. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Repair finished unformed surfaces that contain defects which adversely affect durability of concrete. Surface defects, as such, including crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
3.10. Concrete Surface Protection:

A. Protect concrete surfaces from damage, including damage due to snow, rain, ice, hail and other forms of precipitation.

B. Protect concrete surfaces from damage due to foot traffic and machine finishing.

C. Repair, refinish or replace concrete surfaces that have been damaged to their original, undamaged condition.

3.11. Field Quality Control:

A. Quality control testing during construction by independent testing agency. Concrete will be sampled and tested for quality control during the placement of concrete, as follows:
   1. Slump: ASTM C143; one test for each set of compressive strength test specimens and otherwise as determined by Architect.
   2. Air Content: ASTM C231, pressure method; one for each set of compressive strength test specimens.
   3. Compression Test Specimens: ASTM C31; one set of three standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
   4. Concrete Temperature: Test hourly when air temperature is 35°F and below, and where 85°F and above.
   5. Compressive Strength Tests: ASTM C39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 4,000 sq. ft. of surface area placed; one specimen tested at seven days, two specimens tested at 28 days, unless requested otherwise by Architect.
   6. Reports on compressive strength tests shall contain the project identification name and number, date of concrete placement, temperature of concrete at placement, name of Contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both seven-day tests and 28-days tests.

3.12. Tolerances:

A. Formwork Tolerances: Comply with ACI 117 and ACI 347.

B. Floor Flatness (F_f) and Floor Levelness (F_L) Tolerances:
   1. Typical:
      a. SOV F_f 25/F_L 20
      b. MLV F_f 17/F_L 15
   2. Definitions:
      a. SOV: Specific overall value.
      b. MLV: Minimum local value.

End of Section 03300
DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid.
   1. General Contractor provide:
      a. Carpentry work shown on the drawings and in schedules, including miscellaneous rough framing, furring, and blocking.
      b. Blocking for all wall or ceiling mounted fixtures, appurtenances, and equipment unless indicated otherwise.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 03300 - Concrete
   3. Section 05500 - Metal Fabrications
   4. Section 06400 – Architectural Woodwork
   5. Section 07620 - Sheet Metal Flashing and Trim
   6. Section 09210 - Gypsum Board Assemblies

1.3. References:

A. Publication Dates: Comply with standards in effect as of the date of the Contract Documents unless otherwise indicated.

B. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

C. APA - American Plywood Association: Grades and Standards.

D. AWPA - American Wood Preservers’ Association


G. SFPA - Southern Forest Products Association.

H. WCLIB - West Coast Lumber Inspection Bureau: Standard Grading Rules for West Coast Lumber.

I. WWPA - Western Wood Products Association.

1.4. Submittals:

A. Submit in accordance with Section 01330:
   1. Submit technical data on wood treatment materials and application instructions.

1.5. Quality Assurance:
A. Lumber Standard: Comply with PS 20.

B. Plywood Standard: Comply with PS 1.

1.6. Product Handling:

A. Delivery and Storage: Keep materials dry during delivery and storage. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks.

PART 2 - PRODUCTS

2.1. Materials:

A. Lumber:
   1. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for the moisture content specified for each use. Factory-mark each piece of lumber with type, grade, mill and grading agency.
   2. Provide dressed lumber, S4S.
   3. Provide seasoned lumber with 15% maximum moisture content.

B. Framing Lumber:
   1. For light framing and blocking (less than 6" wide), provide the following grade and species: Construction grade, yellow or ponderosa pine.
   2. For structural framing (6" and wider and from 2" to 4" thick), provide: No. 2 grade; Douglas Fir (WCLIB or WWPA) or Southern Pine (SFPA).

C. Plywood:
   1. Exposed plywood: Where plywood will be exposed in the finished work to receive a paint finish, provide interior type plywood with Grade A exposed faces and Grade D concealed faces.
   2. Concealed plywood: Where plywood will be concealed by other work, provide interior type plywood C-D plugged grade.
   3. Backing panels: For backing panels for electrical or telephone equipment, at ceiling backing, and as otherwise shown, provide fire-retardant treated standard grade plywood with exterior glue, 3/4" thick.
   4. Plywood used in roofing work: APA rated sheathing, exterior exposure durability classification, 24/16 span rating.
   5. Provide plywood manufactured without urea formaldehyde.

D. Miscellaneous Materials:
   1. Fasteners and anchorages: Provide size and type as indicated and as recommended by specified standards, complying with specified Federal Specifications for nails, staples, screws, bolts, nuts, washers and anchoring devices. Provide special galvanized sheet metal connectors, joint hangers and nails as required to provide the framing systems and to support the loads as shown.
   2. Fasteners and anchorages for treated lumber and where rough carpentry work is either in ground contact, in roof/parapet construction, in an area of high related humidity, or exposed to weather must be 304 or 316 stainless steel.
   3. Sheet metal connectors and joint hangers for treated lumber and where rough carpentry work is either in ground contact, in roof/parapet construction,
in an area of high related humidity, or exposed to weather must have a minimum G90 zinc-coating meeting the requirements of ASTM A653.

4. Adhesives for Gluing Wood to Wood: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
   a. VOC Content: 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.2. Wood Treatment:
   A. Wood preservative (Pressure Treatment): FS TT-W-571; AWPA Treatment C2 (lumber) and AWPA Treatment C9 (plywood), using waterborne preservative with 0.30% retainage.

2.3. Fire Retardant-Treated Materials:
   A. General: Provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, US Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
      1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to ASTM D5664, for lumber and ASTM D5516 for plywood.
      2. Use treatment that does not promote corrosion of metal fasteners.

PART 3 - EXECUTION

3.1. Inspection:
   A. Examine the supporting structure and the conditions under which the carpentry work is to be installed. Notify the Architect in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2. Installation:
   A. Basic requirements:
      1. Discard units of material with defects which might impair the quality of the work, and units which are too small to fabricate the work with minimum joints or the optimum joint arrangement.
      2. Set carpentry work accurately to indicated levels and lines, with members plumb and true and accurately cut and fitted.
      3. Securely attach carpentry work by anchoring and fastening as shown or by recognized standards. Countersink nail heads on exposed carpentry work and fill holes. Use common wire nails, except as otherwise indicated. Use finishing nails for finish work. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials.
      4. Make tight connections between members: Install fasteners without splitting of wood; predrill as required.

   B. Wood nailers, blocking and furring:
1. Provide wherever shown and where required for screeding or attachment of other work, including toilet accessories, fire extinguisher cabinets, casework, hollow metal frames and other equipment or items requiring blocking. Form to shapes as shown and cut for true line and level of work to be attached. Coordinate location with other work involved.

2. Attachment shall support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

C. Installation of plywood:

1. Comply with recommendations of the American Plywood Association (APA) for the installation of plywood.

2. Fill or grind edges of the plywood panels to provide an even surface to receive finishes indicated.

D. Wood framing:

1. Provide framing members of sizes and on spacing shown, and frame openings as shown, or if not shown, comply with recommendations of "Manual for House Framing" of National Forest Products Association. Do not splice structural members between supports.

2. Anchor and nail as shown, and to comply with "Recommended Nailing Schedule" of "Manual for House Framing" and other recommendations of NFPA.

End of Section 06100
DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07841
PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid.
   1. General Contractor provide:
      a. Through-penetration firestop systems for penetrations through fire-
         resistance-rated constructions indicated on the Drawings. Through-
         penetrations include both empty openings and openings containing
         penetrating items.
   2. Heating, Plumbing, Ventilation, Sprinkler, and Electrical Contractors shall
      provide the following at all penetrations by each Contractor's respective
      Work:
      a. Through-penetration firestop systems for penetrations through fire-
         resistance-rated assemblies indicated on the Drawings. Through-
         penetrations include both empty openings and openings containing
         penetrating items.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 01400 – Quality Requirements
   3. Section 01730 - Cutting and Patching
   4. Section 07842 - Fire-Resistive Joint Systems
   5. Divisions 15 Sections specifying duct and piping penetrations.
   6. Divisions 16 Sections specifying cable and conduit penetrations.

1.3. References:

A. Publication Dates: Comply with standards in effect as of the date of the Contract
   Documents unless otherwise indicated.

   Materials.
   Firestops.
E. UL 1479 – Fire Tests of Through Penetration Firestops.
F. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)

1.4. Definitions:

A. Annular Space: The penetration space surrounding a penetrating item.

1.5. Performance Requirements:
A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls, including fire walls, fire partitions, fire barriers and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479.

1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
   a. Penetrations located outside wall cavities.
   b. Penetrations located outside fire-resistive shaft enclosures.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.

2. For floor penetrations with annular spaces exceeding 4" in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means acceptable to the Architect.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

4. Firestopping shall be flexible for all normal penetrating item movement due to expansion and contraction.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.6. Submittals:

A. Submit in accordance with Section 01330:

1. Product Data: For each type of through-penetration firestop system product indicated.

2. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation from UL and information that evidences compliance with requirements for each condition indicated.
   a. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
   b. Engineering Judgements: Where Project conditions require modification of a qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit an...
3. Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
   a. Types of penetrating items.
   b. Types of constructions penetrated, including fire-resistance rating and thicknesses of construction penetrated.
   c. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing agency.

4. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

5. Qualification Data: For Installer.

1.7. Quality Assurance:
   A. Installer Qualifications: An experienced Installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
      1. Installer shall be certified by product manufacturers if required by the manufacturer.
   
   B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
   
   C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
      1. Firestopping tests shall be performed by UL (Underwriter's Laboratories).
      2. Through-penetration firestop systems are identical to those tested per ASTM E 814 or UL 1479. Provide rated systems complying with the following requirements:
         a. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in "Fire Resistance Directory."

1.8. Delivery, Storage, and Handling:
   A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
   
   B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.9. Project Conditions:
   A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
B. Ventilate through-penetration firestop systems per manufacturer’s written instructions by natural means or, where this is inadequate, forced-air circulation.

1.10. Coordination:

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Architect/Engineer has reviewed each installation.

PART 2 - PRODUCTS

2.1. Manufacturers:

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Hilti Construction Chemicals, Inc.
   4. Johns Manville
   6. NUCO Industries.
   7. RectorSeal Corporation (The).
   8. Specified Technologies Inc.
   9. 3M Fire Protection Products.
   10. Tremco.
   11. USG (United States Gypsum Company).

2.2. Firestopping, General:

A. General: Provide through-penetration firestop systems indicated in the Through-Penetration Firestop System Schedule at the end of Part 3.

B. Fill Materials: Fill materials are those referred to in directories of the referenced testing and inspecting agencies as “fill”, “void”, or “cavity” materials.

C. Moisture-Resistance: Product formulations after curing shall not re-emulsify during exposure to moisture.

D. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

E. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated.
F. Removable/Adjustable Materials: Where indicated, provide reusable heat-expanding pillows/bags.

2.3. Mixing:
A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1. Examination:
A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. Preparation:
A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
  1. Remove foreign materials that could interfere with adhesion of through-penetration firestop systems from surfaces of opening substrates and from penetrating items.
  2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3. Through-Penetration Firestop System Installation:
A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4. Field Quality Control:
   A. Proceed with enclosing through-penetration firestop systems with other construction only after firestop installation has been reviewed by the Architect/Engineer.
   B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.5. Cleaning and Protection:
   A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
   B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

3.6. Through-Penetration Firestop System Schedule:
   A. Provide UL-classified systems indicated. Systems shall be selected from the UL "Fire Resistance Directory" under product Category XHEZ based on substrate construction and penetrating item size and material. The selected system shall be within the range of numbered systems listed in this schedule.
### THROUGH- PENE TRATION FIRESTOP SYSTEM SCHEDULE

FIRESTOP SYSTEMS ARE LISTED USING THE ALPHA- ALPHA- NUMERIC IDENTIFICATION SYSTEM PUBLISHED IN UL’S FIRE RESISTANCE DIRECTORY UNDER PRODUCT CATEGORY XHEZ

<table>
<thead>
<tr>
<th>TYPE OF PENETRANT</th>
<th>FLOOR PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR F)</th>
<th>WALL PENETRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR W)</th>
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<tr>
<td><strong>NO PENETRATING ITEMS</strong></td>
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<td>C-AJ-0001-0999 or F-A-0001-0999</td>
<td>C-BJ-0001-0999</td>
<td>C-AJ-0001-0999, C-BJ-0001-0999, or W-J-0001-0999</td>
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<td>C-AJ-8001-8999, C-BJ-8001-8999, or W-J-8001-8999</td>
</tr>
</tbody>
</table>

For each location where a fire-resistance-rated floor or wall assembly is penetrated, provide a UL-classified through-penetration firestop system selected from the applicable UL number range listed above that complies with SECTION 07841 - THROUGH-PENETRATION FIRESTOP SYSTEMS and is suitable for the penetration conditions indicated for the Project.

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**B. Empty Openings:** In conditions where there is no penetrating item, an alternate method of firestopping is to patch the penetration to match the original rated construction.

**C. Cable Trays:** Firestopping at cable trays shall be removable and adjustable to allow removal, replacement or addition of cables.

**D. Electrical Boxes:** Electrical boxes on the opposite sides of walls shall be protected by listed putty pads unless separated by a horizontal distance of 24” minimum.

**E. Fire Dampers:** Install firestop elastomeric sealants at perimeter of fire damper mounting angles at both sides of wall/floor; coordinate with fire damper manufacturer.
requirements to maintain damper integrity and damper warranty. Firestopping must
not interfere with function of fire dampers.

F. Required Sleeve Or Opening Sizes For Bare And Insulated Metal Penetrants:
  1. For insulated pipes, a minimum ½ “ annular space must remain between the
     outside of the insulation and the inside of the opening.
  2. All sleeves in fire-rated walls/floors shall be flush with the finish surface on
     both sides of wall/floor unless noted otherwise.
  3. See Table below for additional information.

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<thead>
<tr>
<th>PIPE SIZES</th>
<th>WITHOUT 1/2” INSULATION</th>
<th>WITH 1/2” INSULATION</th>
<th>WITH 3/4” INSULATION</th>
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</table>

G. Required Opening Sizes For Non-Metallic Penetrants:
  1. Non-metallic pipes are to be centered in the opening as best as possible or
     be able to be easily moved to center.
  2. All sides of the penetrant must be accessible.
  3. All sleeves in fire-rated walls/floors shall be flush with the finish surface on
     both sides of wall/floor unless noted otherwise.
  4. See Table below for additional information.

<table>
<thead>
<tr>
<th>PIPE SIZES</th>
<th>MAXIMUM HOLE SIZE IN CONCRETE</th>
<th>MAXIMUM HOLE SIZE IN DRYWALL</th>
</tr>
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<tbody>
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<td>1 1/2”</td>
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<td>2 1/8”</td>
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<td>3 1/2”</td>
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<td>8”</td>
<td>9 to 9 1/2”</td>
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<tr>
<td>10”</td>
<td>11 to 11 1/2”</td>
<td>11 1/2”</td>
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</tbody>
</table>

End of Section 07841
PART 1 - GENERAL

1.1. Work Includes:

   A. Base Bid.
      1. General Contractor provide:
         a. Fire-resistive joint systems for the following:
            1) Floor-to-floor joints at fire-rated floor assemblies.
            2) Floor-to-wall joints at fire-rated floor assemblies.
            3) Head-of-wall joints at fire-rated partitions/walls/barriers and
               smoke barriers.
            4) Wall-to-wall joints at fire-rated partitions/walls/barriers and
               smoke barriers, including joints between dissimilar wall and
               column materials, but does not include control joints within a wall
               plane of identical building materials.
            5) Fire-resistive joint systems are not required at the perimeter of
               gypsum assemblies where acoustic sealants are indicated.

1.2. Related Work:

   A. Specified Elsewhere:
      1. Section 01330 - Submittal Procedures
      2. Section 01400 – Quality Requirements
      3. Section 07841 - Penetration Firestopping
      4. Section 07920 - Joint Sealants (for non-fire-resistive joint sealants)
      5. Section 09210 - Gypsum Board Assemblies (for head-of-wall joints in stud
         partitions)

1.3. References:

   A. Publication Dates: Comply with standards in effect as of the date of the Contract
      Documents unless otherwise indicated.

      Materials.


   F. UL Fire Resistance Directory Joint Systems (XHBN)

1.4. Performance Requirements:

   A. General: Provide fire-resistive joint systems that are produced and installed to resist
      spread of fire according to requirements indicated, resist passage of smoke and other
      gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint
      systems are installed.
B. Joint Systems in-and-between Fire-Resistance-Rated Constructions: Provide systems with assembly ratings equaling or exceeding the fire-resistance ratings of construction that they join as determined by UL 2079.

C. Perimeter Fire-Resistive Joint Systems: For joints between edges of fire-resistance-rated floor assemblies and exterior curtain walls, provide systems of type and with ratings indicated below and those indicated in the Fire-Resistive Joint System Schedule at the end of Part 3, as determined by UL 2079.
1. UL-Listed, Perimeter Fire-Containment Systems: Integrity ratings equaling or exceeding fire-resistance ratings of floor or floor/ceiling assembly forming one side of joint.

D. For fire-resistive joint systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E 84.

1.5. Submittals:

A. Submit in accordance with Section 01330:
1. Product Data: For each type of joint system product indicated.
2. Color selection charts where applicable.
3. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed; also show relationships to adjoining construction. Include fire-resistive joint design designation from UL and information that evidences compliance with requirements for each condition indicated.
   a. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction items.
4. Product Test Reports: From a qualified testing agency indicating fire-resistive joint system complies with requirements, based on comprehensive testing of current products.
5. Qualification Data: For Installer.

1.6. Quality Assurance:

A. Installer Qualifications: An experienced installer who has completed fire-resistive joint systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
1. Installer shall be certified by product manufacturers if required by the manufacturer.

B. Source Limitations: Obtain fire-resistive joint systems, for each kind of joint and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in "Performance Requirements" Article:
1. Fire-resistance tests are performed by UL (Underwriter's Laboratories).
2. Fire-resistive joint systems are identical to those tested per UL 2079. Provide rated systems complying with the following requirements:
   a. Fire-resistive joint systems correspond to those indicated by reference to fire-resistive joint system designations listed by UL in "Fire Resistance Directory."

1.7. Delivery, Storage, and Handling:
A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.8. Project Conditions:

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.9. Coordination:

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Do not cover up fire-resistive joint system installations that will become concealed behind other construction until Architect/Engineer reviewed each installation.

PART 2 - PRODUCTS

2.1. Manufacturers:

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Hilti Construction Chemicals, Inc.
   4. Johns Manville
   6. NUCO Industries.
   7. RectorSeal Corporation (The).
   8. Specified Technologies Inc.
   9. Thermafiber LLC
   10. 3M Fire Protection Products.
   11. Tremco.

2.2. Fire-Resistive Joint Systems:

A. General: Provide fire-resistive joint systems containing the materials indicated in the Fire-Resistive Joint System Schedule at the end of Part 3.
   1. Painted Areas: Joint systems shall be paintable where joints are exposed to view in areas indicated to receive paint.
   2. Unpainted Areas: Color of joint systems where joints are exposed to view and are not indicated to receive paint shall be selected by Architect from manufacturer's standard colors.
B. Moisture-Resistance: Product formulations after curing shall not re-emulsify during exposure to moisture.

C. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

D. Accessories: Provide components for each fire-resistive joint system, including primer and forming materials, that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

PART 3 - EXECUTION

3.1. Examination:

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. Preparation:

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with written recommendations of fire-resistive joint system manufacturer and the following requirements:
   1. Remove foreign materials that could interfere with adhesion of fire-resistive joint systems from surfaces of joint substrates.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fire-resistive joint systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates or damaging adjoining surfaces.

3.3. Installation:

A. General: Install fire-resistive joint systems to comply with "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint systems.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming/packing/backing materials, and accessories as required to achieve fire-resistance ratings indicated.
   2. Apply fill materials so they contact and adhere to substrates formed by joints.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4. Field Quality Control:

   A. Proceed with enclosing fire-resistant joint systems with other construction only after joint system installation has been reviewed by the Architect/Engineer.

   B. Where deficiencies are found, repair or replace fire-resistant joint systems so they comply with requirements.

3.5. Cleaning and Protection:

   A. Clean off excess fill materials adjacent to joint as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistant joint system manufacturers and that do not damage materials in which joints occur.

   B. Provide final protection and maintain conditions during and after installation that ensure fire-resistant joint systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated fire-resistant joint systems immediately and install new materials to produce fire-resistant joint systems complying with specified requirements.

3.6. Fire-Resistive Joint System Schedule:

   A. Provide UL-classified systems indicated. Systems shall be selected from the UL "Fire Resistance Directory" under product Category XHBN. The selected system shall be within the range of numbered systems listed in this schedule.

   B. Joint Description | UL Designation
                       | Floor to Floor: FF-D 0001-4999
                       | Wall to Wall: WW-D 0001-4999
                       | Floor to Wall: FW-D 0001-4999
                       | Head of Wall: HW-D 0001-4999
                       | Perimeter joints at exterior curtain walls: CW-S 1001-2999

End of Section 07842
DIVISION 07 - THERMAL & MOISTURE PROTECTION

SECTION 07920
JOINT SEALANTS

PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid.

1. General Contractor provide:
   a. Preparation of sealant substrate surfaces.
   b. Sealants, primers, and backings.
   c. Interior joints in vertical surfaces and horizontal nontraffic surfaces as indicated below:
      1) Control and expansion joints on exposed interior surfaces of exterior walls.
      2) Joints between tops of non-load-bearing unit masonry walls and underside of cast-in-place concrete slabs and beams.
      3) Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
      4) Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      5) Perimeter joints of plumbing fixtures and adjoining wall, floors and counters.
      6) Perimeter joints of countertops/splashes and adjoining walls.
      7) Other joints as indicated.
   d. Interior joints in horizontal traffic surfaces as indicated below:
      1) Control and expansion joints in cast-in-place concrete slabs.
      2) Other joints as indicated.

1.2. Related Work:

A. Specified Elsewhere:

1. Section 01330 - Submittal Procedures
2. Section 07841 - Penetration Firestopping
3. Section 07842 - Fire-Resistive Joint Systems
4. Section 09210 - Gypsum Board Assemblies
5. Section 09230 - Gypsum Plastering: For sealing concealed perimeter joints of veneer plaster partitions to reduce sound transmission.

1.3. References:

A. Publication Dates: Comply with standards in effect as of the date of the Contract Documents unless otherwise indicated.

B. American Society for Testing and Materials (ASTM):

3. ASTM C804 - Use of Solvent-Release Type Sealants.


D. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.

E. SWRI (Sealant, Waterproofing, and Restoration Institute).

1.4. Definitions:

A. Class: Per ASTM C920, elastomeric sealants are categorized according to tested capabilities. The following classes are expressed as a percentage of joint width.
1. 12-1/2 = 12-1/2% movement in both extension and compression for a total of 25%.
2. 25 = 25% movement in both extension and compression for a total of 50%
3. 35 = 35% movement in both extension and compression for a total of 70%
4. 50 = 50% movement in both extension and compression for a total of 100%
5. 100/50 = 100% movement in extension and 50% in compression.

B. Grade: Per ASTM C920:
1. NS = Non-Sag
2. P = Pourable

C. Type: Per ASTM C920:
1. M = Multi-Component
2. S = Single Component

D. Use: Per ASTM C920, elastomeric sealants are categorized according to tested performance.
1. Substrates:
   a. A = Aluminum (Clear Anodized).
   b. G = Glass (Clear Float).
   c. M = Mortar (Portland Cement Mortar).
   d. O = Other than A, G, or M.
2. I = Immersed in Liquids
3. NT = Non-Traffic
4. T = Traffic

1.5. System Performance Requirements:

A. Provide joint sealants for exterior and interior applications that have been produced and installed to establish and maintain airtight continuous seals that are water resistant and cause no staining or deterioration of joint substrates.
1.6. Submittals:

A. Submit in accordance with Section 01330:
   1. Submit manufacturer’s product data for each sealant/product indicating:
      a. Chemical characteristics.
      b. Performance criteria.
      c. Limitations.
      d. Color availability.
      e. Installation instructions.
   2. Compatibility and Adhesion Test Reports: Test reports from the sealant manufacturer indicating the following:
      a. Materials forming the joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
      b. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
   3. Certificates:
      a. Certification by joint sealant manufacturer that their products comply with specification requirements and are suitable for the use indicated.
   4. Samples for Initial Selection: Manufacturer’s standard bead samples, consisting of strips of actual products showing full range of colors available, for each product exposed to view.
   5. Qualification Data: At the request of the Architect/Engineer, provide documentation to demonstrate the required level of applicator qualifications as specified in the “Quality Assurance” Article in this Specification to document their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.7. Quality Assurance:

A. Conform to Sealant, Waterproofing, and Restoration Institute recommendations for materials and installation.

B. Installer Qualifications: Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project and that have resulted in a record of successful in-service performance. If a manufacturer requires authorized installers for their products, the installer must be authorized to install said products.

C. Source Limitations: Obtain each type of joint sealant from a single manufacturer.

1.8. Delivery, Storage, and Handling:

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer’s recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes. Store all products in a manner to prevent damage; in a secure place, out of the way of construction operations. Provide protection until ready for use.

C. Handle in accord with manufacturer’s recommendations.
1.9. Project Conditions:

A. Environmental Conditions: Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
   2. When joint substrates are wet.
   3. Do not install solvent curing sealants in enclosed building spaces.
   4. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
   5. Weather: Do not install products during adverse weather conditions.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than or greater than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.10. Sequencing and Scheduling:

A. Coordinate the work of this Section with all Sections referencing this Section.

1.11. Warranty:

A. Special Warranty: Contractor agrees to repair or replace joint sealants and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.
   1. Provide three year warranty under provisions of Section 01770.

PART 2 - PRODUCTS

2.1. Materials, General:

A. Products: Subject to compliance with requirements, provide one of each of the types of products listed in this Specification.

B. Compatibility: Provide joint sealants, joint fillers, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

C. Colors: Provide color of exposed joint sealants to comply with the following:
   1. Provide selections made by Architect from manufacturer’s full range of colors for products of type specified.

2.2. Elastomeric Joint Sealants:

A. General, Elastomeric Sealants:
   1. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing elastomeric sealants that comply with ASTM C920 and other requirements indicated for each elastomeric joint sealant, including those
requirements referencing ASTM C920 classifications for Type, Grade, Class, and Uses related to exposure and joint substrates.

2. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

B. Polysulphide Sealants:
1. SEALANT ES-2: Multi-Component Polysulphide Sealant: Manufacturer's standard, two component, homogeneous mix, chemical curing.
   a. Acceptable products/manufacturers:
      1) Synthacalk GC2+ / Pecora Chemical Corp
      2) Sonolastic Two-part Polysulphide Sealant / BASF Building Systems
      3) Thiokol 2235M / PolySpec Corp.
      4) Thiokol 2282 / PolySpec Corp.
   b. Grade: NS (Non-Sag)
   c. Class: 25
   d. Uses Related to Exposure: NT (Non-Traffic)

C. Silicone Sealants:
1. SEALANT ES-3: Single-Component Silicone Sealant: Manufacturer's standard, single component, neutral-curing; low modulus type.
   a. Acceptable products/manufacturers:
      1) Spectrum 1 / Tremco
      2) 790 / Dow Corning
      3) 890 / Pecora Corp.
   b. Grade: NS (Non-Sag)
   c. Class: 100/50
   d. Uses Related to Exposure: NT (Non-Traffic)

2. SEALANT ES-4: Single-Component Silicone Sealant: Manufacturer's standard, single component, neutral-curing; low modulus type.
   a. Acceptable products/manufacturers:
      1) Spectrum 3 / Tremco
      2) 864 / Pecora Corp.
      3) PSI-641 / Polymeric Systems, Inc.
      4) Omniseal 50 / BASF Building Systems
   b. Grade: NS (Non-Sag)
   c. Class: 50
   d. Uses Related to Exposure: NT (Non-Traffic)

   a. Acceptable products/manufacturers:
      1) Spectrum 2 / Tremco
      2) 799 / Dow Corning
      3) PSI-631 / Polymeric Systems, Inc.
   b. Grade: NS (Non-Sag)
   c. Class: 25
   d. Uses Related to Exposure: NT (Non-Traffic)

4. SEALANT ES-6: Single-Component Mildew-Resistant Silicone Sealant: Manufacturer's standard, single component, acid-curing, mildew-resistant; high modulus type.
   a. Acceptable products/manufacturers:
1) Tremsil 200 / Tremco
2) 786 / Dow Corning

b. Grade: NS (Non-Sag)
c. Class: 25
d. Uses Related to Exposure: NT (Non-Traffic)

D. Polyurethane Sealants:
   a. Acceptable products/manufacturers:
      1) Sikaflex 1a / Sika Corp.
      2) NP 1 / BASF Building Systems
      3) Ultra / BASF Building Systems
      4) Vulkem 116 / Tremco
   b. Grade: NS (Non-Sag)
c. Class: 25
d. Uses Related to Exposure: NT (Non-Traffic) and T (Traffic)

   a. Acceptable products/manufacturers:
      1) SL 1 / BASF Building Systems
      2) Vulkem 45 SSL / Tremco
   b. Grade: P (Pourable)
c. Class: 25
d. Uses Related to Exposure: NT (Non-Traffic) and T (Traffic)

   a. Acceptable products/manufacturers:
      1) Dynatrol II / Pecora Corp.
      2) NP 2 / BASF Building Systems
      3) Dymeric 240FC / Tremco
   b. Grade: NS (Non-Sag)
c. Class: 50
d. Uses Related to Exposure: NT (Non-Traffic)

4. SEALANT ES-10: Multi-Component Polyurethane Sealant: Manufacturer's standard, multi-component, chemical curing.
   a. Acceptable products/manufacturers:
      1) Sikaflex 2c NS / Sika Corp.
      2) Vulkem 227 / Tremco
   b. Grade: NS (Non-Sag)
c. Class: 25
d. Uses Related to Exposure: NT (Non-Traffic)

   a. Acceptable products/manufacturers:
      1) Sikaflex 2c SL / Sika Corp.
      2) SL 2 / BASF Building Systems
      3) Dynatrol II-SG / Pecora Corp.
   b. Grade: P (Pourable)
c. Class: 25
d. Uses Related to Exposure: NT (Non-Traffic) and T (Traffic)

2.3. Semi-Elastomeric Joint Sealants:

A. SEALANT SES-1: Acrylic-Based Solvent-Release Sealant: Manufacturer's standard one-part, non-sag, paintable, solvent-release-curing acrylic terpolymer sealant
complying with ASTM C1311 or FS TT-S-00230 or both. Sealant must, without failure in adhesion and cohesion, withstand 12-1/2% movement in both extension and compression for a total of 25% joint movement.

1. Acceptable products/manufacturers: Mono 555 / Tremco
2. Grade: NS (Non-Sag)
3. Class: n/a
4. Uses Related to Exposure: NT (Non-Traffic)

B. SEALANT SES-2: Acrylic-Emulsion Sealant: Provide manufacturer's standard siliconized acrylic latex, one-part, non-sag, paintable product complying with ASTM C 834. Sealant must, without failure in adhesion and cohesion, withstand 5% movement in both extension and compression for a total of 10% joint movement.

1. Acceptable products/manufacturers:
   a. Siliconized Acrylic / Bostik, Inc.
   b. AC-20+ Silicone / Pecora Corp.
   c. Sonolac / BASF Building Systems
   d. Tremflex 834 / Tremco
2. Grade: NS (Non-Sag)
3. Class: n/a
4. Uses Related to Exposure: NT (Non-Traffic)


1. Acceptable products/manufacturers:
   a. Chem-Calk 300 / Bostik, Inc.
   b. BC-158 / Pecora Corp.
   c. PTI 707 / H.B. Fuller
   d. Tremco Butyl Sealant / Tremco
2. Grade: NS (Non-Sag)
3. Class: n/a
4. Uses Related to Exposure: NT (Non-Traffic)

2.4. Acoustical Joint Sealants:

A. Acoustical Sealants: Sealant shall be effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E 90.

1. SEALANT AS-1: Latex Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
   a. Acceptable products/manufacturers:
      1) SHEETROCK Acoustical Sealant / United States Gypsum Co.
      2) AC-20 FTR Acoustical and Insulation Sealant / Pecora Corp.
      3) AIS-919 Acoustical and Insulation Sealant / Pecora Corp.
2. SEALANT AS-2: Synthetic Rubber Acoustical Sealant: Manufacturer's standard, non-drying, non-hardening, non-skinning, non-staining, gunnable, synthetic rubber sealant recommended for sealing interior concealed joints.

2.5. Tape Sealants:
A. SEALANT TS-1: Manufacturer's standard, solvent-free, butyl-based tape sealant with a solids content of 100% formulated to be nonstaining, paintable, and nonmigrating in contact with nonporous surfaces with or without reinforcement thread to prevent stretch and packaged on rolls with a release paper on one side.
   1. Acceptable products/manufacturers:
      a. PTI 606/Protective Treatments, Inc.
      b. Tremco 440 Tape/Tremco, Inc.

2.6. Joint Sealant Backing:

   A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

   B. Cylindrical Joint Backings: ASTM C1330; Type listed below, and of size, shape, and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
      1. Type B: Bicellular material with a surface skin ("soft rod").
      2. Individual rod width must be of adequate width to fit snugly in joint. Combining, twisting or braiding of smaller rods is not acceptable for wider joints.

   C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7. Accessories and Miscellaneous Materials:

   A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated; non-staining type.

   B. Cleaners for Nonporous Surfaces: Cleaners recommended by sealant manufacturer. Chemical cleaners shall be acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.

   C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1. Examination:

   A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.
      1. Beginning of installation means installer accepts the condition of surfaces and substrates.

   B. Verify that sealants are appropriate for the substrates they are to be applied to.
3.2. Preparation:

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturer and the following requirements:
   1. Remove all foreign and loose material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
   3. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Verify that joint backing, primers, and release tapes are compatible with sealant.

C. Measure joint dimensions and size materials to achieve required width/depth ratios.

D. Joint Priming: Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on preconstruction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer’s recommendations. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

E. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

F. Protect elements surrounding the work of this Section from damage or disfiguration.

3.3. Installation of Joint Sealants:

A. General: Comply with joint sealant manufacturer’s printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations of ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint fillers.
   c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.

2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.

E. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

1. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
2. Install sealant in uniform, continuous ribbons free of air pockets, gaps, foreign embedded matter, ridges, and sags.
3. Ensure complete "wetting" of the joints. Bond surfaces equally on opposite sides. Fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer. Tool joints as follows:

1. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

G. Install sealants to depths as shown or as required by sealant manufacturer. When not shown or indicated, install within the following limitations:

1. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but not more than 3/4" deep or less than 3/8" deep.
2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50% of joint width, but not more than 1/2" deep or less than 1/4" deep.
3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 65% to 125% of joint width.

H. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces.

1. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces.

3.4. Curing:

A. Cure sealants and caulking compounds in compliance with manufacturer's instructions to obtain high early bond strength and surface durability.
3.5. Cleaning and Repairing:

A. Clean work under provisions of Section 01770.

B. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

C. Upon completion, carefully examine all sealant and caulking work. Remove all damaged and defective work and replace with new materials.

D. Remove all surplus products, containers, and rubbish and dispose of off site.

E. Remove all spilled or spattered materials from all surfaces. When adjacent surface or other work has been damaged or stained as a result of sealing and caulking work, repair all damage and remove all stains to the satisfaction of the Architect.

3.6. Protection:

A. Protect finished installation under provisions of Section 01500.

B. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage (other than normal wear or weathering) at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

3.7. Schedule:

A. If more than one sealant is listed below for a particular joint type, Contractor may at his option choose which sealant to use.

B. If no color is indicated, use the sealant manufacturer's standard color.

C. Interior Door Perimeter:
   1. Type: SES-1, SES-2
   2. Color: To be selected by Architect/Engineer.

D. Interior Slab Control Joints:
   1. Type: ES-8, ES-11
   2. Color: To be selected by Architect/Engineer.

E. Sheet Metal Lap Joints:
   1. Type: TS-1

F. Perimeter of Countertops/Splashes:
   1. Type: SES-2
   2. Color: To be selected by Architect/Engineer.

G. Acoustic Partitions:
   1. Type: AS-1, AS-2
   2. Color: To be selected by Architect/Engineer.
End of Section 07920
DIVISION 08 – OPENINGS

SECTION 08710
HARDWARE

PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid
   1. General Contractor provide:
      a. Sound Seals and Door Bottom Seals as indicated on the drawings.

1.2. References:

A. All references are the current editions unless noted otherwise.


C. Builders Hardware Manufacturers Association (BHMA):
   1. BHMA A156.1 – Butts and Hinges (ANSI)
   2. BHMA A156.4 – Door Controls – Closers (ANSI)
   3. BHMA A156.6 – Architectural Door Trim (ANSI)
   4. BHMA A156.7 – Template Hinge Dimensions (ANSI)
   5. BHMA A156.13 – Mortise Locks and Latches Series 1000 (ANSI)
   6. BHMA A156.16 – Auxiliary Hardware (ANSI)
   7. BHMA A156.18 – Materials and Finishes (ANSI)
   8. BHMA A156.28 – Recommended Practices for Keying Systems (ANSI)

D. Door and Hardware Institute (DHI):
   1. DHI A115 Series – Door and Hardware Institute Specifications for Steel Door and Frame Preparation and Hardware (ANSI).
   3. DHI WDHS.3 – Recommended Locations for Architectural Hardware for Wood Flush Doors
   5. DHI – Sequence and Format for the Hardware Schedule.


F. Chicago Building Code


I. UL – Underwriters Laboratories, Inc.

1.3. Coordination:
A. Sequence submittal of hardware schedule and door and frame submittals, allowing adequate time for review and resubmittal, if required, so that construction is not delayed; provide adequate information for review.

B. Coordinate the work of this Section with other directly affected Sections involving manufacturer for any internal reinforcement for door hardware.

C. Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate the installation of door hardware to suit the opening conditions and to provide proper door operation.

1.4. Quality Assurance:

A. Qualifications of Supplier: A recognized supplier of architectural finish hardware, with warehousing facilities, who has been furnishing hardware in the vicinity of the project for not less than two years, and who is, or who employs, an Architectural Hardware Consultant.

B. Qualification of Architectural Hardware Consultant(s): Certified by the Door and Hardware Institute.

C. All products specified in this section shall be certified by the Building Hardware Manufacturers Association.

1.5. Submittals:

A. Submit in accordance with Section 01330:
   1. Submit supplier qualifications to the Architect, for information.
   2. Product Data: Manufacturer's technical data for each item of hardware, with installation instructions.
      a. Include evidence of testing of fire door hardware for compliance with requirements.
      b. Obtain approval prior to submittal of final schedule.
      c. Submit three sets of catalog cuts for each hardware item.
   3. Hardware Schedule:
      a. Submit typed vertical Hardware Schedule including all miscellaneous items, sequence and format as recommended by DHI.
      b. Indicate complete designations of every item for each door.
      d. Indicate door and frame sizes and materials.
      e. Explain all abbreviations, symbols, codes, etc.
      f. Indicate hardware mounting locations.
      g. Include the following information for each item.
         1) Type, style, function, size, and finish.
         2) Name of manufacturer and catalog number.
         3) Fastenings.
         4) Keying information.
         5) Other pertinent information.
      h. Schedule will be reviewed only if accompanied by complete product data.
      i. The Architect's review of schedule will not relieve Contractor or Supplier of responsibility for errors or omissions which it might contain.
4. Samples and Templates: Furnish to fabricators of doors and frames as required for proper reinforcement and preparation of their work. When required, the Hardware Supplier shall furnish physical hardware to the door and frame fabricators for application.

B. Submit in accordance with Section 01770:
   1. Contract closeout submittal: Provide the following material in a 3-ring binder clearly tabbed and organized:
      a. Final hardware schedule
      b. Final key schedule and bitting list
      c. Catalog cuts
      d. Installation instructions
      e. Operating and adjustment instructions
      f. Warranties
      g. Maintenance manuals
   2. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.6. Product Handling:
   A. Deliver all items in manufacturer's original package with each item individually packaged and carefully marked for intended opening and use. Each item shall be complete with all necessary screws, bolts, keys, instructions, and where necessary, installation templates.
   B. Store off floor in dry area of building out of way of other work in progress. Provide maximum protection against loss and damage.
   C. Provide secure lockup for hardware not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses. Replace lost or stolen items at no extra cost.
   D. Handle all items in a manner to prevent damage. Marred, defaced, damaged, and defective items will be rejected.

1.7. Warranty:
   A. Provide manufacturer's standard warranty in which manufacturer agrees to repair or replace components of door hardware which fail in materials or workmanship within specified warranty period.
      1. Failures include, but are not limited to, the following:
         a. Structural failures including excessive deflection, cracking or breakage.
         b. Faulty operation of operators and door hardware.
         c. Deterioration of metals, metal finishes and other materials beyond normal weathering and use.

PART 2 - PRODUCTS

2.1. General Hardware Requirements:
   A. Fire-Rated Doors: Provide hardware of types and quality required to comply with NFPA 80.
B. Select style and features of each item to suit configuration and construction of door and frame and door operation indicated.

C. Each type of hardware (all locks, all hinges, all closers, etc.) shall be provided by one manufacturer for the entire project, unless manufacturer does not provide products for each type specified (as in the case of door stops/holders).

2.2. Manufacturers’ Designations:

A. The following manufacturers’ designations are used in this specification. Inclusion here does not imply that the manufacturer may be used for all hardware items. Acceptable manufacturers and products are listed under each item heading.

1. Adams Rite Adams Rite Manufacturing Co., Div. of Assa Abloy, Pomona, CA
2. Best Best Access Systems, Div. of Stanley, Indianapolis, IN
3. Corbin-Russwin Corbin Russwin, Div. of Assa Abloy, Berlin, CT
4. Folger Adam Folger Adam (HES), Div. of Assa Abloy, Phoenix, AZ
5. Glynn-Johnson Glynn-Johnson, Div. of Ingersoll Rand, Indianapolis, IN
6. Hager C. Hager & Sons, St. Louis, MO
7. Ives H. B. Ives, Div. of Ingersoll Rand, Indianapolis, IN
8. LCN LCN Closers, Div. of Ingersoll Rand, Princeton, IL
10. National Guard National Guard Products, Inc. Memphis, TN
12. Precision Precision Hardware, Div. of Stanley, Indianapolis, IN
13. Reese Reese Enterprises, Rosemount, MN
14. Rixson Rixson Door Controls, Div. of Assa Abloy, Franklin Park, IL
15. Rockwood Rockwood Mfg., Div. of Assa Abloy, Rockwood, PA
16. Sargent Sargent Division, Div. of Assa Abloy, New Haven, CT
17. Schlage Schlage Lock Co., Div. of Ingersoll Rand, Carmel, IN
18. Stanley Stanley Security Solutions, Div. of Stanley, Indianapolis, IN
19. Trimco Triangle Brass Mfg. Co., Los Angeles, CA
20. Trine Trine Access Technology, Bronx, NY
21. Von Duprin Von Duprin, Inc., Div. of Ingersoll Rand, Indianapolis, IN
22. Zero Zero International, Bronx, NY

2.3. Materials - General:

A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer’s standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.

B. Fasteners: Provide all fasteners required for secure installation.

1. Use concealed fasteners wherever possible.
2. Select fasteners appropriate to substrate and material being fastened.
3. Use machine screws unless otherwise indicated.
4. Use Phillips flathead screws unless otherwise indicated.
5. Use wood screws for installation in wood.
6. Use fasteners impervious to corrosion outdoors and on exterior doors.
7. Exposed screws: Match hardware finish.
8. Do not use through-bolts where bolt head or nut on opposite face would be exposed in finished work, unless otherwise indicated.
   a. Where bolt head or nut is exposed in finished work, provide the same finish as hardware on that side of the door.
b. Provide sleeves for through-bolts or use sex screw fasteners.
c. Use through-bolts where it is not possible to reinforce substrate adequately.

9. Use expansion shield anchors in concrete and masonry.

10. Adjust specified hardware item designation as required to suit substrate and/or fastener conditions.

11. Provide knurling or abrasive coating to all knobs and levers on doors leading to hazardous areas such as mechanical rooms, boiler and furnace rooms, janitor closets, and as otherwise required by the Illinois Accessibility Code.

2.4. Hardware Finishes:

A. Match specified hardware items to the color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets), except as otherwise specified.

B. Provide finishes that match those established by BHMA A156.18 or, if none established, match the Architect's sample.

C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

D. All hardware, except as otherwise noted, shall be furnished in the following finishes.

1. Plated items:
   a. Oxidized Satin Bronze, Oil Rubbed
   b. BHMA 613

2. Painted items: Sprayed color, to match plated items at door closers only.

3. Base metal items: To match plated items.

PART 3 - EXECUTION

3.1. Preparation:

A. Examine all doors, frames, and hardware for damage, defects, and suitability for intended use. Restore all parts or items found damaged, defective, or inadequate, or replace with good material before installation.

B. Wood doors and wood frames may be field-prepared for installation: All other types of doors and frames are to be factory or shop prepared.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. Installation:

A. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work specified in the Division 09 Sections.
B. Install surface-mounted items after substrates have been completely finished; install recessed items and recessed portions of items before finishes are applied and provide suitable, effective protection.
   1. When surface-mounted items are installed before final finish, remove, store, and reinstall, or apply suitable effective protection.

C. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations and except as otherwise directed by Architect.
   1. “Specifications for Steel Door and Frame Preparation and Hardware” by the Door and Hardware Institute.
   2. “Wood Door Hardware Standards – Hardware Preparation” by the Door and Hardware Institute.
   3. “Recommended Locations for Architectural Hardware for Wood Flush Doors” by the Door and Hardware Institute.
   4. “Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames” by the Door and Hardware Institute.
   5. Mounting Heights: Heights given are center line heights up from finish floor unless stated; heights given "Number to Number" indicate that all shall be at one height within limits given. Where heights of items are not listed, mount in accord with recommendations of the Door and Hardware Institute.
      a. Bottom Hinge  10" to 13"
      b. Top Hinge  6" to 8" down from head
      c. Intermediate Hinges  Equally Spaced
      d. Door Knob or Lever  36" to 40"
      e. Push/Pull  45"

D. Fitting: Fit all hardware accurately and properly. Remove exposed parts until after painter’s finishing is completed, then reinstall. Securely fasten all fixed parts. Fit faces of mortised parts snug and flush. Make sure operating parts move freely and smoothly without binding, sticking, or excessive clearance.

E. Set units level, plumb, and true to line and location.

F. Adjust and reinforce substrates as necessary for proper installation and operation.

G. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

3.3. Adjustment:

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and perform a final check and adjustment of all hardware items in such space or area.

C. Clean adjacent surfaces soiled by hardware installation. Adjust each operating item of hardware and each door for proper operation and function; replace units which cannot be adjusted to operate freely and smoothly.
D. After work has been otherwise completed, examine all hardware for complete and proper installation. Lubricate bearing surfaces of moving parts.

E. Require lock supplier to test keys for conformance to accepted keying system.

F. Clean all exposed surfaces, check for surface damage and polish.

3.4. Defective Work:

A. Where hardware is found defective in materials or installation, rework, replace or otherwise correct as indicated by the Architect.

B. Following will be considered as defective materials:
   1. Unauthorized substitutes.
   2. Items delivered with missing, broken, damaged or defaced parts.
   3. Items of incorrect hand or function.

C. Following will be considered as defective installation:
   1. Items broken, damaged, or defaced after delivery.
   2. Items incomplete, misaligned, or incorrectly located.

3.5. Cleaning:

A. Clean exposed surfaces of hardware items. Check for surface damage and repair or replace as required. Polish plated items where required.

B. Clean adjacent surfaces soiled by hardware installation.

3.6. Hardware Schedule:

A. Provide hardware items conforming to the project specifications, as indicated in the hardware section of the door schedule on the drawings, and according to the Hardware Groups below.

HARDWARE GROUPS

A. Set No. 1.02:

   (1) Replaceable Seal Strips – Type W1
   (1) Door Bottom Seals – DS-1

HARDWARE LEGEND

WEATHERSTRIPPING
W1 – Replaceable Seal Strip

DOOR BOTTOM SEAL
DS-1 – Neoprene bottom seal

End of Section 08710
DIVISION 09 – FINISHES

SECTION 09210
GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1. Work Includes:
A. Base Bid.
   1. General Contractor provide:
      a. Gypsum drywall (gypsum wallboard) work shown on the drawings and in
         schedules, and defined to include gypsum board work with a tape-and-
         compound joint treatment system known as "drywall finishing" work.
      b. Gypsum drywall applied to metal and/or wood framing and furring.
      c. Drywall finishing (joint tape-and-compound treatment).

1.2. Related Work:
A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedure
   2. Section 06100 - Rough Carpentry
   3. Section 07842 - Fire-Resistive Joint Systems
   4. Section 07920 - Joint Sealants
   5. Section 09230 - Gypsum Plastering
   6. Section 09910 - Paints and Coatings

1.3. References:
A. All references are the current editions unless noted otherwise.
B. American Society for Testing and Materials (ASTM):
   1. ASTM A1003 - General Requirements for Steel Sheet.
   2. ASTM A641 - Zinc Coated (Galvanized) Carbon Steel Wire.
   3. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized)
      or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   5. ASTM C557 - Adhesive for Fastening Gypsum Wallboard to Wood Framing.
   6. ASTM C645 - Non-Load (axial) Bearing Steel Studs, Runners (Track), and Rigid
      Furring Channels for Screw Application of Gypsum Board.
   7. ASTM C754 - Installation of Framing Members to Receive Screw Attached
      Gypsum Wallboard, Backing Board, or Water Resistant Backing Board.
      Board.
  10. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of
      Gypsum Board or Metal Plaster Bases.
      Surface of Interior Coatings.
      Sound Transmission Loss of Building Partitions.
  15. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and
      Materials.
C. FS HH-I-521 - Insulation Blankets, Thermal (Mineral Fiber, for Ambient Temperatures).
D. Gypsum Association:
   1. GA-201 - Gypsum Board for Walls and Ceilings.
   2. GA-203 - Installation of Screw Type Steel Framing Members to Receive Gypsum Board.
   4. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.


1.4. Submittals:
   A. Submit in accordance with Section 01330:
      1. Manufacturer's Data: Submit manufacturer's product specifications, samples, and installation instructions for each gypsum drywall component, including other data to show compliance with these specifications.

1.5. Quality Assurance:
   A. Applicator: Company specializing in gypsum board systems work with five years documented experience.
   B. Fire-Protection Ratings: At locations indicated on drawings, provide fire-rated assemblies tested per ASTM E119 and acceptable to authorities for ratings required. Provide assemblies as listed in the following:
      1. GA-600, "Fire Resistance Design Manual."
      2. Underwriters Laboratories Inc.'s (UL) "Fire Resistance Directory".
   C. Industry Standard: Comply with requirements of GA-216 "Application and Finishing of Gypsum Board" by the Gypsum Association, except where more detailed or more stringent requirements are indicated including the recommendations of the manufacturer.
   D. Source Limitations: Obtain gypsum boards, trim accessories, adhesives and joint treatment products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.
   E. Perform work in accordance with GA203 and ASTM C754.
   F. Sound-Rated Construction: Unless otherwise noted, provide construction built in accordance with manufacturer's assemblies laboratory-tested per ASTM E90 for designated STC ratings.
      1. Minimum STC ratings: STC 45.

1.6. Product Handling
   A. Deliver gypsum drywall materials in sealed containers and bundles, fully identified with manufacturer's name, brand, type and grade; store in a dry, well ventilated space, protected from the weather, under cover and off the ground.

1.7. Project Conditions:
   A. Temperature: Maintain temperature in areas of installation at not less than 55°F for at least 24 hours before installation begins and for not less than 48 hours after joint finishing has been completed.
B. Ventilation: Provide controlled ventilation during joint finishing operations, to eliminate excessive moisture. Avoid drafts during hot, dry weather to prevent excessively fast drying of joint compound.

PART 2 - PRODUCTS

2.1. Metal Support Materials:

A. Acceptable manufacturers:
1. Dietrich Industries, Inc.
2. Clark Steel Framing Systems.
3. Unimast, Inc.
4. The Steel Network, Inc.

B. Comply with Gypsum Association Specification GA-203 "Installation of Screw-Type Steel Framing Members to Receive Gypsum Board" as specified and recommended for metal system supporting gypsum drywall work.

C. Studs: Sheet Steel ASTM A1003, ASTM C645; galvanized (ASTM A653, G40 for interior partitions and G90 for exterior walls)
1. Sizes (unless otherwise indicated on the Drawings):
   a. 20 gauge x 3-5/8" actual depth studs at interior partitions.
   b. 20 gauge x 3-5/8" actual depth - double studs - at all doors and window openings and at all partitions to receive cementitious backer board.
2. Runners: Match stud gauges except where noted otherwise; type recommended by stud manufacturer for top and bottom support of studs, and for abutment of drywall work at other work.
   a. Vertical Deflection Systems: To accommodate structural deflection, at all non-load bearing partitions that extend to the underside of the building structure above, provide one of the following systems. All systems must be capable of 2” total movement (1” up and 1” down). No wallboard anchoring screws may be driven into the top runner.
      1) Single Runner and Horizontal Bridging System: ASTM C645 top runner with 3” deep leg. The top of all studs shall be cut a minimum of 1” short of the top of the runner. Horizontal bridging shall be light gauge galvanized steel angle or channel specifically manufactured as stud bridging; bridging shall be continuous, located within 12” of top of studs and anchored to each stud. All screws anchoring studs to the top track shall be removed after bridging installation.
      2) Double Runner System: ASTM C645 top runners, inside runner with 3” deep leg; outer runner sized to friction fit inside runner. Friction-fit deep-leg runner assemblies and runners relying on steel flexure to perform are unacceptable. Wallboard may be anchored to inside runner.
      3) Vertical Deflection Clips System: Clips to have step-bushings to ensure positive connection having friction free movement between clip and stud. (Basis-of-Design: The Steel Network, Inc: VertiClip® SLD) Use only vertical deflection connection products that have a valid ICC ES Report complying with ICC Acceptance Criteria AC261.
   b. Fire-Rated Vertical Deflection Systems: To accommodate structural deflection in fire-rated, non-load bearing partitions that extend to the underside of the building structure above, provide one of the following products. System must accommodate deflection, capable of 2” total movement (1” up and 1” down), while maintaining continuity of the indicated fire-rated assembly.
1) Product/Manufacturer:
   a) Fire Trak / Fire Trak Corp.
   b) The System / Metal-Lite Inc.
   c) Substitutions: Under provisions of Section 01600.
3. Stud System Accessories: Provide stud manufacturer's standard clips, shoes, ties, reinforcements, fasteners and other accessories as needed for a complete stud system.

D. Furring Channels: ASTM C645 channels with dimensions as indicated on Drawings.

E. Fasteners GA203: Type and size recommended by furring manufacturer for the construction and application indicated. Phillips flange-head, self-tapping sheet metal type screw for use with power screw gun.

F. Sheet metal members: Provide miscellaneous custom fabricated wall framing shapes as shown or required from galvanized sheet metal.

2.2. Gypsum Board Products:

A. General:
   1. Comply with GA-216 and ASTM C1396, as specified and recommended.
   2. Sheet Size: 48" wide, maximum length available which will minimize end joints.
   3. Acceptable manufacturers:
      a. Georgia Pacific
      b. National Gypsum Co.
      c. U. S. Gypsum Co. (USG)

B. Gypsum Board, Typical:
   1. Thickness: 5/8".
   2. Type X.

C. Impact Resistant Type: Manufactured to produce greater resistance to surface indentation and through-penetration (impact resistance) than standard Type X gypsum board.
   1. Thickness: 5/8".
   2. Type X.
   4. Acceptable Products: The following products, provided they comply with all requirements of the Contract Documents, will be considered acceptable:
      a. Hi-Impact XP / National Gypsum Co.
      b. Fiberock AR / USG
      c. Substitutions: Under provisions of Section 01600.

D. Trim Accessories: Manufacturer's standard galvanized steel beaded units with flanges for concealment in joint compound, including corner beads, edge trim and control joints; except provide semi-finishing type (flange not concealed) where indicated.
   1. Control joint: No. 093 made from roll-formed zinc.
   2. Vinyl trim will not be acceptable unless noted otherwise.
   3. Pre-taped metal trim is acceptable.

E. Joint Treatment Materials:
   1. ASTM C475, GA201, and GA216; type recommended by the manufacturer for the application indicated.
   2. Joint Tape:
      a. Interior, typical: Glass mesh.
      b. Interior, mold and moisture-resistant board: Glass mesh.
      c. Exterior: Glass mesh.
   3. Joint Compound:
      a. Interior:
1) On typical interior work provide:
   a) Embedding and First Coat: Setting-type (chemical-hardening-type).
   b) Additional and Final Coats: Ready-mixed vinyl-type or non-casein-type (all-purpose type).

F. Miscellaneous Materials:
   1. Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.

PART 3 - EXECUTION

3.1. Inspection:
   A. Examine the areas and the spaces to receive gypsum drywall, and the conditions under which gypsum drywall is to be installed. Notify the Architect, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected.

3.2. Installation of Metal Support Systems:
   A. Comply with ASTM C754, ASTM C840, GA-203, and manufacturer's instructions.
   B. Furnish concrete inserts, steel deck hanger clips, and similar devices to other crafts for installation well in advance of time needed for coordination with other work.
   C. Space ceiling suspension main runners 4'-0" o.c., and space hangers as indicated or, at 4'-0" o.c. along runners. Locate main runners parallel with long axis of recessed light fixtures, unless otherwise directed by the Architect.
   D. Install additional framing channels to provide direct connection to structural beams or joists. Do not anchor hanger wires to metal roof deck. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other effective means.
      1. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
   E. Install runner tracks at ceiling and structural system where gypsum drywall stud system abuts other work.
      1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
      2. Isolate partition framing and wall framing where it abuts structure. Install Vertical Deflection System as specified herein at head of assemblies that avoid axial loading of assembly and laterally support assembly.
a. Use of Single Runner and Horizontal Bridging System requires the removal of all screws anchoring studs to the top track after bridging installation.

F. Screw furring members to structural support where possible, otherwise wire tie.

G. Install supplementary framing, runners, furring, wood grounds, blocking and bracing at opening and terminations in the work, and at locations to support fixtures, equipment, services, heavy trim, furnishings and similar work which cannot be adequately supported directly on gypsum board alone. Wood grounds shall consist of not less than 2 x 6 blocking bolted or screwed to wall framing.

H. Coordinate installation of bricks, anchors, blocking, electrical, and mechanical work placed in or behind partition framing.

3.3. Gypsum Board Installation Requirements:

A. Standards: In addition to compliance with ASTM C840, GA201 and GA216, comply with manufacturer's instructions and requirements for fire-resistance ratings.

B. Insure that sound attenuation blankets and wall insulation, as indicated, are installed prior to gypsum board installation.

C. Install ceiling boards in the direction and manner which will minimize the number of end-butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 1'-0".

D. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories. Install control or expansion joints as indicated on the drawings. When not shown, provide control joints at 30'-0" maximum intervals in both directions, and in conjunction with door heads. Coordinate locations with other work and with Architect.

E. Install wall/partition board vertically and avoid end-butt joints wherever possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

F. Space fasteners in gypsum board accordance with GA-216 and manufacturer's recommendations.

G. At partitions designed to allow vertical deflection of the building structure, no wallboard anchoring screws may be driven into the top runners.

H. Unless otherwise noted, install boards on one side of studs completely to metal floor and roof deck above at each room. Provide one coat tape and compound treatment in non-exposed area above ceiling. Seal boards tight to underside of roof or floor deck and seal all penetrations. Where insulation occurs in stud walls, install boards on both sides of studs to deck above. Boards not extending to deck above shall be a minimum of 4" above ceiling.

3.4. Gypsum Board Application:

A. Single-Layer Ceilings, Soffits, and Partitions:
   1. Fasten with screws at metal support.
   2. Fasten to wood supports with adhesive and screws.
   3. Provide drywall finishing as specified herein.

B. Adhesive Application of Gypsum Board to Concrete and Masonry Walls.
1. Interior surfaces to which gypsum board is to be adhered should be free from any foreign matter, projections, or depressions that will impair bond.
   a. Scarify slick or glossy surfaces.

2. Install in accordance with manufacturer's installation instructions or as follows:
   a. Apply adhesive directly to back of gypsum board or on wall in continuous beads spaced not to exceed 12" o.c. or daubs spaced not to exceed 16" when applying gypsum board to monolithic concrete, brick, or concrete block. Beads should not be less than 3/8" in diameter to provide continuous bond between gypsum board and wall surface and daubs should not be less than 2" diameter x 1/2" thick with a row centered at all vertical joint locations.
   b. Position gypsum board to provide a tight fit at abutting edges or ends. Do not slide board. Press the panels into place to achieve maximum contact. Use mechanical fasteners or temporary bracing as required to support gypsum board until adhesive sets or adequate bond strength is attained.
   c. Allow adhesive to cure a minimum of 24 hours prior to application of joint treatment, base coat and finish.

3.5. Installation of Drywall Trim Accessories:
   A. Use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.
   B. Install metal corner beads at external corners of drywall work.
   C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work, such as ceiling to wall intersections, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
   D. Install J-type semi-finishing trim where indicated, and where exterior gypsum board edges are not covered by applied moldings.
   E. Install metal control joint (beaded type) where indicated or as directed by Architect.
   F. Install acoustical sealants per manufacturer's written instructions and per section 07900.

3.6. Installation of Drywall Finishing:
   A. Provide GA-214 Level 4 finish.
   B. Drywall finish for exposed drywall shall not begin until temperatures can be maintained above 55° F.
   C. Apply treatment at gypsum board joints both directions, flanges of trim accessories, penetrations, fasteners heads, surface defects and elsewhere to prepare work for decoration. Prefill open joints and rounded or beveled edges, using type of compound recommended by manufacturer.
      1. Apply joint tape at joints between gypsum boards.
      2. Apply joint compound in three coats (not including prefill of repaired openings in base), and sand between last two coats and after last coat.
      3. Feather coats onto adjoining surfaces so that camber is maximum 1/16".
D. Partial Finishing (Level 2 finish): Omit third coat and sanding on concealed drywall work which is indicated for drywall finishing, including sound, fire, air, smoke-rated work and partitions above suspended ceilings.

E. For drywall applied to concrete masonry with adhesive, joint treatment should not be applied until gypsum board is firmly bonded and adhesive has hardened.

3.7. Tolerances:

A. Maximum Variation From True Position: 1/4”.

B. Maximum Variation of any Member from Plane: 1/4”.

C. Maximum Variation from True Flatness: 1/8” in 10’ in any direction.

D. Maximum joint camber (concave or convex): 1/16”.

3.8. Protection of Work:

A. Protect gypsum drywall work from damage and deterioration during the remainder of the construction period.

End of Section 09210
PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid.
   1. General Contractor provide:
      a. Provide plaster work shown on the drawings and in schedules.
         1) Interior plaster work.
         2) Interior plaster patching.
         3) Veneer plaster.
         4) Accessories for plastering.
         5) Metal lath and supporting systems.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 04200 - Unit Masonry
   3. Section 07920 - Joint Sealers
   4. Section 09210 - Gypsum Board Assemblies
   5. Section 09910 - Paints and Coatings

1.3. References:

A. All references are the current editions unless noted otherwise.
B. PCA (Portland Cement Association) - Plaster (Stucco) Manual.
C. American Society for Testing and Materials (ASTM):
   4. ASTM C926 - Application of Portland Cement - Based Plasters.
   5. ASTM C897 - Aggregate for Job-Mix Portland Cement - Based Plasters.
   6. ASTM C61 - Gypsum Keene’s Cement.
   7. ASTM C150 - Portland Cement.
   11. ASTM C841 - Installation of Interior Lathing and Furring.
   13. ASTM C847 - Metal Lath.
D. GA (Gypsum Association) - 201 - Gypsum Board for Walls and Ceilings.
E. ML/SFA (Metal Lath/Steel Framing Association) - Specifications for Metal Lathing and Furring.
F. U.L. (Underwriters Laboratories, Inc.) - Fire Resistive Index.

1.4. Submittals:
A. Submit in accordance with Section 01330:
   1. Manufacturer's Data: Submit the manufacturer's product specifications and installation instructions for each material, and include other data to show compliance with these specifications.

1.5. Quality Assurance

A. Applicator: Company specializing in lath and plaster work with five years experience.
B. ANSI Standards: Comply with specified requirements of ASTM C926.
C. Allowable Tolerances: For flat surfaces, do not exceed 1/4" in 8'-0" for bow, warp, plumb or level, including surfaces to receive applied finishes.
D. UL-Rated Assemblies: Where lathing and metal supports are included in construction indicated to have a fire-resistance rating, comply with the specified UL design in the "Fire Resistance Index".

1.6. Environmental Requirements

A. Do not apply plaster when substrate or ambient air temperature is less than 50°F nor more than 80°F.
B. Maintain minimum ambient temperature of 50°F during and after installation of plaster.

1.7. Product Handling

A. Except for sand and water, deliver materials to the site in sealed containers or bags fully identified with manufacturer's name, brand, type, and grade.
B. Store materials in a dry, well-ventilated space under cover and off the ground.
C. Protect lath from exposure to weather. Deliver in manufacturer's unopened bundles, identified with name, brand, type and grade. Store inside in a dry ventilated space.

PART 2 - PRODUCTS

2.1. Manufacturers:

A. Metal Lath
   1. Alabama Metal Industrial Corp.
   2. Bostwick Steel Lath Co.
   4. Inland Ryerson Construction Products Inc.
   5. National Gypsum Co.
   7. Western Metal Lath Div.
   8. Wheeling Corrugating Div.
   9. Milwaukee Corrugation Co.
   10. Unimast, Inc.

2.2. Materials:

A. Lath and Metal Support Materials
1. Provide the type, weight, grade and finish of materials, and include for each system the clips, fasteners, ties, reinforcing, stiffeners, shoes, tracks, hangers, corner beads, casing beads, base screeds, expansion/control joints, brackets, anchors, accessories and trim recommended by the manufacturer for the application indicated.

2. Metal and Finishes: Manufacturer's standard steel products unless indicated as zinc alloy or other metal. Provide manufacturer's standard galvanized finish on steel products except as follows:
   a. Metal Lath: Galvanized ASTM 525, G90.
   b. Framing Members: Hot-dip galvanized finish, ASTM A525 G90 for 18 gage and lighter formed metal products, ASTM A123 galvanized after fabrication for 16 gage and heavier products.
   c. High Humidity Area Exposed Plastering Accessories: Provide zinc alloy accessories for exterior work and work in shower rooms and coolers, except where fully concealed in plaster.


4. Ceiling Furring Materials:
   a. Runner Channels: 1-1/2", 0.475 lb. per ft. cold-rolled or 1.12 lb. per ft. hot-rolled.
   b. Cross Furring: 3/4" x 0.3 lb. per ft. cold-rolled channel.
   c. Hangers: No. 9 galvanized wire; comply with ANSI A42.4.

5. Metal Lathing Materials:
      1) Product Standards: Comply with FS QQ-L
   b. Comply with lath manufacturer's recommendations.
   c. Diamond Mesh Lath: 3.4 lbs. per sq. yd., std. mesh.
   d. Rib lath, 3/8: 3.4 lbs. per sq. yd., 3/8" rib depth (high rib).

6. Plastering Accessories and Trim:
   a. Provide items specified and recommended by the furring and lathing manufacturer.
   b. Provide 26 gage units of the pattern/profile as indicated, manufacturer's standard.
   c. Coordinate depths with depths of plaster indicated.
   d. Include corner beads, #66 casing beads with expanded flange, joints, caps, screens, moldings and similar units indicated.
   e. Expansion/Control Joint - #75 zinc coated or #15 galvanized steel.

B. Gypsum Plaster Materials
1. Base Coat Plaster: Provide either neat or ready-mixed (where available) materials, at Installer's option, unless otherwise indicated: Sand aggregate for Base Coat Plaster, ASTM C35.

2. Finish Coat Plaster: Gypsum gauging plaster, ASTM C28 or gypsum ready-mixed finished plaster, manufacturer's standard mill-mixed gauged interior finish, at installer's option.


C. Portland Cement Plaster Materials and Accessories
1. Plaster Base Coat Materials
   b. Lime: ASTM C206, Type S.
d. Water: Clean, fresh, potable, and free of mineral or organic matter which can affect plaster.
e. Admixtures: Air entrainment compound as acceptable to the Architect.
f. Plaster Mix Reinforcement: Glass fibers, 1/2” nominal length, alkali resistant.

2. Plaster Finish Coat Materials
   a. Premixed Finishing Coat: Factory prepared oriental white portland cement plaster by one of the specified manufacturers.
   b. Color Pigment: Pre-portioned for batch control; color as selected by Architect.
   c. Water: Clean, fresh, potable, and free of mineral or organic matter which can affect plaster.
   d. Finish Aggregate: Uniformly graded silica sand.

3. Accessories
   a. Corner Beads: Formed steel, minimum 26 gage thick; bullnosed edge, or longest possible length, sized and profiled to suit application; galvanized finish.
   b. Base Screeds: Formed steel, minimum 26 gage thick; square edge, of longest possible length; sized and profiled to suit application; galvanized finish.
   c. Casing Bead: Formed steel, minimum 26 gage thick; thickness governed by plaster thickness; maximum possible lengths; expanded metal flanges, with square edges; galvanized finish.
   d. Control and Expansion Joint Accessories: Formed steel; minimum 26 gage thick; accordion profile, 2” expanded metal flanges each side; galvanized finish.
   e. Anchorages: Nails, staples, or other approved metal supports, of type and size to suit application, galvanized, to rigidly secure lath and associated metal accessories in place.

2.3. Plaster Mixes

A. Mixing:
   1. Basic Requirements:
      a. Proportion and measure material for each plaster batch accurately.
      b. Size batches for complete use within a maximum of three hours after mixing.
      c. Do not retemper or use partially set plaster.
      d. Do not use frozen, caked, or lumpy material and remove such material from job site immediately.
      e. Mix factory-prepared plaster in accordance with manufacturer’s written instructions for type of surface to which applied.
      f. Use moist, loose sand in mix proportions.
      g. Withhold 10% of mixing water until mixing is almost complete, then add as needed to produce proper consistency.
   2. Mechanical mixing:
      a. Mix each batch separately.
      b. Clean mixer of set or hardened materials before loading materials for new batch.
      c. Maintain mixer in continuous operation while adding and mixing materials.
      d. Conform to mixing sequence, cycle of operation and time recommended by manufacturer of plaster material.
   3. Hand Mixing: Do not hand mix unless authorized by Architect.
B. Mix Proportions: Comply with specified mix requirements of ASTM C926 for basecoat and finish coat proportions and as follows:
   1. Plaster Base Coat Compositions: Three-coat work over metal lath; base coats, as indicated below:
      a. Scratch Coat: Gypsum neat plaster with job-mixed sand; maximum aggregate, 2 cu. ft. per 100 lb. plaster.
      b. Brown Coat: Gypsum neat plaster with job-mixed sand; maximum aggregate, 3 cu. ft. per 100 lb. plaster.
      c. Use 2:1 mix for cove molding plaster.

C. Cement Plaster Mixes:
   1. Mix and proportion cement plaster in accordance with PCA Plaster (Stucco) Manual with manufacturer's instructions.
   2. Mix only as much plaster as can be used in two hours.
   3. Add color pigments in accordance with manufacturer's instructions. Ensure uniformity of mix and coloration.
   4. Mix materials dry, to uniform color and consistency, before adding water.
   5. Add air entrainment admixtures to provide 5-7% entrainment.
   6. Protect mixes from frost, contamination, and evaporation.
   7. Do not retemper mixes after initial set has occurred.

PART 3 EXECUTION

3.1. Inspection:
A. Examine surfaces which are to receive plaster, grounds and other accessories which act as ground or screeds. Notify the Architect in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the plaster work until unsatisfactory conditions have been corrected.

B. Ceiling Anchorages: Coordinate work with structural ceiling work to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling hangers.

C. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.

3.2. Preparations for Plastering:
A. Clean plaster bases and surfaces to be plastered, removing loose materials, coatings and other substances which might impair the work.

B. Install diagonal strips of glass reinforcing tape at corners of openings of plaster.

C. Install temporary grounds and screeds to control plaster thickness and comply with tolerances.

D. Install plastering accessories, anchored at 8" o.c. along each flange. Miter corners and spline joints to form tight accurate joints without offsets.

E. Install casing beads where shown and at exposed terminations of plaster work.
F. Install control joints where indicated or at locations to limit any one plaster area to a maximum of 100 sq. ft. in ceilings.

G. Dampen masonry surfaces to reduce excessive suction.

H. Roughen all smooth surfaces.

I. Scrape and sand all existing painted walls to remove all loose paint and foreign matter, scheduled to receive veneer plaster.

J. Remove projections greater than 1/8" and fill depressions greater than 1/4" with Portland Mortar or Latex Filler.

K. Cut out and remove all cracked or loose existing plaster down to existing substrate and patch with Portland Cement Mortar.

L. Apply bonding agent in accordance with manufacturer's instructions.

3.3. Installation:

A. Lath and Metal Support System:
   1. Comply with manufacturer's installation instructions and recommendations where other more stringent requirements are not indicated.
   2. Comply with ML/SFA "Specs. for Metal Lathing and Furring" and ASTM C841.
   3. Isolation: Where lathing and metal support system abuts building structure horizontally, isolate the work from structural movement sufficiently to prevent transfer of loading into the work from the building structure. Install slip or cushion type joints to absorb deflections but maintain lateral support.
   4. Support Framing: Install supplementary framing, blocking, and bracing for support of fixtures, equipment, services, heavy trim and similar work requiring attachment and support.
   5. Wire Tying: Tie exterior furring with 14 gage or double 16 gage wire and tie exterior lath with 16 gage wire. Tie interior furring with 16 gage or double 18 gage wire, and tie interior lath with 18 gage wire.
   6. Splicing Members:
      a. Lap furring members 8" and runner channels 12", and wire-tie near each end of lap.
      b. Splice plastering accessories by use of concealed splines, anchored to prevent offsets.
   7. Installation of Ceiling Suspension:
      a. Space runner channels at a maximum of 4'-0" o.c. and as indicated and space hangers along channels as required by manufacturer. Space cross furring at 12" o.c. maximum.
      b. Secure hangers from building structural members only, by looping and wire-typing wherever possible. Provide holes in structural channels to anchor hanger wire.
      c. Secure ceiling support system to building structure.
      d. Level runner channels to a tolerance of 1/8" in 12'-0".
   8. Installation of Metal Lath: Install metal lath by wire-tying, nailing, screwing or clipping to supports or substrate in the manner indicated and in accordance with industry standards.
   9. Installation of Plastering Accessories:
      a. Anchor each flange of accessories 8" o.c. to plaster base.
b. Miter or cope accessory corners, and install with tight joints accurately aligned.
c. Set accessories plumb, level and true to line, with a tolerance of 1/8" and 10'-0". Shim as required.
d. Install metal corner beads at external corners.
e. Install casing beads at terminations of plaster work. Set casing beads (for application of sealant).
f. Install prefabricated control joints of one-piece design. Locate interior control joints at 20' o.c. maximum unless noted otherwise. Locate exterior control joints at every 12' o.c. center in each direction unless noted otherwise. Coordinate joint placement with other related work and Architect.

B. Plaster
1. Basic Requirements:
   a. Comply with ASTM C926 and with manufacturer's instructions if more detailed or more stringent.
   b. Sequence plaster installation properly with the installation and protection of other work, so that neither will be damaged by the installation of the other.
   c. Provide three-coat plaster and portland cement plaster over metal lath installations in 3/4" thickness, or as indicated otherwise on the drawings.
   d. Apply plaster to an entire panel with interruptions occurring only at junctions of plaster planes or at openings or expansion joints.
   e. Place mixed plaster within a minimum of 2-1/2 hours after mixing, except during hot, dry weather, reduce maximum placing time to prevent premature stiffening of plaster. Do not retemper stiffened plaster with additional water.
   f. When plaster ceilings or soffits abut walls, plaster shall float free from the wall. The joint between ceiling or soffit and wall shall be caulked.
2. Base Coat Installation:
   a. Apply three-coat plaster over all metal lath, consisting of first (scratch) basecoat, second (brown) base coat and finish coats as further specified.
   b. Apply first and second base coats 5/16" thick for a total thickness of 5/8", unless otherwise indicated on the drawings.
   c. Measure thickness of plaster from back plane of metal reinforcement, unless metal reinforcement is applied over solid base, measure from face of base.
   d. Apply first base coat with sufficient material and pressure to form full keys through metal reinforcing and to embed reinforcing. After first coat is firm, scratch (score) in one direction only, to provide mechanical bond for second coat.
   e. Apply second base coat with sufficient material and pressure to ensure tight contact with first base coat. Bring surface to a true, even plane by rodding, and float to a uniformly rough surface. Fill Finish Coat Installation: Apply finish plaster to a 1/8" nominal thickness including fine and moderate texture variations. Apply in the number of coats and of the proper consistency to achieve smooth trowel finish. defects and scratches with plaster.
3. Finish Coat Installation: Apply finish plaster to a 1/8" nominal thickness including fine and moderate texture variations. Apply in the number of coats and of the proper consistency to achieve smooth trowel finish.
4. Veneer Plaster Installation:
a. Apply base coat to a thickness of 1/8", ± 1/64".
b. Apply final coat over slightly green, almost dry base coat, to a nominal thickness of 1/16".
c. Total thickness or veneer plaster to be a nominal 3/16", or as indicated otherwise on the drawings.
d. Finish surface to be flat, smooth, hard trowel finish.

3.4. Moisture Retention, Curing:

A. Cure plaster by maintaining each coat in a moist condition for two days following application; keep enclosed for fog-spray (after initial set) to prevent dry-out.

B. Alternate curing method: Apply each coat of plaster on three consecutive days and keep the final coat moist by spraying for four days.

C. Plaster which is cracked or crazed due to improper curing will not be accepted. Remove and replace.

3.5. Cutting and Patching:

A. Cut, patch, point-up and repair plaster to accommodate other work and to restore cracks, dents and imperfections. Repair or replace work at all locations where surfaces exposed to view to exhibit blisters, buckles, excessive crazing and chick cracking, dry-outs efflorescence, sweat-outs and similar defects, including areas of the work which do not comply with specified tolerances and where bond to the surface has failed.

B. Sand smooth-troweled finished lightly to remove trowel marks and arises.

3.6. Cleaning and Protection:

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from metal structure, masonry, and other surfaces which are not to be plastered. Repair floors, and other surfaces which have been stained, marred or otherwise damaged during the plastering work. When plastering work is completed, remove unused materials, containers and equipment and clean floors and walks of plaster debris.

B. Protect plaster from deteriorations and damage during the remainder of the construction period.

End of Section 09230
DIVISION 09 - FINISHES

SECTION 09510
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid.
   1. General Contractor provide:
      a. Suspended metal grid ceiling system.
      b. Acoustical ceiling panels as shown on drawings and in schedules.
      c. Maintenance Stock.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01310 - Project Coordination
   2. Section 01330 - Submittal Procedures
   3. Section 01770 - Closeout Procedures
   4. Section 09210 - Gypsum Board Assemblies
   5. Section 09910 - Paints and Coatings

1.3. References:

A. All references are the current editions unless noted otherwise.
B. ASTM C635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
C. ASTM C636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
D. UL - Underwriter's Laboratories System Ratings.

1.4. Quality Assurance:

A. The installation of acoustical ceilings shall be by an experienced installation firm which is certified by the manufacturer of the acoustical units.
B. Compliance with specification requirements is the exclusive responsibility of the Contractor.
D. Fire Hazard Classification: UL tested, listed and labeled as "Class 0-25" for flame spread, fuel contributed, and smoke developed.

1.5. Environmental Requirements:

A. Maintain a uniform temperature of a minimum 60°F. and humidity of 20 to 40% prior to, during, and after installation.
1.6. Submittals:
   A. Submit in accordance with Section 01330:
      1. Submit product data on metal grid system components and acoustic units.
      2. Submit manufacturer's installation instructions.
      3. Samples:
         a. Submit two samples, 12" x 6" in size, illustrating material and finish of each type of acoustic unit.
         b. Submit two samples, 12" long, of suspension system main runner, cross runner, edge trim.
   B. Submit in accordance with 01770:
      1. Provide manufacturer's cleaning information for grid system and acoustic units.
      2. Provide Maintenance Stock materials to Owner as specified in this Specification.
         Provide the Architect/Engineer an itemized letter of transmittal of material delivery signed by the Owner.

1.7. Sequencing/Scheduling:
   A. Do not install acoustical ceilings until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
   B. Schedule installation of acoustic units after interior wet work is dry.

1.8. Maintenance Stock:
   A. At time of completing installation, deliver a stock of at least 3% of total cartons of extra tile panels to the Owner. Panels shall match units installed and be packaged with protective covering for storage and identified with appropriate labels.

PART 2 - PRODUCTS

2.1. Acceptable Manufacturers – Suspension System:
   A. Same as acoustical unit manufacturer or one of the following:
      1. Chicago Metallic Corp.
      2. USG Interiors, Inc.
      3. Gordon, Inc.
      4. Certainteed Celotex
      5. Armstrong

2.2. Suspension System Material:
   A. Grid: ASTM C635; intermediate duty, non-fire rated; exposed T components; die cut and interlocking.
      1. Color: To match existing where patching is done to existing grid, white where entire room to receive new grid.
   B. Accessories: Stabilizer bars, clips, splices, edge moldings, and hold down clips required for suspended grid system. Size for five times the design load indicated in ASTM C635, Table 1, Direct Hung.
1. Provide prefabricated corner trims at all outside corners, including radiused pieces as required for radiused corners such as bull-nosed concrete masonry units.

C. Grid Materials: Commercial quality cold rolled steel with galvanized coating.

D. Support Channels and Hanger Wires: Galvanized carbon steel, ASTM A 641, soft temper, pre-stretched, yield-stress load of at least three times design load, but not less than 12 gauge (0.106") with a maximum deflection of 1/360.

2.3. Acceptable Manufacturers – Acoustical Panels:

A. Type ACT-1: reveal edge
   1. Product/Manufacturer:
      a. Dune 1774NF / Armstrong
      b. Sand Micro SHM-154 / Certainteed Celotex
      c. Olympia Micro ClimaPlus #4221 / USG Interiors
   2. Type: Wet-felted mineral fiber.
   3. Texture: Fine.
   4. Color: White
   5. LR: Not less than 0.83
   6. NRC: Not less than 0.50
   7. CAC: Not less than 33
   8. Edge/Joint Detail: Tegular/Revel Edge.
   10. Modular Size: 24"x24"

PART 3 - EXECUTION

3.1. Inspection and Preparation Work:

A. Examine the conditions under which the acoustical ceiling work is to be performed. Notify the Architect in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling unless shown otherwise on reflected ceiling plans. Avoid the use of less-than-half width units at borders wherever possible, and comply with reflected ceiling plans.

3.2. Installation:

A. Install suspension systems level, and to comply with ASTM C 636, with hangers supported only from building structural members as indicated. Locate hangers near each end and spaced 4'-0" along each carrying channel or direct-hung runners, leveling to a tolerance of 1/8" in 12'-0".

B. Install system capable of supporting imposed loads to a deflection of 1/360 maximum.

C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.

D. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws or other devices which are secure and appropriate for the Substrate, and which will not deteriorate or fail with age or elevated temperatures.
E. Hang system independent of walls, columns, ducts, pipes, and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Locate system on room axis leaving equal border units, unless indicated otherwise on Drawings.

H. Coordinate installation of fixtures, components, and work of other trades with the grid installation. Do not support fixtures and components on main runners or cross runners if weight causes total dead load to exceed deflection capability. Support fixtures and components independently of the grid if required elsewhere in the Contract Documents, or support fixture/component loads by supplementary hangers located within 6” of each fixture/component corner.

I. Cope exposed flanges of intersecting suspension system members so that flange faces will be flush (cope flange of member supported by other member).

J. Do not eccentrically load system or produce rotation of runners.

K. Install grid components using longest practical lengths.

L. Install edge molding at intersection of ceiling and vertical surfaces, using longest practical lengths. Cut and bend moldings to conform to outside corners and install prefabricated corner trims. Cut and butt or miter at inside corners to provide hairline joints or use prefabricated corner trims to accept molding from each direction.

M. Field rabbet tile panel edges where required, and paint exposed cut edges to match panel finish.

N. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.

O. Cope, cut and fit materials as required for proper fit as it abuts all adjacent materials.

P. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.

Q. Install hold-down clips to retain panels tight to grid system within 20’ of an exterior door.

3.3. Tolerances:

A. Variation from Flat and Level Surface: 1/8” in 12’.

B. Variation from plumb of grid members caused by eccentric loads: 2° maximum.

3.4. Cleaning and Protection:

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

B. Protect acoustical ceilings and provide proper temperature and humidity and dust control, so that the work will be without damage and deterioration at the time of acceptance.

End of Section 09510
DIVISION 09 – FINISHES

SECTION 09650

RESILIENT FLOORING

PART 1 GENERAL

1.1. Work includes:

A. Base Bid.
   1. General Contractor provide:
      a. Preparation of subfloors.
      b. Resilient tile flooring.
      c. Resilient base.
      d. Adhesives and accessories.

1.2. Related Work

A. Specified Elsewhere:
   1. Section 03300 - Concrete
   2. Section 09910 - Paints and Coatings

1.3. References

A. All references are the current editions unless noted otherwise.

B. American Society for Testing and Materials (ASTM):
   5. ASTM F710 - Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   7. ASTM F1066 - Specification for Vinyl Composition Floor Tile.

1.4. Submittals

A. Submit in accordance with Section 01330:
   1. Product Data: Submit manufacturer's technical data for each type of resilient product.
   2. Initial Samples: Submit manufacturer's standard color charts consisting of actual product samples, showing full range of colors and patterns available for each type of product required.
   3. Installation Instructions: Submit manufacturer's installation instructions for each type of resilient product.
4. Substrate Test Results and Substrate Acceptance: Provide on Installer’s letterhead. Provide comparison of test results to manufacturer’s recommendations. Include a statement indicating acceptance of substrate conditions.

B. Submit in accordance with Section 01770:
   1. Maintenance Instructions: Submit manufacturer’s recommended maintenance practices for each type of resilient product required.

1.5. Quality Assurance

A. Manufacturer: Whenever possible, provide each type of resilient product by a single manufacturer, including recommended primers, adhesives, sealants, and leveling compounds.

B. Installer qualifications:
   1. Engage an Installer who has a minimum of 3 years experience in completed flooring applications similar in material and extent to that indicated for this Project with a record of successful in-service performance. Provide a list of successful projects including a contact list if requested.
   2. Engage installer who is certified in writing by resilient flooring manufacturer as qualified for installation of vinyl flooring employing heat welded seams.

C. Fire Test Performance: Provide resilient products which comply with the following fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction:
   1. Critical radiant flux (CRF): Not less than the following rating per ASTM E648 or NFPA 253: 0.45 watt per square centimeter.
   2. Smoke developed: Not more than 450 per ASTM E662.

1.6. Project Conditions

A. Unless otherwise required by flooring manufacturer, maintain the following conditions. Maintain minimum temperature of 65°F in spaces to receive resilient flooring products for at least 48 hours prior to installation, and for not less than 48 hours after installation. Store resilient flooring materials in spaces where they will be installed for at least 48 hours before beginning installation. Subsequently, maintain minimum temperature of 55°F in areas where work is completed.

B. Install resilient flooring products after other finishing operations, including painting, have been completed.

C. Perform flooring manufacturer’s recommended bond and calcium chloride moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry, as well as to ascertain presence of curing compounds, or compatibility of curing/sealing compounds.
   1. Do not install resilient flooring products over concrete slabs until testing has determined the substrate conditions are acceptable.

PART 2 - PRODUCTS

2.1. Tile Flooring Materials

A. Vinyl Composition Tile: Per ASTM F1066 and as follows:
   1. Manufacturers: The indicated product line of the following manufacturers, provided it complies with requirements of the contract documents, will be considered acceptable:
1.  Armstrong / Excelon and Migrations  
   b.  Mannington / Essentials  
   c.  Azrock / Standard  

2.  Type:  Class 1, solid-color tile or Class 2, through-pattern tile as shown on finish plans.  
3.  Gage:  1/8".  
4.  Size:  12" x 12" unless otherwise indicated.  
5.  Colors/Patters:  
   1)  To match colors shown on finish plans.

2.2.  Resilient Base Materials  

A.  Wall Base:  Provide base complying with ASTM F1861, vinyl homogenous material, with matching end stops and preformed or molded corner units, and as follows:  
   1.  Manufacturers:  Products of the following manufacturers, provided they comply with requirements of the contract documents, will be considered acceptable:  
      a.  Armstrong / Vinyl  
      b.  Johnsonite / Traditional Vinyl  
      c.  Roppe / Vinyl Wall Base  
      d.  VPI / Vinyl  
      e.  Substitutions:  Under provisions of Section 01600.  
   2.  Height:  4" high.  
   3.  Thickness:  1/8".  
   4.  Length:  Coils in manufacturer's standard length.  
   5.  Styles:  Unless indicated otherwise on the Drawings, provide the following base styles:  
      a.  Carpeted locations:  Straight base without cove.  
      b.  Non-Carpeted locations:  Cove base with toe.  
   7.  Color:  To match VPI Jet.  

2.3.  Miscellaneous Accessories  

A.  Resilient Edge/Transition Strips:  Homogeneous rubber composition.  
   1.  Color:  As selected by the Architect from manufacturer's standard selection.  
   2.  Width:  1" minimum.  
   3.  Profile:  Unless indicated otherwise, provide profile as required for adjacent flooring materials.  
   4.  Provide at all doorways and other terminations against dissimilar floor materials.  

B.  Adhesives (cements):  Waterproof, stabilized type as recommended by resilient product manufacturer to suit material and substrate conditions.  All adhesives shall be from the manufacturer of the product being installed (floor and base) or from a manufacturer listed as acceptable by the floor or base manufacturer.  

C.  Concrete Slab Primer:  Nonstaining type as recommended by flooring manufacturer.  

D.  Leveling and Patching Compounds:  Cementitious type - Underlayment shall be formulated with a Portland cement matrix, which develops a compressive strength of 4200 psi when tested in accordance with ASTM C109/mod (air-cure only).  
   1.  Acceptable Manufacturers / Products  
      a.  Adex / Feather Finish  
      b.  Mapei / Plani-Patch  

E.  Sealers or Polishes:  Types recommended by flooring manufacturer.  

PART 3- EXECUTION
3.1. Inspection:

A. Require installer to inspect substrate surfaces to determine that they are satisfactory. A satisfactory substrate is defined as one that is free of moisture and is smooth and free of cracks, holes, ridges, coating preventing adhesive bond, and other defects impairing performance or appearance.

B. Perform bond and moisture tests on concrete subfloors as recommended by flooring and adhesive manufacturers to determine if surfaces are sufficiently cured and dry, as well as to ascertain presence of curing compounds, or compatibility of curing/sealing compounds.  
   1. Submit test reports and statement indicating acceptance of substrate conditions.

C. Do not allow resilient flooring work to proceed until substrates are satisfactory.

3.2. Preparation:

A. Substrates:
   1. Provide a full skim coat of cementitious levelling and patching compound at all floor surfaces that have been previously abated.
   2. At unabated floor surfaces use cementitious leveling and patching compounds as recommended by resilient flooring manufacturer for filling small cracks, holes, and depressions in subfloors.
   3. Remove coatings from substrates that would prevent adhesive bond, including curing compounds incompatible with resilient flooring adhesives.

B. Broom clean or vacuum surfaces to be covered.

C. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.3. General Installation Requirements:

A. Install resilient flooring using method indicated, in strict compliance with manufacturer's printed instructions. Extend resilient flooring into toe spaces, door reveals, and closets and similar openings.

B. Scribe, cut, and fit resilient flooring to permanent fixtures; built-in furniture and cabinets; pipes; outlets; and permanent columns, walls, and partitions.

C. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.

D. Install resilient flooring on covers for telephone and electrical ducts, and on similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly cement edges to perimeter of floor around covers and to covers.

E. Tightly cement resilient flooring to substrate without open cracks, voids, raising, or puckering at joints; telegraphing of adhesive spreader marks; or other surface imperfections.

3.4. Tile Installation:

A. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters.
B. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged if so numbered, or from same lot number or production run. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.
1. Lay tile square to room axis, unless otherwise indicated.
2. Lay tile in patterns as shown on the Drawings.

C. Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions.

3.5. Installation of Resilient Base:

A. Apply wall base to walls, casework, and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
1. Apply wall base to freestanding columns and attached pilasters in areas where resilient base is required.
2. On masonry surface or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

3.6. Installation of Miscellaneous Accessories:

A. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.7. Cleaning and Protection:

A. Perform the following operations immediately upon completion of resilient flooring:
1. Sweep or vacuum floor thoroughly.
2. Do not wash floor until time period recommended by resilient flooring manufacturer has elapsed, to allow resilient flooring to become well-sealed in adhesive.

B. Damp-mop floor, being careful to remove black marks and excessive soil. Remove excess adhesive or other surface blemishes, using appropriate cleaner recommended by manufacturer of resilient flooring product.

C. Protect flooring against damage during construction period to comply with directions of resilient flooring manufacturer. Protect against damage from rolling loads for initial period following installation by covering with plywood or hardboard. Use dollies to move equipment or furnishings across floors.
1. At VCT, apply protective polish (sealer and at least one coat of wax) to resilient flooring surfaces free of soil, excess adhesive and surface blemishes, unless manufacturer of resilient product recommends otherwise.
2. Cover resilient flooring with undyed, untreated building paper until inspection for substantial completion.

End of Section 09650
PART 1 - GENERAL

1.1. Work Includes

A. Base Bid.
   1. General Contractor provide:
      a. Painting work shown on the drawings and schedules, and herein
         specified, including surface preparation and field painting of the
         following:
          1) Exposed interior items and surfaces.
          2) Surface preparation, priming, and finish coats specified in this
             Section are in addition to shop priming and surface treatment
             specified in other Sections.
      b. Paint exposed surfaces whether or not colors are designated in
         "schedules", except where the natural finish of the material is specifically
         noted as a surface not to be painted. Where items or surfaces are not
         specifically mentioned, paint these the same as adjacent similar
         materials or areas. When color or finish is not designated, the Architect
         will select these from standard colors available for the materials system
         specified.
          1) Painting includes field painting of exposed bare and covered
             pipes and ducts (including color coding), hangers, exposed steel
             and iron work, and primed metal surfaces of mechanical and
             electrical equipment where the wall surfaces of the area are
             indicated to be painted.
          2) Paint walls behind cabinets, convectors, ventilators, and
             mechanical and electrical items in finished areas. Surface
             preparation and priming shall be included.
      c. Painting of Mechanical and Electrical Work: Limited to items exposed in
         equipment rooms and in occupied spaces.
          1) Color-code items in accordance with color schedules.
          2) Color-band and identify each component with the following:
             a) Flow arrows.
             b) Name.
          3) Mechanical items to be painted include, but are not limited to, the
             following:
             a) Piping, pipe hangers, and supports.
             b) Heat exchangers.
             c) Tanks.
             d) Ductwork.
             e) Insulation.
             f) Motors and mechanical equipment.
             g) Accessory items.
             h) Others as noted on drawings.
          4) Electrical items to be painted include, but are not limited to, the
             following:
             a) Conduit and fittings.
             b) Panelboards (wall mounted electrical panels).
      d. Do not paint prefinished items, concealed surfaces, finished metal
         surfaces, operating parts, and labels.
          1) Prefinished items include the following factory-finished
             components:
             a) Architectural woodwork and casework.
b) Lay-in acoustical ceiling tiles.
c) Finished mechanical and electrical equipment.
d) Light fixtures.
e) Distribution cabinets.

2) Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
a) Furred areas.
b) Ceiling plenums.
c) Pipe spaces.
d) Duct shafts.

3) Finished metal surfaces include the following:
a) Stainless steel.
b) Chromium plate.

4) Operating parts include moving parts of operating equipment and the following:
a) Valve and damper operators.
b) Linkages.
c) Sensing devices.
d) Motor and fan shafts.

5) Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
e) Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of the work.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01770 - Closeout Procedures
   2. Section 05120 - Structural Steel: Shop priming structural steel.
   3. Section 05500 - Metal Fabrications: Shop priming ferrous metal.
   4. Section 06200 - Architectural Woodwork for shop priming exterior and interior architectural woodwork.
   5. Section 08110 - Metal Doors and Frames for shop priming steel doors and frames.
   7. Section 09720 - Wall Coverings for substrate sealer under wall coverings.
   8. Divisions 15 and 17: Painting of mechanical and electrical work is specified in Divisions 15 and 17, respectively.

1.3. References:

A. Publication Dates: Comply with standards in effect as of the date of the Contract Documents unless otherwise indicated.


C. PDCA (Painting and Decorating Contractors of America): P5 – Benchmark Sample Procedures for Paint and Other Decorative Coating Systems.

D. SSPC (Steel Structures Painting Council) - Surface Preparation Specifications
   1. SSPC - SP1 - Solvent Cleaning
   2. SSPC - SP2 - Hand Tool Cleaning
   3. SSPC - SP3 - Power Tool Cleaning
4. SSPC - SP6 - Commercial Blast Cleaning
5. SSPC – SP10 – Near-White Blast Cleaning

1.4. Definitions:

A. Drawdown: Color sample produced by a paint shader. This is created by placing roughly a tablespoon of paint on Leneta form WD plain white coated cards. Drawdowns shall be created using a 4 mil. WFT drawdown bar. The bar is pulled across the paint to produce a smooth parabolic-shaped sample of color.

B. Gloss: Conform to ASTM D 16 for interpretation of terms used in this section.
   1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85° meter.
   2. Eggshell refers to low-sheen finish with a gloss range between 5 and 20 when measured at a 60° meter.
   3. Satin refers to low-sheen finish with a gloss range between 15 and 35 when measured at a 60° meter.
   4. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60° meter.
   5. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60° meter.

C. Paint and Paint Materials: As used herein includes all coating systems materials, including primers, emulsions, enamels, lacquers, stains, sealers and fillers, and other applied materials whether used as prime, intermediate, or finish coats.

1.5. Submittals:

A. Submit in accordance with Section 01330:
   1. Product Data: For each paint system specified. Include block fillers and primers.
      a. Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use. Highlight the following:
         1) Type of resin.
         2) Dry film thickness.
         3) Volume solids.
         4) Units of sheen.
         5) Other performance or descriptive data required by Part 2 of this Specification.
         6) If the data listed above is not on the manufacturer’s printed data literature, provide the information in a letter of certification from the manufacturer.
   2. Schedule: Provide a schedule detailing each substrate in the same order as the schedule used in Part 3 of this Specification. Include the following:
      a. The specific products to be used for each coat.
   3. Documentation that the manufacturer has reviewed and approved each painting system.
      a. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
   4. Samples for Verification:
      a. Paint: Submit three 3-7/8” x 6” drawdowns of each product and color combination.
      b. Stained or Natural Wood: Provide three 4” x 8” samples of natural- or stained-wood finish on actual wood surfaces. Wood species and cut must match that which is to be used in the project.
      c. Concrete/Masonry Coatings (Stains): Provide three 4” x 8” samples of concrete and/or masonry. Samples of concrete and masonry must
match that which is to be used in the project. Include mortar joint with masonry samples.
d. Label each card or sample with the following:
1) Project name.
2) Date.
3) Product name.
4) Product number.
5) Color number as stated in the color schedule.
6) Name, address and phone number of the supplying facility.

5. Substrate Test Results and Substrate Acceptance, for Masonry, Plaster and Concrete substrates: Provide on Installer’s letterhead. Provide comparison of test results to manufacturer’s recommendations. Include a statement indicating acceptance of substrate conditions.

6. Qualification Data: At the request of the Architect/Engineer, provide documentation to demonstrate the required level of applicator qualifications as specified in the “Quality Assurance” Article in this Specification to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

B. Submit in accordance with 01770:
1. Provide one drawdown of each paint finish and one wood sample for each stained or natural wood finish utilized on this project. Label each as indicated above.

1.6. Quality Assurance

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance. Provide a list of successful projects including a contact list if requested.
1. Maintain throughout duration of the work a crew of painters who are fully qualified to satisfy requirements of the specifications.

B. Single Source Responsibility:
1. To the maximum extent practicable, select a single manufacturer to provide all materials required by this section, using additional manufacturers to provide systems not offered by the selected principal manufacturer.
2. For each individual system: Provide primer and other undercoat paint produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and use only within recommended limits.

C. Inspection Agency: The Owner reserves the right to employ an independent testing agency to verify acceptability of substrates and test coating quality, dry mil thickness, and conformance to application requirements.

1.7. Delivery, Storage, and Handling:

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
1. Product name or title of material and manufacturer's name.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Assign a suitable area to the Painting Subcontractor for mixing and storing materials.
1. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

2. Protect from freezing. Remove frozen or damaged materials from the job site. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.8. Project Conditions:

A. Comply with paint manufacturer’s written recommendations for temperature, moisture, humidity, and ventilation conditions. These conditions must be maintained and monitored throughout the application and drying process. Where the manufacturer does not have written recommendations, comply with the following:
1. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50° and 90° F.
2. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45° and 95° F.
3. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5° F above the dew point; or to damp or wet surfaces. Avoid painting surfaces while they are exposed to full sun.
   a. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.
4. Provide continuous ventilation and heating to prevent accumulation of hazardous fumes and to maintain surface and ambient temperatures above 45° F. for 24 hours before, during, and for 48 hours after application of finishes.

B. Material Safety Data Sheets (MSDS) for the materials utilized shall be kept on site at all times.

PART 2 - PRODUCTS

2.1. Manufacturers:

A. Products: Subject to compliance with requirements, provide the products in the paint schedules.

B. Paint Manufacturers:
1. Materials, paint numbers, and trade names specified are used to indicate type and quality of materials required.
2. Unless otherwise approved in advance in writing by the Architect or as otherwise specified, all painting materials shall be the products of one or more of the following manufacturers:
   a. B. Moore Benjamin Moore & Co., Montvale, NJ
   b. Chemprobe Chemprobe Corporation, Garland, TX
   c. Hydrozo Hydrozo Coatings Co., Lincoln, NE
   d. ICI ICI Paints, Cleveland, OH
   e. L&M L&M Construction Chemicals, Inc, Omaha, NE
   f. MAB M.A. Bruder & Sons, Inc., Philadelphia, PA
g. P&L Pratt & Lambert, Inc., Chicago, IL
h. Pittsburgh PPG Architectural Finishes, Inc., Pittsburgh, PA
i. ProSoCo ProSoCo, Inc., Kansas City, KS
j. SW Sherwin-Williams Company, Cleveland, OH
k. Thompson E.A. Thompson Co., Memphis, TN
l. Tnemec Tnemec Company, Inc.

3. No claim by Contractor concerning unsuitability of any material specified, or his ability to produce first class work with same, will be entertained unless such claim is made in writing to the Architect prior to starting the work.

C. Manufacturer's products which comply with coating qualitative requirements, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.

2.2. Paint Materials, General:

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Conform to materials specified in "Paint Materials Application Schedule" at end of this Section.

D. Deliver paint to the job site color-mixed except for tinting of undercoats and possible thinning.

E. Conform to paint manufacturer's recommendations for all thinning and tinting.

2.3. Colors and Finishes:

A. Color Pigments:
   1. Pure, nonfading paints to suit substrates and service indicated.
   2. Lead content: Not more than 0.06% lead, based on total nonvolatile (dry-film) weight. This limitation is extended to all surfaces readily accessible to children under seven years of age.

B. Surface treatments and finishes are indicated in the "Finish Schedules" of the Contract Documents.

C. Colors:
   1. Architect will issue a color schedule describing locations for colors selected.
   2. Provide color selections made by the Architect.

2.4. Primers:

A. Interior/Exterior:
1. Galvanized Metal Primer
   a. A single component acrylic vehicle formulated for use on galvanizing in mild industrial and commercial environments.
   b. Acceptable products/manufacturers:
      1) Devflex 4020PF DTM Int/Ext Waterborne Primer / ICI (Devoe)
      2) P04 Super Spec HP Acrylic Metal Primer / B. Moore
      3) Rust-O-Lastic Hydro Prime II / MAB
      4) DTM Acrylic Primer/Finish B66W1 / SW
      5) Pitt-Tech 90-708 Interior/Exterior Primer-Finish DTM Enamel / PPG

2. Modified Alkyd Rust Inhibitive Primer:
   a. A fast-dry brown or off-white, lead-free, rust inhibitive alkyd metal primer.
   b. Acceptable products/manufacturers:
      1) DevGuard 4360 VOC Compliant Metal Primer / ICI (Devoe)
      2) Alkyd Metal Primer M06 / B. Moore
      3) HydroPrime Acrylic DTM Maintenance Latex Primer (non-alkyd) / MAB
      4) Pro Industrial ProCryl Universal Primer B66_310 / SW
      5) 95-908,919 Fast Dry 35 Inhibitive Primers / PPG

B. Interior:
   1. Interior Latex Primer/Sealer
      a. A white pigmented internal vinyl acrylic latex primer.
      b. Acceptable products/manufacturers:
         1) Prep & Prime 1030 Interior Primer Sealer / ICI (Glidden)
         2) Moorcraft Super Spec Latex Enamel Primer Sealer 253 / B. Moore
         3) Rich-Lux Prime Fast / MAB
         4) ProGreen 200 Interior Latex Primer B28W600 / SW
         5) Speedhide 6-2 Interior Latex Primer-Sealer, White / PPG

2.5. Finishes:

A. Interior:
   1. Interior Latex-Eggshell
      a. A vinyl acrylic latex eggshell enamel for interior use.
      b. Acceptable products/manufacturers:
         1) Ultra-Hide Latex Eggshell 1412 / ICI (Glidden)
         2) Super Spec Latex Eggshell Enamel 274 / B. Moore
         3) Rich-Lux Eggshell / MAB
         4) ProGreen 200 Interior Latex Egg-Shel B20-600 Series / SW
         5) 6-411 Latex Eggshell / PPG
   2. Interior Non-Blocking 100% Acrylic Semi-Gloss
      a. Pencil Hardness (ASTM D3363): H or harder.
      b. Acceptable products/manufacturers:
         1) Devflex Waterborne Semi-Gloss 4206QD / ICI
         2) ProClassic Waterborne Acrylic Semi-Gloss B31W20 / SW
         3) Manor Hall Interior Semi-Gloss 87-6 Series / PPG
         4) IronClad Latex Low Lustre Metal & Wood Enamel 363 / B. Moore
         5) Rust-O-Lastic Low Sheen Acrylic DTM063 / MAB
   3. Interior Waterborne Acrylic Dryfall – Flat
      a. Flash rust-resistant, 100% acrylic coating designed to fall dry in 10 feet or less.
      b. Acceptable products/manufacturers:
         1) 1280 Spraymaster Pro Uni Grip WB Aquacrylic Primer/Finish / ICI
2) Super Spec Sweep-Up Spray Latex Flat V153 / B. Moore
3) Master Painters DryFall Latex Flat 013171 / SW
4) SuperTech DryFog 6-725XI / PPG

2.6. Wood Stains and Varnishes:

A. Interior:
   1. Interior Oil Penetrating Stain
      a. An alkyd based, non-masking, penetrating stain for interior use.
      b. Acceptable products/manufacturers:
         1) WB Interior 1700V Wood Pride (non-alkyd) / ICI (Glidden)
         2) Benwood Interior Wood Finishes Penetrating Stain 234 / B. Moore
         3) Rich-Lux Alkyd Wood Stain / MAB
         4) Wood Classics Interior Oil Stain - 250 A49-800 Series / SW
         5) Olympic Oil Based Wood Stain Low VOC 44500 / PPG

2. Interior Polyurethane Varnish – Semi-Gloss
   a. A durable, very high-film build, abrasion resistant, polyurethane based satin (hand-rubbed) clear finish.
   b. Acceptable products/manufacturers:
      1) WB Wood Pride 1802 / ICI (Glidden)
      2) Benwood Polyurethane Finish Low Lustre 435 / B. Moore
      3) Rich-Lux Urethane Wood Finish-Satin / MAB
      4) Wood Classics Waterborne Polyurethane Varnish A68F90 / SW
      5) Olympic Water Based Polyurethane Clear 42786 / PPG

2.7. Miscellaneous Materials:

A. Solvents, Thinners, and Cleaners: Shall be approved by paint manufacturer and meet applicable VOC requirements.

PART 3 - EXECUTION

3.1. Examination:

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements. Test surfaces as required.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. No priming or painting of wood will be permitted on or in building where concrete, masonry, plaster, or other "wet" operations are in process of installation, application, or drying.
   3. Do not apply finish coats on interior of building until all interior "wet" and dust producing work is complete and dry, and until heating and ventilating systems are in operation.
   4. If a surface cannot be prepared or painted as specified, notify the Architect immediately in writing.
   5. Start of painting will be construed as the Contractor’s and Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates.
   1. Examine the specifications for the various other trades and be thoroughly familiar with all of their provisions regarding painting.
2. Furnish information on characteristics of finish materials to other trades to ensure use of compatible primers.
3. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

C. Testing:
1. Moisture Content: Conduct moisture tests as required and as recommended by paint manufacturers. Do not apply paint if moisture content exceeds paint manufacturer’s recommendations.
2. Alkalinity: Test concrete, masonry and plaster surfaces for alkalinity as required and as recommended by paint manufacturers. If problems exist, take corrective action as recommended by paint manufacturers.
3. Compatibility: All existing painted surfaces that will be repainted shall be tested for compatibility of new coatings to be applied over existing.

D. Report and Acceptance: Submit test reports and statement indicating acceptance of substrate conditions.

3.2. Cooperation with other Trades:
A. Schedule and coordinate all work with other trades, and do not proceed until other work and/or job conditions are as required to achieve satisfactory results.
B. Perform painting work in proper sequence with work of other trades to avoid damage to finished work.

3.3. Workmanship:
A. Conform to paint manufacturer’s explicit recommendations and requirements in all aspects unless otherwise directed by the Architect.
B. Employ only skilled and experienced painters, working under the supervision of capable foremen. All workmanship must be of highest quality to the Architect's complete satisfaction. Apply all materials in accord with manufacturer’s current printed directions. Thin materials only for proper workability and only in compliance with such directions.

3.4. Preparation:
A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting. Remove, if necessary, for the complete painting of the items and adjacent surfaces. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified herein.
   1. Do not paint over scuffed surfaces.
   2. Patch holes, cracks, and other minor defects in surfaces as recommended by paint manufacturer. Bring all areas to true, even surfaces.

C. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Make sure all surfaces are free from dirt, dust, grease, moisture, and all other substances which might interfere with proper application and functioning of paint system.
1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
   a. Before painting is started in any area, broom clean and remove excessive dust.
   b. After painting begins in a given area, broom cleaning will not be allowed; cleaning shall then be done only with commercial vacuum cleaning equipment.

D. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
   1. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

E. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, rust, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
   1. Remove dirt and grease with an approved solvent (SSPC-SP1) and wipe dry with clean cloths.
   2. Remove rust, mill scale, and defective paint down to sound surfaces or bare metal by approved hand tool cleaning (SSPC-SP2) or power tool cleaning (SSPC-SP3) methods.
   3. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 6.
   4. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   5. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

F. Galvanized Surfaces:
   1. Prepare galvanized surfaces for painting by washing with suitable non-petroleum based cleaning solvents (SSPC-SP1) so surface is free of oil and surface contaminants.
   2. Do not use gasoline, benzine, and low-flash naphtha.
   3. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

G. Shop-Primed Metallic Surfaces: For shop-primed metallic surfaces such as door frames, access panels, fire extinguisher cabinets, etc. prepare for painting as follows:
   1. Thoroughly clean shop-primed surfaces as recommended by finish coat manufacturer.
   2. Abrade or de-gloss shiny or slick shop-prime coats.
   3. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

H. Plaster: Wash and neutralize high-alkali surfaces.

I. Brick - interior or exterior: Make surfaces free from dirt, loose-excess mortar, or foreign material by brush, air, or steam cleaning. Allow all brick to weather at least one year, followed by wire brushing to remove efflorescence. Treat surfaces to be painted with one coat of masonry conditioner as approved by the final coatings manufacturer.

J. Impervious Surfaces:
1. Remove mildew by scrubbing with solution of trisodium phosphate and bleach.
2. Rinse with clean water and allow surface to dry.

K. Insulated Coverings: Remove dirt, grease, and oil from canvas, cotton, and other insulated coverings to be painted.

L. Previously Coated Surfaces: Paint or touch up all surfaces to match new work as closely as possible. Put existing work to be repainted in condition to provide good adhesion and to receive paint by an approved method.

M. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.
4. Paint which is badly settled, caked or thickened in the container, or which cannot be readily dispersed with a paddle to a smooth consistency is unacceptable.

3.5. Application:

A. Project Conditions: Comply with paint manufacturer’s written recommendations for temperature, moisture, humidity, and ventilation conditions or as indicated elsewhere in this Section. These conditions must be maintained and monitored throughout the application and drying process.

B. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Provide application equipment adequate for the work and workmanship required herein.
2. The final coat of wall painting system shall be roller applied.
3. Provide adequate illumination in all areas where painting operations are in progress.
4. Provide and maintain scaffolding, staging, ladders, planks, and drop cloths required for proper execution of the work. Remove when no longer needed. If necessary, temporarily remove such items to avoid interference with work of other trades and relocate at no additional expense to Owner.
5. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

C. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
2. If undercoats, stains or other conditions show through the final coat of paint, apply additional coats until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
3. Provide finish coats that are compatible with primers used.
4. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications. Sand lightly between each succeeding enamel or varnish coat.

5. Painting includes all exposed surfaces of every member. Before installation, paint all parts which will be inaccessible after assembly.

6. Verify that all mixed colors match the color selection made by the Architect prior to application of the coating.

7. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

8. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer.

9. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

D. Priming, General:
1. Provide barrier coats over incompatible primers, or remove and reprime as required.

2. Priming includes all exposed surfaces of every member including all sides, edges and end cuts.

3. Apply a prime coat to material which is required to be painted or finished, and which has not been prime coated by others.

4. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

5. Utilize tinted primer if recommended by finish coat manufacturer.

6. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless touch-up work is not complete.

7. Before glazing, prime all rabbets and glazing stops.

8. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

9. Wood: Prime all wood to be painted immediately on delivery. Prime edges, cutouts, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling. Prime with primer for painted wood, stain and varnish for stained finish wood, and varnish for natural finish wood.

E. Interior and Exterior Painting:
1. Unless otherwise directed, paint items without factory finish, such as conduits, pipes, ducts, grilles, registers, vents, access panels, wire mold, and other items of similar nature to match adjacent wall or ceiling surfaces.

2. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.

3. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.

4. Before the final installation of fixed equipment and fixtures, paint surfaces behind them with prime coat.

5. Paint interior surfaces of ducts with a flat, non-specular (non-reflecting) black paint where visible through registers or grilles.

6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.

7. Wood: Trim installation: Putty used to cover holes or fasteners must be colored to match the finish carpentry and be top-coated with a minimum of one coat of
clear coat (varnish or polyurethane as specified) or paint finish, as appropriate. Final appearance of "exposed" fastening shall be barely detectable to the naked eye from a distance of 6' to 8'.

F. Interior Painting:

G. Stain: Adjust stain application technique as required to match and/or blend different work pieces. Utilize fillers on end-grain as required.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.

J. Eggshell Enamel Finishes: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

3.6. Touching-Up:

A. Touch up, repair, and repaint blemished, damaged, defaced, and otherwise inferior work.

B. Spot repairs must be primed before finish coats are applied.

C. If touch-up spot painting results are not acceptable to the Architect, repaint the defective surface at no additional cost to the Owner.

3.7. Field Quality Control:

A. Contractor will be required to replace all unsatisfactory work caused by improper or defective surfaces as directed, at no additional cost to Owner.

B. Completed Work must match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

C. Painted exterior and interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent. This list includes, but is not limited to, the following:
   1. Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
   2. Evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
   3. Evidence of blistering, peeling, scaling, streaks, and stains.
   4. Colors of all surfaces shall be free from fading.
   5. Damage due to touching before paint is sufficiently dry or any other contributory cause.
   6. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
   7. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
D. Painted surfaces shall be considered unacceptable if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces. This list includes, but is not limited to, the following:
1. Visible defects are evident on vertical or horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39”.
2. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
3. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

E. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:
1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:
   a. Quantitative material analysis.
   b. Abrasion resistance.
   c. Apparent reflectivity.
   d. Flexibility.
   e. Washability.
   f. Absorption.
   g. Accelerated weathering.
   h. Dry opacity.
   i. Accelerated yellowness.
   j. Recoating.
   k. Skinning.
   l. Color retention.
   m. Alkali and mildew resistance.
3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.8. Cleaning:

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
2. Repair any damage to painter's room.

3.9. Protection:

A. Protect work of other trades, whether being painted or not, against damage by painting and finishing work.

B. Protect all surfaces from damage and/or staining due to painting operations. Properly protect all painted and finished surfaces subject to damage or defacement due to other work on building. Contractor will be responsible for restoring, repairing, and/or replacing all work damaged by painting operations, or by his failure to provide and maintain proper protection from damage. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
C. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.10. Paint Materials Application Schedule – Interior Surfaces:

A. Drywall (Gypsum Wallboard) and Plaster
   1. Drywall
      a. Primer: One coat Interior Latex Primer/Sealer.
      b. Finish: Two coats Interior Latex – Eggshell
      c. Provide 2.5 mils dry film thickness, minimum.

B. Metal
   1. Galvanized Metal - Latex Finish
      a. Primer: One coat Galvanized Metal Primer.
   2. Steel, Miscellaneous, and Ornamental Iron (non-galvanized)
      a. Primer: One coat Modified Alkyd Rust Inhibitive Primer.

C. Wood
   1. Clear (Stained/Natural) Finish
      a. Stain and Primer: One coat Interior Oil Penetrating Stain and one coat Interior Polyurethane Varnish - Gloss.
      b. Finish: Two coats Interior Polyurethane Varnish - Semi-Gloss

D. Items not specifically mentioned above shall be coated with materials which are designed for the environment to which the items are exposed and the substrate to which the coatings are to be applied. The Architect shall be contacted prior to application.

End of Section 09910
DIVISION 10 – SPECIALTIES

SECTION 10110
VISUAL DISPLAY SURFACES

Part 1 - GENERAL

1.1. Work Includes:

A. Base Bid.
   1. General Contractor provide: Chalkboards, markerboards, and tackboards as shown on drawings, including all required accessories.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 01770 - Closeout Procedures
   3. Section 04200 - Unit Masonry
   4. Section 06100 - Rough Carpentry
   5. Section 09210 - Gypsum Board Assemblies

1.3. References:

A. All references are the current editions unless noted otherwise.

B. ANSI A208.1 - Mat Formed Wood Particleboard.


D. American Society for Testing and Materials (ASTM):
   1. ASTM A526 - Steel Sheet, Zinc-coated (galvanized) by the Hot-Dip Process, Commercial Quality.
   2. ASTM B209 - Aluminum-Alloy Sheet and Plate.
   4. ASTM C36 - Gypsum Wallboard
   5. ASTM 424 - Steel Sheets for Porcelain Enameling.
   6. ASTM C208 - Insulation Board (cellulose fiber) Structural and Decorative.

E. FS CCC-W-408 - Wall Covering, Vinyl-Coated.


G. FS L-P-1040 - Plastic Sheets and Strips, Polyvinylfloride.

H. Porcelain Enamel Institute - Performance Specifications for Porcelain Enamel Chalkboards and Markerboards.

1.4. Submittals:

A. Submit in accordance with Section 01330:
   1. Shop drawings: Indicating wall elevations, dimensions, and anchor details.
2. Product data: Data on chalkboards, markerboards and tackboards, 
tackboard surface covering, trim, and accessories. Include manufacturer's 
installation instructions.
3. Samples for initial selection: Manufacturer's color charts for chalkboard, 
markerboard, tackboard surfaces and trim. Minimum size of samples: 2"x2".
4. Samples for verification purposes: Submit actual samples of chalkboard, 
markerboard, tackboard surfaces and trim in previously selected 
colors/finishes. Provide 6" square samples of sheet materials and 6" lengths 
of trim members.

B. Submit in accordance with Section 01770:
1. O&M Data: At project closeout, provide maintenance instructions in the O&M 
manuals for each type of chalkboard, markerboard and tackboard supplied.
2. Materials: Place markerboard pens and erasers on markerboard tray in each 
room for Substantial Completion inspection.

1.5. Quality Assurance:
A. Where possible, furnish all chalkboards, markerboards and tackboards by one 
manufacturer for the entire project.
B. In addition to the requirements of these specifications, comply with manufacturer's 
instructions and recommendations for all phases of the work, including preparation of 
substrate, installation of grounds and anchors, and applications of materials.
C. Take field measurements prior to preparation of shop drawings and fabrication where 
possible to ensure proper fitting of the work.

1.6. Warranty:
A. Provide a 50 year manufacturer's written warranty agreeing to replace any 
chalkboards and markerboards that do not retain their original writing and erasing 
qualities, become slick, or exhibit crazing, cracking or flaking.

Part 2 - PRODUCTS

2.1. Porcelain Enamel Markerboards:
A. Product/Manufacturer: The following products and manufacturers, provided they 
comply with the requirements of the Contract Documents, are considered acceptable:
1. Vitracite / Claridge Products and Equipment, Inc.
3. Markerboard / Marsh Industries, Inc.
B. Provide the following for each markerboard:
1. Porcelain-on-Metal: Balances, high pressure laminated, 3-ply construction; 
with facing sheet, core and backing; complying with the following 
requirements.
2. Facing Sheets: 24 gauge porcelain enamel steel.
3. Provide manufacturer's standard special writing surface with gloss finish 
intended for use with liquid chalk markers.
4. Wearability Test Method - Comply with requirements of PEI Test CB-1 (+) 
established by Porcelain Enamel Institute, Inc.
6. Backing Sheet: Aluminum foil, 0.015" thick.
7. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.
8. Color: To be selected by Architect/Engineer from manufacturer's full range of colors.
9. Size: 4'-0" high x width as indicated on drawings.
10. Trim: Snap on anodized aluminum.
11. Mullions at Board Joints: "H" Type
13. Map Rail, 1" high, width to match markerboard include the following accessories:
   a. Extruded aluminum map rail with cork insert.
   b. Spring clip map hook - four pieces per markerboard.
   c. Roller brackets - four pieces per markerboard.
   d. End stops - two pieces per markerboard.
14. Marker Pens: One box of one dozen assorted colors.
15. Erasers: Provide two erasers, appropriate for the specified markerboard.

2.2. Sliding Visual Display Units:

A. Vertical-Sliding Visual Display Units: Factory-fabricated units consisting of extruded-aluminum tubular frame, fixed-rear visual display panel, and aluminum-framed vertical-sliding panels; designed for recessed mounting. Provide panels that operate smoothly without vibration or chatter.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AARCO Products, Inc.
      b. ADP Lemco, Inc.
      c. Aywon.
      d. Claridge Products and Equipment, Inc.
      e. Tri-Best Visual Display Products.
   2. Type: Tubular frame on top and two sides, with sides extending to floor; with kick panel to conceal sliding panels. Unit shall be designed to support panels independent of wall.
   3. Three-Track Units: Fabricate unit with fixed rear panel covering entire rear surface. Provide three sliding panels, each equal to not less than one-half of overall height of unit.
   4. Sliding Panels: Fabricated from not less than 3/8-inch thick, kraft-paper honeycomb core; designed to be rigid and to resist warpage.
      a. Fabricate sliding panels with 0.021-inch uncoated thickness, porcelain-enamel face sheets.
   5. Hardware: Manufacturer's standard, neoprene ball-bearing end rollers, four on each side of each sliding panel. Counterbalance each sliding panel with lead counterweights supported by steel aircraft cable over ball-bearing sheaves; with removable cover plate for access to counterweights. Provide rubber bumpers at top and bottom for each sliding panel.

2.3. Trim and Accessories:

A. Basic Requirements:
   1. Provide straight single-length units wherever possible and keep joints to a minimum.
   2. Miter corners to a neat, hairline closure.
   3. When structural support accessories are required in addition to normal trim, provide such additional support.

2.4. Fabrication:
A. Shop Assembly:
   1. Porcelain Enamel Boards: Fabricate each board from a single panel of material. Panel joints will not be permitted.
   2. Trim to be factory applied and feature concealed fasteners.

2.5. Visual Display Surface Schedule:

   A. Sliding Visual Display Unit:
      1. Vertical-Sliding Type: Three-track unit with tubular frame on top and two sides with kick panel.
      2. Fixed Rear Panel: Porcelain-enamel [High-pressure-laminate] markerboard assembly.
         a. Color: White
      4. Overall Width: As indicated on Drawings.
      5. Overall Height: 10'-0"
      6. Mounting Height: As indicated on Drawings.
      7. Factory-Applied Aluminum Trim: Manufacturer's standard
      8. Manufacturers' standard is clear anodic finish. Verify availability of other finishes with manufacturers and add color if required.
         a. Finish: Clear anodic.

   B. Accessories:
      1. Chalktray.

Part 3 - EXECUTION

3.1. Inspection:

   A. Examine the areas and conditions under which units are to be installed. Notify the Architect/Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

   B. Verify that substrate surfaces to receive units are true and plumb. Correct inadequate surfaces before installation of boards.

   C. Verify that moisture and temperature levels of substrate and environment have stabilized.

   D. Take field measurements prior to shop fabrication when necessary in order to ensure proper fitting of work.

3.2. Installation:

   A. Install boards in locations and mounting heights shown on the drawings and in accordance with the manufacturer's instructions. Provide all grounds, clips, backing materials, brackets and anchors, trim, and accessories for a complete installation.

   B. Install units with concealed hangers plumb and level, in accordance with the manufacturer's printed instructions.

3.3. Installation of Factory-Fabricated Visual Display Units:
A. Sliding Visual Display Units: Install units in recessed locations and at mounting heights indicated. Attach to wall framing with fasteners at not more than 16 inches o.c.
   1. Adjust panels to operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.4. Protection and Cleaning:

A. Protection: Cover completed work with building paper or other covering recommended by manufacturer until Substantial Completion.

B. Cleaning: Prior to Substantial Completion, clean all tackboard, markerboard and chalkboard surfaces per manufacturer's cleaning instructions.

End of Section 10110
DIVISION 10 – SPECIALTIES

SECTION 10440
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1. Work Includes:
A. Base Bid.
   1. General Contractor provide: Provide fire extinguishers, cabinets, and accessories where shown on the drawings.
      b. Provided Bracket Mounted Fire Extinguisher at all other locations unless otherwise noted.

1.2. Related Work:
A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 06100 - Rough Carpentry
   3. Section 09210 - Gypsum Board Assemblies
   4. Section 09910 - Paints and Coatings

1.3. Submittals:
A. Submit in accordance with Section 01330:
   1. Submit Manufacturer's technical data and installation instructions for all fire extinguishers and accessories. Include physical dimensions, operational features, color and finish, wall mounting brackets with mounted measurements, anchorage details, rough-in measurements, location, and details.
   2. Submit certification that fire extinguishers comply with classifications and requirements.

1.4. Quality Assurance:
A. Furnish all fire extinguishers and brackets by one manufacturer. Furnish all specified fire extinguisher cabinets by one manufacturer.
B. Regulatory Requirements:
   1. Applicable Codes:
   C. Tests by independent agencies whose classifications and requirements have general acceptance as regulatory and are acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1. Fire Extinguishers:
A. Provide new fire extinguishers for each location shown on drawings, labeled and approved by acceptable testing agency.
B. Fill extinguishers in accordance with requirements for A, B, C classifications.
C. Provide multi-purpose dry chemical, minimum 4A: 60B: C classification; 10 lb. capacity; in steel container with pressure indicating gauge, for Classes A, B, C fires. Fire extinguisher finish shall be red enamel.
   1. A10T / Ansul
   2. B441 / Amerex
   3. MP 10 / Larsen
   4. Cosmic 10E / J. L. Industries
   5. 3010 / Potter-Roemer, Inc.


2.2. Fire Extinguisher Cabinets:

A. Provide cabinets, each suitable for housing one (1) 10 lb. size dry chemical fire extinguisher as listed above.
   1. Provide fire-rated cabinets where cabinets are recessed into fire-rated construction.

B. Cabinet, door and trim to be fabricated of the following minimum steel gauges.
   1. Box and Flange - 20 gauge.
   2. Door panel - 20 gauge.

C. Construction:
   1. One piece cold rolled steel box with flange extending around the box outside the wall, mitered, welded & buffed smooth.
   2. Continuous hinges of material matching the door & trim.
   4. Satin finish or zinc plated pull handle with self-adjusting roller catch.

D. Size: Approximately 10-1/2" W x 24" H x 6" deep.

E. Finish: Baked white enamel interior and exterior.

F. Multi-purpose (Type A:B:C) fire extinguisher cabinets:
   1. Semi-recessed product/manufacturer:
      a. 2409-6R-Vertical Duo (acrylic)/Larsen
      b. Ambassador 1017V10 (acrylic)/J. L. Industries
      c. 7023-DV-6 (acrylic)/Potter-Roemer, Inc.

2.3. Brackets:

A. Brackets shall be designed and sized to securely hold the fire extinguishers specified.

B. Brackets shall support the fire extinguisher from the bottom and have a strap or other means to securely hold the extinguisher. Hook-type brackets will not be acceptable.

C. Brackets shall be steel; finish shall be red enamel.

D. Multi-purpose (Type A:B:C) fire extinguisher brackets:
   1. 30865 / Ansul
   2. 862 / Amerex
   3. B-2 or 846/ Larsen
   4. MB-846 / J. L. Industries
   5. 3903 / Potter-Roemer
PART 3 - EXECUTION

3.1. Inspection:

A. Examine construction and conditions under which the fire-fighting devices are to be installed, and notify the Architect/Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Architect/Engineer.

3.2. Installation:

A. Install in locations indicated on drawings. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.

B. Install cabinets with the bottom of the cabinet interior at 2'-6". Install wall mounted fire extinguishers at 4'-6" to the top of the extinguisher, unless otherwise directed by the Architect/Engineer.

End of Section 10440
PART 1 GENERAL

1.1. Work Includes:

A. Base Bid
   1. General Contractor provide:
      a. Fume hoods as specified herein and as shown on the drawings.
      b. Lamps for fume hood light fixtures.
      c. Qualified independent Testing Agency to provide field quality control testing specified herein.
   2. Plumbing Contractor provide:
      a. Final connection of plumbing fixtures provided with hood.
   3. Ventilation Contractor provide:
      a. Final connection of fume hoods to ductwork and roof top fan units.
   4. Electrical Contractor Provide:
      a. Final connection of electrical utilities for fume hoods.

1.2. Related Work

A. Specified Elsewhere:
   1. Section 01 3300 - Submittal Procedures
   2. Section 01 4000 – Quality Requirements: Testing responsibility.
   3. Section 01 7700 - Closeout Procedures
   4. Section 12 3553.19 - Wood Laboratory Casework
   5. Division 22: Furnishing and installation of piping, drainline, traps, final connections and setting of sinks and fixtures.
   6. Division 23: Furnishing and installation of exhaust ductwork, transition(s), blowers and equipment, and final connection to fume hood(s).
   7. Division 26: Furnishing and installation of electrical wiring, conduit and/or electrical items and final connections.

1.3. Submittals

A. Submit in accordance with Section 01 3300:
   1. Shop Drawings: Indicate equipment locations, large scale plans, elevations, cross sections, rough-in and anchor placement dimensions and tolerances and all required clearances.
   2. Product Data: Submit manufacturer's data for each component and item of laboratory equipment specified including all plumbing and electrical fixtures. Include component dimensions, configurations, construction details, joint details, and attachments, utility and service requirements and locations.
   3. Samples: Submit three sets of 2” x 2” minimum samples of finish for fume hood, work surfaces and for other pre-finished equipment and accessories for selection by Architect/Engineer.
   4. Certificates:
      a. Fume Hood Pre-installation (Factory) Test Certificate: Submit test reports from an independent testing laboratory on each size and type of hood verifying conformance to test performances as specified in this Section.
      b. UL 1805 Certification: Certified by Underwriter's Laboratories.
      c. SEFA 8-1999 Certification for metal lab casework: Certified by an independent testing laboratory.
   5. Testing Agency qualifications.
B. Submit in accordance with Section 01 7700:

1. Operating and Maintenance Data.
2. Operating instructions to be inscribed on instruction plate to be attached to hood, as specified in Part 2 of this Section.
3. Written instructions in booklet form providing additional details on safe and proper operation and maintenance.
4. Professional quality video – minimum 15 minutes in length on proper hood usage.
5. Certificates:
   a. Fume Hood Post-installation (Field) Test Certificate: Prior to Substantial Completion, provide certified field test results showing that each installed fume hood meets the performance test as specified in this Section. Submit additional copies of certificates with Project Closeout materials (O&M manuals).

1.4. Quality Assurance

A. Single source responsibility: Fume hood casework, work surfaces, and other laboratory equipment and accessories shall be manufactured or furnished by a single laboratory furniture company.

B. Manufacturer Qualifications: Modern plant with proper tools, dies, fixtures and skilled workers to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:
   1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
   2. Ten installations of equal or larger size and complexity.
   3. UL 1805 Specification: Fume Hood must be Underwriters Laboratories subject 1805 classified. The 1805 standard covers electrical and mechanical hazards, investigates the flammability of materials and measures the effectiveness of airflow characteristics. Proper labeling must be affixed to the face of each fume hood indicating classification to the UL 1805 standard for Laboratory Fume Hoods. UL listing covering electrical components only or other listings that do not encompass all issues covered in UL 1805 is insufficient. All factory testing shall be performed in a U.L. certified test facility.
   4. SEFA 8-1999 Specification: Metal lab casework must comply with Scientific Equipment & Furniture Association (SEFA) 8 recommendations. All testing must be performed by an independent testing laboratory.

C. Installer Qualifications: Factory certified by the manufacturer.

D. Regulatory Requirements:
   2. NSF STD#49 – Photometric Method of Testing
   3. NIH03-112C – National Institute of Health Specification
   4. UL – Underwriters Laboratories
   7. SEFA LF-1 – Fume hood test.
   8. SEFA 8 – Metal lab casework.

E. Testing Agency: Qualified independent testing agency with not less than three years documented experience in performing the tests and inspections specified herein and acceptable to the Architect.

1.5. Delivery, Storage and Handling

A. General Contractor shall co-sign all shipments of equipment to himself and not to the Owner.
B. General Contractor shall pay all transportation and shipping charges, handling and unloading costs.

C. General Contractor shall be responsible for inspecting materials to determine if there is any damage resulting from shipment.

D. General Contractor shall protect finished surfaces from soiling and damage during storage, handling and installation. Keep covered with polyethylene film or other protective covering.

1.6. Sequencing/Scheduling
A. General Contractor shall coordinate exact fume hood locations with Architect/Engineer and Ventilation and Plumbing Contractors.

B. General Contractor shall keep other contractors advised regarding dates of delivery and installation of fume hoods.

C. Do not deliver or install equipment until the following conditions have been met.
   1. Windows and doors are installed and the building is secure and weather tight.

PART 2 - PRODUCTS

1.7. DYNAMIC BARRIER LOW CONSTANT VOLUME FUME HOODS
A. Acceptable Products/Manufacturers: The following products and manufacturers are acceptable provided they meet the requirements specified in this Section.
   2. Concept Fume Hood / Fisher Hamilton, Two Rivers, WI 54241.

B. Sash: Dual Vertical / Combination Sash System.

C. Width: As indicated on drawings, 48", 60" and 72".

1.8. FUME HOOD GENERAL DESIGN REQUIREMENTS
A. Laboratory fume hoods shall function as ventilated, enclosed work spaces, designed to capture, confine and exhaust fumes, vapors and particulate matter produced or generated within the enclosure.

B. Laboratory fume hoods shall provide safe operation when properly installed and connected to an exhaust system that provides the proper exhaust air volume to permit the fume hood to operate at the specified face velocity. Refer to Mechanical Drawings.

C. Average illumination of work area: Minimum 80 footcandles. Work area shall be defined as the area inside the superstructure from side to side and from face of baffle to the inside face of the sash, and from the working surface to a height of 28 inches.

1.9. Materials
A. Steel: High quality, cold rolled, mild steel meeting requirements of ASTM A366; gauges U.S. Standard and galvanized.

B. Stainless steel: Type 304; gauges U.S. Standard.
C. Ceiling closure panels: Minimum 18 gauge; finish to match hood exterior.

D. Bypass grilles: Low resistant type, 18 gauge steel, upward directional louvers.

E. Safety glass: 7/32” thick laminated safety glass.

F. Sash cables: Stainless steel, uncoated, 1/8” diameter military spec. quality. (MIL-W-83420D-3)

G. Sash guides: Corrosion resistant poly-vinyl chloride.

H. Pulley assembly for sash cable: 2” diameter, zinc dichromate finish, ball bearing type, with cable retaining device. (Nylon tires are not acceptable.)

I. Sash pull: Full width corrosion resistant plastic, stainless steel or steel with chemical resistant powder coating.

J. Gaskets: 70 durometer PVC for interior access panels. Gasket interior access panels to eliminate air leakage and to retain liquids inside hood.

K. Fasteners:
   1. Exterior structural members attachments: Sheet metal screws, zinc plated.
   2. Interior fastening devices concealed. Exposed screws are not acceptable. Screw head “caps” are not acceptable.
   3. Exterior panel member fastening devices to be corrosion resistant, non-metallic material. Exposed screws are not acceptable.

L. Instruction plate: Corrosion resistant or plastic plate attached to the fume hood exterior with condensed information covering recommended locations for apparatus and accessories, baffle settings and use of sash.

1.10. Fume Hood Construction

A. Superstructure: Rigid, self-supporting assembly of double wall construction, maximum 4-7/8” thick.
   1. Wall consists of a sheet steel outer shell and a corrosion resistant inner liner, and houses and conceals steel framing members, attaching brackets and remote operating service fixture mechanisms and services. Panels must be attached to a full frame construction, minimum 14 gauge galvanized members. Panels and brackets attached to eliminate screw heads and metallic bracketry from hood interior.
   2. Access to fixture valves concealed in wall provided by exterior removable access panels, gasketed access panels on the inside liner walls, or through removable front posts.

B. Exhaust outlet: Rectangular with ends radiused, shaped and flanged; 18 gauge stainless steel exhaust collars welded in place.

C. Access opening perimeter: Air foil or streamlined shape with all right angle corners radiused or angled. Bottom horizontal foil shall provide nominal 1” bypass when sash is in the closed position. Bottom foil shall be removable without use of special tools. Bottom foil shall provide access areas sufficient in size to pass though hospital grade electrical plugs. Bottom foil: Steel with urethane powder coating or stainless steel to increase acid and abrasion resistance. Air foil and sill to extend no more than 1.5” in front of work surface on non-auxiliary air hoods to provide maximum aisle space and allow deeper usage.

D. Ceiling Closure: Provide panels as specified herein above fume hoods; extend panels 4” minimum above finished ceiling.
E. Fume hood sash: Full view type with clear, unobstructed, side-to-side view of fume hood interior and service fixture connections.

1. Bottom sash rail: 2” maximum, 18 gauge steel with powder coating finish. Provide integral formed, flush pull the full width of bottom rail.
2. Set safety glass into rails in deep form, extruded poly-vinyl chloride glazing channels.
3. Counter balance system: Single weight, pulley, cable, counter balance system which prevents sash tilting and permits one finger operation at any point along full width pull. Maximum 7 pounds pull required to raise or lower sash throughout its full length of travel. Design system to hold sash at any position without creep and to prevent sash drop in the event of cable failure. Life cycle test 100 pound sash and weight to 100,000 cycles without sign of failure. Provide independent test data at request of Architect/Engineer.
4. Open and close sash against rubber bumper stops.
5. Sash Stops: Provide sash stops to stop sash at 18” above work surface. Sash stops shall allow manual release to fully open the sash for hood cleaning and for placing large apparatus within the hood.

F. Fume hood liner: Poly-resin Fiberglass: Reinforced polyester panel; smooth finish and white color in final appearance. Flexural strength: 14,000 psi. Flame spread: 15 or less per U.L. 723 and ASTM E84.

G. Baffles: Baffles providing controlled air vectors into and through the fume hood shall be fabricated of the same material as the liner. Provide minimal exhaust slots full height on vertical sides of the baffle with upper and lower slots adjustable. Provide fixed, permanently open horizontal slot 17” above the work surface. Minimum depth of 19” for interior work space is required at the extreme upper portion of the fume hood to provide maximum interior work area. All baffles, supports, and brackets to be non-metallic.

H. Remote baffle adjustment: Toggle style, one handed, single point control, accomplished while hood is in use, without disturbing apparatus, from outside right hand corner post of fume hood with sash in either the open or closed position, and permitting setting for (1) high thermal loading, (2) heavier than air gases for fumes generated near work surface, and (3) normal or average operation.

1. Remote adjuster: Toggle style control handle and an acid resistant label indicating proper control handle location for baffle function.
2. Rigidly correlate control handles to baffle positioner; cable-type adjustments are not acceptable.
3. Design baffle adjuster to engage and disengage from the adjustable baffle without the use of tools.
5. Baffles providing no adjustment or requiring internal manipulations are not acceptable.

I. Fume Hood Plumbing:

1. Plumbing services shall consist of remote control valves as selected located within the end panels, controlled by extension rods projecting through the control panels of the hood, with color coded plastic handles. All plumbing fittings shall be factory installed and piped between the valve and the outlet. Inlet piping shall have a single-point connection for each valve provided and carried to a point 1” above the fume hood roof or 1” above the worktop rear corner depending on the rough-in locations shown in the drawings. Points of final service connection by the Plumbing Contractor shall be at the stub provided by the fume hood manufacturer.
a. Interior fittings for gases and water shall be nylon panel flanges and angle serrated hose connectors, color coded.

1) Fittings for hot and cold water must have vacuum breakers.

b. Interior fittings for distilled water shall consist of a brass tin lined, color-coded, panel flange and angled serrated hose connector.

c. Interior fittings for de-ionized water shall consist of PVC, a color-coded panel flange and angled serrated hose connector.

d. Interior fittings for steam shall consist of a cast brass flange and angled serrated hose connector with a chemical resistant metallic brass finish.

e. Water goosenecks shall be cast brass with a chemical resistant metallic brass finish.

2. Service Outlets Identification: Provide colored plastic index discs with embossed identification letters at each service fixture handle or knob. Secure discs to fixture handles to be virtually tamperproof. Color-code discs as follows:

<table>
<thead>
<tr>
<th>Service</th>
<th>Button/Fixture Color</th>
<th>Letter Color</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Orange</td>
<td>White</td>
<td>AIR</td>
</tr>
<tr>
<td>Gas</td>
<td>Blue</td>
<td>White</td>
<td>GAS</td>
</tr>
<tr>
<td>Vacuum</td>
<td>Yellow</td>
<td>Black</td>
<td>VAC</td>
</tr>
<tr>
<td>Cold Water</td>
<td>Green</td>
<td>White</td>
<td>CW</td>
</tr>
<tr>
<td>Hot Water</td>
<td>Red</td>
<td>White</td>
<td>HW</td>
</tr>
<tr>
<td>Steam</td>
<td>Black</td>
<td>White</td>
<td>STM</td>
</tr>
</tbody>
</table>

3. Cupsinks

a. Size: 3" x 9"

b. Material: Black molded epoxy resin

c. Location: Where shown on Drawings, [One per fume hood, at [rear] [left hand] [right hand] corner] .

d. Outlet: 1-1/2" diameter molded epoxy resin with tailpiece. Provide “back” tailpiece on cupsinks located at front of fume hoods to prevent interference with base cabinets.

J. Fume Hood Electrical:

1. The hood superstructure shall be pre-wired and contain a UL label certifying acceptable wire gauge, connections, fixtures and wire color coding. Wiring shall terminate in one service junction box located on the fume hood roof for a single-point connection. Final wiring and circuit dedication shall be by the Electrical Contractor.

a. Light Switch: One 20 amp, 120 volt AC single pole toggle switch in single gang box and stainless steel faceplate.

b. Duplex Receptacles: Two 20 amp, 120 volt AC, 3-wire polarized grounded with ground fault interruption in single gang boxes and stainless steel faceplates.

c. Light Fixture: Two lamp, rapid start, UL listed fluorescent light fixture with sound rated ballast installed on exterior of roof.

1) Interior of fixture: White, high reflecting plastic enamel.

2) Size of fixture: Largest possible up to 48" for hoods with superstructure up to six feet. Provide two 36” for hoods with eight foot superstructure.

3) Illumination: Per performance values as specified in this section.

4) Lamps: Lamps are furnished and installed by the General Contractor.

K. Work surfaces: 1-1/4" thick surface, dished a nominal one-half inch to contain spills.

2. Finish: Gray, non-glaring.

L. Provide sound-deadening construction in walls, at deck and ballast.

M. Safety Monitor/Alarm System: Where shown or specified provide Safety Monitor/Alarm System which monitors face velocity and provides audible and visual alarm if face velocity drops below safe levels. The technology used will be based on thermally compensated thermistor based in the alarm module. As the internal fume hood pressure changes as the sash opening is closed and opened, the flow passing over the thermistor is calibrated to a face velocity which is displayed on the front of the monitor.

1. Safety monitor: UL listed, tamper proof, with all alarm circuits, electric components, external tubing, and manifolds furnished complete and factory installed. The monitor shall have light emitting diode display which provides clear indication of airflow conditions.
2. Calibration: The set point is to be factory set and calibrated to approximately 70 FPM. Field calibration is possible with adjustment of recessed zero potentiometer on front of unit.
3. Airflow sensor: Thermally compensated glass-beaded thermistor, factory connected to a side-wall port on the interior of the fume hood.
4. Alarm Signal: Audible signal and a visual, red large light emitting diode.
   a. Silence pushbutton, which disables the audible alarm, shall be accessible on the front of the safety monitor.
   b. Provide alternate mode in which audible alarm is silenced indefinitely but visual alarm remains activated until the alarm condition is corrected.
   c. When alarm condition is corrected and face velocity and volume return to specified levels, the Safety Monitor will automatically reset and begin routine monitoring.
5. Provide test circuit to verify proper Safety Monitor operation.
6. Electrical rating: Maximum 12 VDC, and maximum current rating of 200MA.

N. Fume Hood Base Cabinets
1. General:
   a. Unless otherwise indicated, base units under hoods are specified in Section 12350, Wood Laboratory Casework.
   b. Accessibility: Where accessible workstations are indicated on drawings, provide base cabinets as shown with dimensions and configurations that comply with the “ADA Accessibility Guidelines” (ADAAG) and the “Illinois Accessibility Code”.

1.11. FINISHES

A. Metal Finish:

1. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.
2. Application: Electrostatically apply urethane powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Liquid dripped, solvent based finishes are not and will not be acceptable. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness:
   a. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.
   b. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.
3. Color to be selected by Architect/Engineer from manufacturer’s full range of standard colors.

B. Metal – Unexposed: Metal shall receive a baked-on coat of black acid-resistant finish.

1.2. Source Quality Control

A. Factory Testing:

1. All fume hoods shall be successfully factory tested by an independent testing laboratory before being installed and tested in the field. Production of the hoods specified herein shall not commence until the “Performance Test” has been successfully performed by the manufacturer. In general, the “Performance Test” will consist of the ANSI/ASHRAE 110 test procedure using a five minute trace gas challenge at a rate of four liters per minute. The PPM concentration outside the hood of a tracer gas released inside the hood will be measured utilizing a MiRAN 1A Gas Analyzer, or equivalent.

PART 3 EXECUTION

3.1. Inspection

A. Verify that ventilation outlets, service connections and supports are correct and in scheduled location.

B. Beginning of installation means acceptance of existing conditions.

3.2. Installation

A. Use anchoring devices for the materials encountered and the usage expected.

B. Installation:

1. Install fume hoods and equipment in accordance with manufacturer’s instructions.
2. Install equipment plumb, square, and straight with no distortion and securely anchored as required.
3. Secure work surfaces to casework and equipment components with material and procedures recommended by the manufacturer.

C. Insulate to prevent electrolysis between dissimilar metals.

D. Remove and replace equipment creating excessive noise or vibration.

E. Sequence installation and erection to ensure mechanical and electrical connections are achieved in an orderly and expeditious manner.

F. Securely attach access panels, but provide for easy removal and secure re-attachment.

3.3. Adjust and Clean

A. Repair or remove and replace defective work, as directed by Architect/Engineer upon completion of installation.

B. Adjust sash, fixtures, accessories and other moving or operating parts to function smoothly. Sash shall operate with single hand and with uniform contact with jambs.

C. Remove masking or protective covering from finished surfaces. Wash and clean equipment. Polish glass, plastic, hardware and accessories, fixtures and fittings. Clean glass on both sides.
3.4. Field Quality Control

A. General:

1. Test and balance to ensure equipment, including specified accessories, is operational.
2. Manufacturer’s representative shall do preliminary tests to ensure system works correctly before General Contractor schedules formal field testing mentioned in this section. Correct any unsafe conditions disclosed by these tests before scheduling field certification test.
3. Submit three operation and maintenance manuals during field test using them as an instructional aid.
4. Manufacturer’s representative shall be present at test to explain to Owner the complete operation of the fume hood before Substantial Completion.
5. Tests shall be performed in presence of Owner, Architect/Engineer and other personnel as needed.

B. The Testing Agency shall perform the following tests and inspections:

1. Field testing requirements:
   a. Perform tests in field to verify proper operation of the fume hoods before they are put in use, using only qualified personnel.
   b. Perform tests after installation is complete, the building ventilation system has been balanced, all connections have been made, and written verification has been submitted that the above conditions have been met.
   c. Verify that the building make-up air system is in operation, the doors and windows are in normal operating position, and that all other hoods and exhaust devices are operating at designed conditions.

2. Testing equipment:
   a. Properly calibrated hot wire thermal anemometer equal to Alnor Model No. 8500D-1 Compuflow.
   b. Supply of 30-second smoke bombs.
   c. Supply of titanium tetrachloride.

3. Test procedure – SEFA LF-1:
   a. Check room conditions in front of fume hood using a thermal anemometer and a smoke source to verify that the velocity of cross drafts does not exceed 20% of the specified average fume hood face velocity. Eliminate any cross drafts that exceed these values before proceeding.

   1) CAUTION: Titanium tetrachloride fumes are toxic and corrosive. Use sparingly; avoid inhalation and exposure to body, clothing and equipment that might be affected by corrosive fumes.
   2) NOTE: No fume hood can operate properly if excessive cross drafts are present.

   b. Perform the following test to verify conformance of actual fume hood face velocities to those specified. With the sash in full open position, determine the face velocity by averaging the velocity of six readings taken at the fume hood face: at the centers of a grid made up of three sections of equal area across the top half of the fume hood face and three sections of equal area across the bottom half of the fume hood face.
1) If not in accordance with specifications, refer to manufacturer’s Troubleshooting Guide for aid in determining cause of variation in air flow.

c. Check sash operation by moving sash through its full travel. Verify that sash operation is smooth and easy, and that vertical rising sash shall hold at any height without creeping up or down.

4. Field testing of air flow in fume hoods:

a. With sash in the open position check air flow into the fume hood using a cotton swab dipped in titanium tetrachloride or other smoke source. Verify that air flow is into the fume hood over the entire face area by a complete traverse of the fume hood 6” inside the face. Reverse flow is evidence of unsafe conditions. Take necessary corrective actions and retest.

b. Move a lighted smoke bomb throughout the fume hood work area directing smoke across the work surface and against the side walls and baffle. Verify that smoke is contained within the fume hood and rapidly exhausted.

C. Additional Tests: Testing Agency shall make additional tests when test results indicate that requirements have not been satisfied. This additional testing will be at the Contractor’s expense.

1. This Work will be considered defective if it does not pass inspections. Repair or replace deficient components and assemblies. Then reinspect as specified above.

D. Test Results: Provide certificate of test results for each fume hood. Submit certificates prior to Substantial Completion.

3.5. Protection

A. After installation, fume hoods shall be protected from damage as a result of continuing construction activities.

End of 11 5313
PART 1 GENERAL

1.1. Work Includes:

A. Base Bid
   1. General Contractor provide:
      a. Flammable Storage Cabinet as specified herein and as shown on the drawings.

1.2. Related Work

A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 01770 - Closeout Procedures
   3. Section 12350 - Wood Laboratory Casework

1.3. Submittals

A. Submit in accordance with Section 01 3300:
   1. Product Data: Submit manufacturer’s data for flammable storage cabinet. Include component dimensions and construction details.

B. Submit in accordance with Section 01 7700:
   1. Operating and Maintenance Data.
   2. Written instructions in booklet form providing additional details on safe and proper operation and maintenance.

1.4. Quality Assurance

A. Regulatory Requirements:
   1. UL – Underwriters Laboratories
   3. OOSH 29 CFR 1910.106
   5. SEFA 8 – Metal lab casework.

1.5. Delivery, Storage, and Handling

A. General Contractor shall co-sign all shipments of equipment to himself and not to the Owner.

B. General Contractor shall pay all transportation and shipping charges, handling and unloading costs.

C. General Contractor shall be responsible for inspecting materials to determine if there is any damage resulting from shipment.

2. Products

2.1. Flammable Storage Cabinets

A. Acceptable Products/Manufacturers: The following products and manufacturers are acceptable provided they meet the requirements specified in this Section.
   2. Uline Flammable Storage Cabinet, Self-Closing, 12 Gallon.
2.1. Flammable Storage Cabinet General Design Requirements

A. Flammable storage cabinets shall function as self-closing storage cabinets designed to contain flammable liquids.

B. Flammable storage cabinets shall include double wall construction.

C. Flammable storage cabinets to include sloped shelves to safely direct spills away from containers.

2.2. Flammable Storage Construction

A. Galvanized steel, 18-guage, with unitized weld construction.

   a. Solvent (Flammable) Storage Cabinets:
      1) Solvent storage cabinets shall be UL labelled and specifically designed for the storage of flammable and combustible liquids. Design and construct in accordance with OSHA regulations, FM, UL and NFPA 30 (National Fire Protection Association, Flammable and Combustible Liquids Code). Cabinets shall be Factory Mutual (FM) approved and Underwriters (UL) listed with UL/FM approval label affixed to inside of cabinet door.
      2) The bottoms, top, sides and doors shall be fabricated of 18 gauge steel and shall be all double panel construction with a 1-1/2” air space between panels.
      3) All joints shall be welded to provide a rigid enclosure.
      4) The doors shall swing on full-length stainless steel piano hinges and shall be fully insulated.
      5) Each door shall be equipped with a fusible-link hold-open feature that will ensure the door closes should the temperature outside the cabinet exceed 165 degrees Fahrenheit.
      6) A 2” deep liquid tight pan that covers the entire bottom of the cabinet shall be furnished to contain liquid leaks and spills.
      7) A full-depth adjustable shelf is also provided. The shelf is perforated to allow air circulation within the cabinet.
      8) Two diametrically opposed vents with spark screens are provided in the back of the cabinet as well as a grounding screw.
      9) The cabinet shall have interior finish same as exterior.
     10) The cabinet shall be labelled “FLAMMABLE – KEEP FIRE AWAY” in 2” high (minimum) durable letters of a color contrasting to the background.

2.3. Finishes

A. Metal Finish:
   1. Metal shall receive a bake-on coast of yellow acid-resistant finish.

3. Execution

3.1. Installation

A. Installation:
   1. Flammable storage cabinets include (4) level adjusting feet.
   2. Install flammable storage cabinets plumb and square to the adjacent laboratory casework.

3.2. Protection
A. After installation, flammable storage cabinets shall be protected from damage as a result of continuing construction activities.
DIVISION 12 - FURNISHINGS

SECTION 12362

WOOD LABORATORY CASEWORK

PART 1 - GENERAL

1.1. Work Includes:

A. Base Bid
   1. General Contractor Provide:
      a. Wood laboratory casework and associated components where indicated on the drawings.
      b. Deliver and install laboratory casework as shown on the drawings and specified herein, including cabinets, shelf units, sinks, service fixtures, and composition tops, and other units as indicated. The work shall also include all accessories, including hardware, glazing, scribe trim, filler pieces, reagent racks, enclosures for laboratory service drops, and similar accessories.
      c. Any special anchoring devices applied to the finished wall surfaces as required for installation of wall hung casework, as shown and specified.
      d. All necessary cutouts and openings for plumbing and electrical services where required for laboratory casework, and all filler panels and scribe strips as required where equipment abuts walls and at corners to obtain a completely enclosed assembly, including mastic sealer between tops and neoprene gasket between curbs and service shelves abutting walls.
      e. All laboratory plumbing fixtures and gas, air and vacuum outlets.
      f. Base storage cabinet for fume hood.

2. Plumbing Contractor Provide:
   a. Final connection of plumbing fixtures and service fittings provided with casework.

3. Electrical Contractor Provide:
   a. Final connection of electrical fittings provided with casework.

1.2. Related Work:

A. Specified Elsewhere:
   1. Section 01330 - Submittal Procedures
   2. Section 01770 - Closeout Procedures
   3. Section 06100 - Rough Carpentry
   4. Section 09650 - Resilient Flooring
   5. Division 15: Furnishing and installation of piping, drainline, traps, final connections and setting of sinks and fixtures.
   6. Division 15: Furnishing and installation of exhaust ductwork, transition(s), blowers and equipment, and final connection to fume hood(s).
   7. Division 16: Furnishing and installation of electrical wiring, conduit and/or electrical items and final connections.

1.3. Definitions

A. Exposed Surfaces:
   1. Surfaces visible when drawers and solid doors are closed.
   2. Surfaces visible behind clear glass doors.
   3. Interior surfaces of open units.
   4. Bottoms of cabinets 42” or more above finished floor.
   5. Tops of cabinets less than 78” above finished floor, or are visible from an upper floor or staircase after installation.
6. Front edges of cabinet body members visible through a gap greater than 1/8" with doors and drawers closed.
7. Surfaces visible when fixed appliances are installed.

B. Semi-Exposed Surfaces:
1. Surfaces visible when doors are open.
2. Bottoms of cabinets 30"-42" above finished floor.
3. All front edges of shelving behind doors.

C. Concealed Surfaces
1. Surfaces not normally visible after installation.
2. Bottoms of cabinets less than 30" above finished floor.
3. Tops of cabinets over 78" above finished floor which are not visible from an upper level.
4. Stretchers, blocking, components concealed by drawers.

1.4. Submittals

A. Submit in accordance with Section 01330:
1. Manufacturer’s data:
   a. Submit manufacturer’s data and installation instructions for each type of laboratory furniture unit. Manufacturer’s data to include detailed descriptions of cabinet construction and components, including cut sheets for service fixtures and equipment.
   b. Indicate by transmittal that a copy of each instruction has been forwarded to the installer.
2. Samples:
   a. Submit three sets of 6” x 6” wood finish color samples of manufacturer’s full range of colors for each type of specified wood.
   b. Submit three sets of 6” x 6” metal finish color samples of manufacturer’s full range of colors.
   c. Submit samples of epoxy resin top.
   d. Submit samples of casework pulls and hinges in specified finishes.
3. Shop Drawings:
   a. Submit shop drawings for laboratory furniture showing plans, elevations, ends, cross-sections, service run spaces, location and type of service fixtures with lines thereto. Show details and location of anchorages and fitting to floors, walls, and base. Include layout of units with relation to surrounding walls, doors, windows, and other building components.
   b. Coordinate shop drawings with other work involved.
4. Roughing-in Drawings:
   a. Locations of waste, vents, water supply, electrical outlets, etc. for this equipment are indicated on the equipment, mechanical and electrical drawings in their approximate locations. Obtain cuts and rough-in dimensions from mechanical and electrical trades for all work performed by the respective trades and coordinate with casework.
   b. Roughing-in drawings must be supplied in three copies, and one reproducible copy. After Architect/Engineer review, copies of the reproducible copy shall be distributed by the Contractor to the effected trades.
5. Certificates:
   a. Finish certification for wood lab casework: Certified by an independent testing laboratory.

B. Submit in accordance with Section 01770:
1. Operating and Maintenance Data: At project closeout, provide operations and maintenance instructions in the O&M manuals for casework, tops and equipment, including the maintenance of finishes and schedule of preventative maintenance.

2. Operations Equipment: Turn over to the Owner any special tools, keys and materials required for the operation/use of the casework/equipment. Include letter of transmittal signed by Owner in O&M manual.

1.5. Quality Assurance

A. The Contractor shall be responsible for taking field dimensions required for the proper fitting of his equipment. If any discrepancies exist between the drawings and the field dimensions, the Contractor shall, in writing, report this condition to the Architect or his representative and shall not proceed with that portion of the work in question until all discrepancies are clarified.

B. Comply with all provisions of specifications for the design, quality testing, manufacturing and installation of laboratory furniture and specified equipment.

C. Single source responsibility: Lab casework, work surfaces, and other laboratory equipment and accessories shall be manufactured or furnished by a single laboratory furniture company.

D. Manufacturer Qualifications: Modern plant with proper tools, fixtures and skilled workers to produce high quality laboratory casework and equipment, and shall meet the following minimum requirements:
   1. Five years or more experience in manufacture of laboratory casework and equipment of type specified.
   2. Ten installations of equal or larger size and complexity

E. Installer Qualifications: Minimum of 5 years experience in the installation of laboratory equipment specified herein. Upon request of Architect/Engineer, Installer shall furnish a list of comparable projects including Owner contact information.

F. All electrical devices and materials shall be Underwriter’s Laboratories (U.L.) listed.

1.6. Product Delivery, Storage and Handling

A. Contractor shall consign all shipments to himself and not to the Owner.

B. Contractor shall pay all transportation and shipping charges, handling and unloading costs.

C. Contractor shall be responsible for inspecting delivered materials to determine the presence of damage during shipment.

D. Contractor shall protect finished surfaces from soiling and damage during storage, handling and installation. Keep covered with polyethylene film or other protective covering.

1.7. Job Conditioning

A. Conditioning: Do not install woodwork until the specified temperatures and relative humidity have been stabilized and will be maintained in installation areas.
B. Maintain temperature and humidity in installation area to maintain moisture content of installed casework within a 1.0% tolerance of the optimum moisture content, from the date of installation through the remainder of the construction period.

1.8. Warranty

A. The manufacturer shall from two years from date of Substantial Completion, warrant all parts of product manufactured and finished against manufacturing defects in material and workmanship. Any such parts which under normal use prove defective within one year from date of shipment, will be repaired or replaced without charge to the Owner.

PART 2 - PRODUCTS

2.1. Acceptable Styles and Manufacturers (Full Overlay Casework):

A. The following models and manufacturers, provided they comply with the requirements herein, will be considered acceptable:

2.2. Casework Materials:

A. Materials: Materials used for construction of cabinets and tables shall meet or exceed the specifications in this Section:
   1. Solid lumber shall be hardwood, clear and sound, free from checks and case hardening defects. Air-drying for one year shall precede kiln drying. Lumber shall be kiln-dried to a moisture content of 4%, then returned to a 6% moisture content by weight for fabrication. Thickness as called for in the construction specifications shall be the final dimension after machining and sanding.
      a. Exposed solid lumber shall be select for compatible grain and examined to eliminate mineral stains: Hard Maple, Grade I, minimum.
      b. Unexposed solid lumber shall be hardwood, unselected for grain and color, suitable for the intended purpose.
   2. Plywood shall be of the thickness, number of plies and grade required for each part and location in case. All plywood shall consist of core, cross-plies and face plies, glued under pressure with water-resistant glues. All plywoods shall be solid core.
      a. Exterior finished surfaces and panels normally exposed in open front or glass front cases shall be:
         1) Plain-sliced Hard Maple veneer, (no heartwood), grade A. Book matched only.
      b. Semi-exposed: Same species as specified for exposed face veneer, grade 1 for maple. Birch, poplar or other hardwoods or softwoods are not acceptable.
      c. Unexposed: Same species as specified for exposed and semi-exposed veneer, grade at option of manufacturer. Birch, poplar or other hardwoods or softwoods are not acceptable.
      d. Particleboard and chipboard will not be considered as equal to plywood core or lumen core construction materials.
   3. Tempered hardboard (Masonite) shall be light colored “broomed” wood fibers, uniformly mixed and evenly pressed under heat and pressure for high internal bond strength with lignin and resin binders into smooth flat sheets.
   4. Glazing: Shall be 1/8” thick (nominal) tempered safety glass.
   5. Glue: Laminating – Type II water-resistant; assembly – Type III water-resistant.
   a. Minimum gauges:
      1) 20 gauge: Solid door interior panels, drawer fronts, scribing strips, filler panels, enclosures, drawer bodies, shelves, security panels and sloping tops.
      2) 18 gauge: Case tops, ends, bottoms, bases, backs, vertical posts, uprights, glazed door members, door exterior panels, knee space panels, reagent racks, vertical and horizontal pipe enclosures, and access panels.
      3) 16 gauge: Top front rails, top rear gussets, intermediate horizontal rails, table legs and frames, leg rails and stretchers.
      4) 14 gauge: Drawer suspensions, door and case hinge reinforcements and front corner reinforcements.
      5) 11 gauge: Table leg corner brackets and gussets for levelling screws.

7. Edgebanding: 3mm hardwood of same species as exposed face veneers.

2.3. Cabinet Construction – GENERAL

A. Fabrication of all wood laboratory furniture equipment shall evidence the combined efforts of the latest design and engineering practices and of skilled craftsmanship. Construction shall produce a high quality cabinet specifically designed for the laboratory environment. Construction shall be the full-frame type, with the framework of hardwood assembled in accordance with the best practices of the Wood Laboratory Furniture Industry, using mortise and tenon joints and reinforced with blocking, fasteners, and glue, using dovetails, dadoes, shouldering, and rabbets, in accordance with the requirements of the particular joint involved. All joints shall be glued under pressure. All exposed joints shall be closely fitted and tight. Construction shall provide dust-proof cabinet interiors with an overlap on all sides of the drawer fronts and swinging doors to completely cover the opening. All cabinets shall be integral units, completely factory-assembled and finished.

B. Each cabinet shall be complete so that units can be relocated at any subsequent time without requiring field application of finished ends or other such parts.

C. General Requirements for Full Overlay Casework: The cabinet shall be full overlay construction with ¾” thick door and drawer fronts. The door and drawer fronts shall occupy a plane extending ¾” past the plane of the front of the cabinet body. Edges of door and drawer fronts shall be square. The doors and drawer fronts shall overlay the face of the cabinet leaving minimal reveals between doors and drawers of approximately 1/8”. The exposed grain for doors shall run vertical and the exposed grain for drawer fronts shall run vertical and be matched to the door or drawer front above or below it.

2.4. Cabinet Components

A. Base Units:
   1. Cabinet ends: ¾” thick plywood (for both exposed and unexposed ends) with 3mm hardwood banding on front edges. Bore interior faces, as appropriate, for security panels, rails, and four rows of shelf support holes.
      a. No levelers required – wood shimming is acceptable.
   2. Top Frame
      a. Two-Piece Top Frame
         1) Horizontal front top rail: 1” x 3” solid hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
         2) Vertical back top rail: ¾” x 3-3/4” hardwood. Attach to cabinet ends with glued 8mm dowel joinery and screws.
         3) All screws shall be concealed. Exposed fasteners shall not be considered equal.
3. Intermediate rails:
   a. Front horizontal intermediate rail: $\frac{3}{8}'' \times 1\frac{1}{2}''$ exposed hardwood rail to be provided between doors and drawers. Secure to cabinet end panels with glued 8mm dowel joinery.

4. Toe space rail: 3 $\frac{3}{8}'' \times \frac{3}{4}''$ hardwood or 7-ply veneer core plywood, mounted between end panels with glued 8mm dowel joinery and metal fasteners, forming a 4'' high x 2 1/2'' deep toe space, closed to cupboard bottom.

5. bottoms: $\frac{3}{4}''$ thick plywood, set flush and joined to cabinet end panels with glued 8mm dowels on 96mm spacing and metal fasteners. Front edge to be banded with 3mm hardwood banding. Suspended units to be 1'' thick. Removable bottoms are not acceptable.

6. Backs:
   b. Drawer units: Removable 3/16'' thick hardboard split back panels, rabbetted into top rail.
   c. Sink units: Half-height, one piece 3/16'' thick hardboard, rabbetted into rear rail for easy removal from inside of cabinet.

7. Vertical dividers in combination cabinets: 1 1/2'' thick plywood panel (frames not permitted) glued and screwed in place, top and bottom, with 3mm hardwood banding on front edge.

8. Security panels: Hardboard panel rabbetted into front and rear rails and end panels, between drawers and above doors on units with locks.

9. Shelves (base units):
   b. Thickness: $\frac{3}{4}''$ thick for all shelves up to and including 30” wide, 1” thick for all shelves over 30” wide.

10. Drawer construction:
    a. Box: Four-sided drawer box with back, front and sides of 12mm (1/2” nominal) 9-ply Birch plywood with chemical-resistant finish and finished top edges. (Three-sided drawer box attached to outer drawer front is not acceptable.) Sides shall be joined by multiple dovetail at all four corners.
    b. Bottom: Nominal $\frac{1}{4}''$, inset into all four sides of drawer box and sealed with hot melt glue process around entire drawer bottom perimeter. Material to be tempered hardboard, smooth side up.

11. Door and removable drawer front construction:
    a. 3 ply $\frac{3}{4}''$ thick particleboard core plywood with 3mm hardwood banding on all four edges.

12. Fillers, kneespace panels, scribes, etc.: Shall be of same species and grade as adjacent exposed surfaces, either $\frac{3}{4}''$ thick veneer core plywood or lumber as required, with same stain and finish.

B. Wall, upper and tall cases:

1. Shall be manufactured with appropriate materials and joinery methods as specified for base units except as noted below.
2. Tops: 1” thick, 9-ply veneer core plywood with 3mm hardwood banding on front edge.
3. bottoms:
   a. Wall and upper case: 1” thick, 9-ply veneer core plywood with 3mm hardwood banding on front edge.
   b. Tall case: $\frac{3}{4}''$ thick, 7-ply veneer core plywood with 3mm hardwood banding on front edge. Bottom plywood kick rail 3 3/4” high joined to cabinet sides.

4. Backs: $\frac{3}{4}''$ thick veneered plywood with backs recessed 7/8” and set into top, bottom and ends, sealed with hot melt glue process around entire perimeter. Tempered hardboard is not acceptable.
5. Shelves: Veneer core plywood, 3mm hardwood banded on front edge, adjustable on 32mm centers.
   a. Solid door cabinets: ¾" thick, 7-ply, for all shelves up to and including 30" wide, 1" thick for all shelves over 30" wide.
   b. Open and glass door cabinets: 1" thick, 9-ply, for all shelves.
6. Door construction: ¾" thick, 3 ply particleboard core plywood with 3mm hardwood banding on all four edges.
7. Framed glass doors: Solid hardwood, ¾" x 2 ¾" frame stock machined to accept glass, mitered joints, extruded vinyl retaining molding to allow glass to be replaced without tools. With lipped overlay, meeting edges of pairs of doors to include overlapping astragals: right over left.
8. Unframed sliding glass doors: Glass as specified with edges ground, set in extruded aluminum shoe with integral pulls, nylon wheel assemblies and top and bottom extruded aluminum track. Provide rubber bumpers at fully opened and closed door position.

C. Hardware:

1. Standard drawer suspension: Full extension or overtravel, ball-bearing slides (nylon rollers are not acceptable), 100 lb. minimum dynamic load, zinc-coated on all drawers except file drawers. Suspension to feature hold-in detent to prevent drawer roll-out and bounce-back. Minimum slide models are as follows:
   a. Drawers up to 24" in width:
      1) 7432 / Accuride.
      2) 422.29.3 / Hafele.
      3) 4910 / Hettich.
   b. Drawers up to 42" in width:
      1) 3640 / Accuride.
      2) 422.07 / Hafele.
      3) 8520 / Hettich.
2. File drawer suspension: Full extension with overtravel, ball-bearing slides (nylon rollers are not acceptable), 150 lb. minimum dynamic load, zinc-coated. Suspension to feature hold-in detent to prevent drawer roll-out and bounce-back.
   a. Drawers up to 24" in width:
      1) 4034 / Accuride.
      2) A/E approved equal / Hafele.
      3) A/E approved equal / Hettich.
   b. Drawers up to 42" in width:
      1) 3640 / Accuride.
      2) 422.07 / Hafele.
      3) 8520 / Hettich.
3. Drawer and hinged door pulls: 5/16 wire type on 3" centers; Type 304 stainless steel with brushed finish.
   a. All pulls are mounted horizontally on drawers and vertically on doors.
   b. Drawers up to 24" wide shall have one pull. Drawers over 24" wide shall have two pulls.
4. Hinges: 5-knuckle, institutional style, hospital tipped, Type 304 stainless steel brushed finish.
   a. Provide minimum of two hinges for doors up to 48" high; three hinges for doors over 48" high.
5. Unit shelf supports: Metal pin and socket.
7. Elbow catches: Spring type with strike.
8. Locks, at all cabinet doors and drawers:
   a. 5-disc tumbler, chrome-faced, heavy-duty cam type lock.
   b. Keys shall be double bitted and can only be duplicated by a registered locksmith.
c. Provide 2 keys for each lock.
d. Each lock shall be keyed the same and master-keyed per Owner’s direction.

9. Label holders shall be Stainless Steel, 1-3/8” x 2-5/8”, pinned to drawer and door fronts.
a. Provide one on each drawer.

10. Bumpers/Silencers: All cabinet doors and drawer fronts shall feature a minimum of 2 non-marking resilient dome-shaped bumpers/silencers.

2.5. Table Frame:

A. Construction:
1. Perimeter table frame rails: ¾” x 4-5/16” hardwood with attached steel corner braces, grooved and screwed into both rails at each corner. Bottom rail edges to be radiused.
2. Reinforcing cross rails: ¾” veneer core plywood, doweled and glued and pinned into front and back rails, at intervals not more than 33” o.c. in tables without drawers.
3. Separate cross rails: ¾” x 4-5/16” hardwood with attached steel brackets at both ends.
4. Legs: 2” x 2” hardwood, with 3/8” – 16 x 3-1/2” hanger bolt inserted 1-3/4” into leg and fastened to perimeter rail corner brace.
5. Leg rails shall be provided for all table legs over 30” high: ¾” x 4-5/16” hardwood, mortised into legs and secured with 3/8” – 16 x 5” stove bolt.
6. Leg shoes: Black rubber or vinyl, open type to cover glides or floor clips. Provide floor glides. Shoes must have provision for floor clip (for anchorage of table to floor).

2.6. Finishes:

A. Wood.
1. All surfaces to be finished shall be sanded smooth, free from dirt, defects and mill marks resulting from fabrication prior to finish application.
2. All materials used in finishing shall be free of dirt and foreign matter, of superior quality, highly acid-resistant and shall be evenly applied under proper room conditions to insure a smooth satin luster finish.
3. Finish on all visible wood exteriors of cabinetry and tables shall consist of an application of stain of the required color, and, when thoroughly dried, shall receive two coats of sealer. The sealer coats, when thoroughly dried, shall be sanded to a smooth surface over which shall be applied two successive finish coats of a highly chemical-resistant catalyst type finish. The resultant finish shall be a smooth satin luster 4-coat finish.
a. Color to be selected by Architect/Engineer from manufacturer’s full range of standard colors.
4. The completed exterior finish shall withstand the following tests:
a. Chemical Resistance Test Procedure: Finished panels shall be oriented horizontally and vertically during exposure to the test chemicals. Chemical concentrations shall be adjusted by the volume method. Ambient temperature and chemical temperature shall be 68-72F. At the end of the test period, the surface shall be washed with detergent and warm water. Areas exposed to solvents shall be cleaned with a cloth dampened with the respective solvent. Prior to evaluation, 16-24 hours after the chemicals have been removed, the test surface shall be scrubbed with a damp paper towel and dried with paper towels.
1) Horizontal Test: Apply 5 drops of the acid, base or salt substance to correspondingly numbered areas of the surface to be tested. Position a 1” diameter watch glass in the liquid,
convex side downward. Solvents shall be applied by saturating a 1” ball of cotton, then covering with an inverted two-ounce wide-mouth bottle. Test duration shall be one hour.

2) Vertical Test: The test surface shall be marked to indicate divisions; 12” high, ¾” wide, and numbered to identify the chemicals. Five drops of each substance shall be applied to its respective numbered area in a vertical track pattern to prevent crossover. Test duration shall be two hours.

b. Ratings:
1) Excellent – Indicates excellent to superior integrity of finish film. No effect or slight change in gloss and slight discoloration.
2) Good – Allows change of gloss or discoloration or slight swelling while retaining integrity of finish film.
3) Poor – Obvious and significant deterioration, including blistering, pitting, cratering, erosion and/or loss of finish material.

c. Test results (minimum requirements):

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<th>VERTICAL TEST</th>
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<td>21</td>
<td>Kerosene</td>
<td>Excellent</td>
</tr>
<tr>
<td>22</td>
<td>Sodium Hypochlorite, 5.25%</td>
<td>Excellent</td>
</tr>
<tr>
<td>23</td>
<td>Sodium Hydroxide, 25%</td>
<td>Excellent</td>
</tr>
<tr>
<td>24</td>
<td>Sodium Hydroxide, 35%</td>
<td>Excellent</td>
</tr>
<tr>
<td>25</td>
<td>Sodium Hydroxide, 40%</td>
<td>Excellent</td>
</tr>
<tr>
<td>26</td>
<td>Sodium Hydroxide, 50%</td>
<td>Excellent</td>
</tr>
<tr>
<td>27</td>
<td>Potassium Hydroxide, 40%</td>
<td>Excellent</td>
</tr>
<tr>
<td>28</td>
<td>Potassium Hydroxide, 45%</td>
<td>Excellent</td>
</tr>
<tr>
<td>29</td>
<td>Zinc Chloride Saturated</td>
<td>Excellent</td>
</tr>
<tr>
<td>30</td>
<td>Sodium Chloride Saturated</td>
<td>Excellent</td>
</tr>
<tr>
<td>31</td>
<td>Sodium Carbonate Saturated</td>
<td>Excellent</td>
</tr>
<tr>
<td>32</td>
<td>Glycerin</td>
<td>Excellent</td>
</tr>
<tr>
<td>33</td>
<td>Hydrogen Peroxide, 30%</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

5. Performance Test Results (Heat Resistance): Hot water (190°F - 205°F) shall be allowed to trickle (with a steady stream at a rate not less than 6 ounces per minute) on the finished surface, which shall be set at an angle of 45° from horizontal, for a period of five minutes. After cooling and wiping dry, the finish shall show no visible effect from the hot water treatment.

6. Performance Test Results (Moisture Resistance): A cellulose sponge (2” x 3” x 1”) shall be soaked with water and placed on the finished surface for a period of 100 hours. The sponge shall be maintained in a wet condition throughout the entire test period. At the end of the test period, the surface shall be dried and no visible effect shall be shown on the finish.

7. Performance Test Results (Impact Resistance): A one-pound ball (approximately 2” diameter) shall be dropped from a distance of 12 inches onto the finished surface of a ¾” thick plywood panel supported underneath by a solid surface. There shall be no evidence of cracks or checks in the finish due to impact upon close eye examination.

B. Metal Finish:

1. Preparation: Spray clean metal with a heated cleaner/phosphate solution, pretreat with iron phosphate spray, water rinse, and neutral final seal. Immediately dry in heated ovens, gradually cooled, prior to application of finish.

2. Application: Electrostatically apply urethane powder coat of selected color and bake in controlled high temperature oven to assure a smooth, hard satin finish. Liquid dripped, solvent based finishes are not and will not be acceptable. Surfaces shall have a chemical resistant, high grade laboratory furniture quality finish of the following thickness:
   a. Exterior and interior exposed surfaces: 1.5 mil average and 1.2 mil min.
   b. Backs of cabinets and other surfaces not exposed to view: 1.2 mil average.
3. Color to be selected by Architect/Engineer from manufacturer's full range of colors.

C. Metal – Unexposed: Metal shall receive a baked-on coat of black acid-resistant finish.

2.7. Sinks and Cupsinks:
A. Sinks shall be of one-piece cast construction using modified epoxy resins of same composition of laboratory tops. Sinks shall be non-glaring in a color to match Durcon "Graphite", shall be coved in all corners and sloped a minimum of 1° to drain outlet in bottom of sink.

B. Sinks shall be furnished in standard sizes as indicated below or the manufacturer’s closest size of equal or greater volume, as acceptable to the Architect/Engineer.
   1. Standard: 18"x15"x11"
   2. Accessible (1 per lab unless otherwise noted): 18"x15"x5"

C. Sink drains shall be located at back corner of sinks.

D. Sinks shall be drop-in type with integral mounting flange requiring no additional support.
   1. All sinks installed below tops shall have a non-hardening mastic to caulk joint between top of sink and top.

E. Sink fittings for epoxy resin sinks shall be one-piece molded modified epoxy resin. Outlet shall be designated to accept overflows, strainers and screw-on tailpieces.

F. Color: Match color of laboratory tops specified in this Section.

G. Traps shall be molded acid-resistant plastic similar to Lab Line Enfeld jar “P” type with adapter to connect resin sink outlet.

2.8. Laboratory Tops:
A. Tops shall be molded from a modified epoxy resin to provide optimum chemical resistance and physical strength. Tops shall be a homogenous material compounded and cured without a surface coating to provide a uniform finish that will resist acid, alkali and solvent materials.

B. Color: To match Durcon "Graphite"

C. Long tops shall be made up in sections as long as practicable with butt joints joined with an acid and alkali-resistant epoxy cement to render a smooth seam.

D. A drip groove shall be provided on the underside of all exposed horizontal edges in tops which have sinks.

E. Tops shall be securely fastened to table rails and base cabinetry with heavy-duty metal fastening devices or with ample screws where fastening devices are not feasible.

F. Tops and 4" high curbs shall be 1" thick with all exposed edges rounded to a 1/8" radius. Sink cutouts shall be smooth and finished to have 1/8" radius on top edge and 3/4" minimum corner radius.

G. Work Top Performance Requirements:
   1. Molded Epoxy Resin:
      a. Physical Properties:
         Flexural Strength (ASTM Method D790)= 15,000 PSI
         Compressive Strength (ASTM Method D695)= 30,000 PSI
         Hardness, Rockwell E (ASTM Method D785)= 100
Water Absorption (ASTM Method D570)% by weight, 24 Hours = 0.04
% by weight, 7 Days = 0.05
% by weight, 2 Hour Boil = 0.04
Specify Gravity = 1.97
Tensile Strength = 8,500 PSI

b. Performance Test Results (Heat Resistance): A high form porcelain crucible, size 0, 15 ml capacity, shall be heated over a Bunsen burner until the crucible bottom attains an incipient red heat. Immediately, the hot crucible shall be transferred to the top surface and allowed to cool to room temperature. Upon removal of the cooled crucible, there shall be no blisters, cracks or any breakdown of the top surface whatsoever.

c. Performance Test Results (Chemical Resistance): Tops shall resist chemical attacks from normally used laboratory reagents. Weight change of top samples submerged in the reagents* listed in the next paragraph for a period of seven (7) days shall be less than one-tenth of one percent, except that the weight change for those reagents marked with ** shall be less than one percent. (Tests shall be performed in accordance with ASTM Method D543 at 77°F).

*Where concentrations are indicated, percentages are by weight.

<table>
<thead>
<tr>
<th>Acetic Acid, Glacial</th>
<th>Iso-Octane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid, 5%</td>
<td>Kerosene</td>
</tr>
<tr>
<td>Acetone</td>
<td>Methyl Alcohol</td>
</tr>
<tr>
<td>Ammonium Hydroxide, 28%</td>
<td>Mineral Oil</td>
</tr>
<tr>
<td>Ammonium Hydroxide, 10%</td>
<td>Methyl Ethyl Ketone</td>
</tr>
<tr>
<td>Aniline Oil</td>
<td>Nitric Acid, 70%**</td>
</tr>
<tr>
<td>Benzene</td>
<td>Nitric Acid, 40%</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>Nitric Acid, 10%</td>
</tr>
<tr>
<td>Chromic Acid, 40%**</td>
<td>Oleic Acid</td>
</tr>
<tr>
<td>Citric Acid, 10%</td>
<td>Olive Oil</td>
</tr>
<tr>
<td>Cottonseed Oil</td>
<td>Phenol, 5%</td>
</tr>
<tr>
<td>Dichromate Cleaning Solution**</td>
<td>Soap Solution, 1%</td>
</tr>
<tr>
<td>Diethyl Ether</td>
<td>Sodium Carbonate, 20%</td>
</tr>
<tr>
<td>Dimethyl Formamide</td>
<td>Sodium Carbonate, 2%</td>
</tr>
<tr>
<td>Distilled Water</td>
<td>Sodium Chloride, 10%</td>
</tr>
<tr>
<td>Detergent Solution, 1/4%</td>
<td>Sodium Hydroxide, 50%</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>Sodium Hydroxide, 10%</td>
</tr>
<tr>
<td>Ethyl Alcohol, 95%</td>
<td>Sodium Hydroxide, 1%</td>
</tr>
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<td>Ethyl Alcohol, 50%</td>
<td>Sodium Hypochlorite, 5%</td>
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<tr>
<td>Ethylene Dichloride</td>
<td>Sulfuric Acid, 85%</td>
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<tr>
<td>Heptane</td>
<td>Sulfuric Acid, 30%</td>
</tr>
<tr>
<td>Hydrochloric Acid, 37%</td>
<td>Sulfuric Acid, 3%</td>
</tr>
<tr>
<td>Hydrochloric Acid, 10%</td>
<td>Toluene</td>
</tr>
<tr>
<td>Hydrogen Peroxide, 28%</td>
<td>Transformer Oil</td>
</tr>
<tr>
<td>Hydrogen Peroxide, 3%</td>
<td>Turpentine</td>
</tr>
</tbody>
</table>

NOTE: Dichromate cleaning solution is a formula from Lange’s Handbook of Chemistry.

d. Performance Test Results (Chemical Spot Tests – 24 Hours): Chemical spot tests shall be made by applying 10 drops (approximately ½ cc) or each reagent to the surface to be tested. Each reagent (except those marked **) shall be covered with a 1-1/2” diameter watch glass, convex side down to confine the reagent. Spot tests of volatile solvents marked ** shall be tested as follows: A 1” or larger ball of cotton shall be saturated with the solvent and placed on the surfaces to be tested. The cotton ball shall then be covered by an inverted 2-ounce, wide mouth
bottle to retard evaporation. All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire 24-hour test period and at a temperature of 77 degrees F + 3 degrees F. At the end of the test period, the reagents shall be flushed from the surfaces with water and the surface scrubbed with a soft bristly brush under running water, rinsed, and dried. Volatile solvent test areas shall be cleaned with a cotton swab soaked in the solvent used on the test area. Spots where dyes have dried shall be cleaned with a cotton swab soaked in alcohol to remove the surface dye. The test panel shall then be evaluated immediately after drying.

Ratings:
A = No effect or slight change in gloss
B = Slight change in color or marked loss of gloss.
C = Slight surface etching or severe staining.
D = Swelling, pitting, or severe etching.

<table>
<thead>
<tr>
<th>Reagents</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid, 98%</td>
<td>A</td>
</tr>
<tr>
<td>Acetone **</td>
<td>A</td>
</tr>
<tr>
<td>Ammonium Hydroxide, 28%</td>
<td>A</td>
</tr>
<tr>
<td>Carbon Tetrachloride**</td>
<td>A</td>
</tr>
<tr>
<td>Chloroform**</td>
<td>A</td>
</tr>
<tr>
<td>Chromic Acid, 60%</td>
<td>C</td>
</tr>
<tr>
<td>Chromic Acid, 40%</td>
<td>C</td>
</tr>
<tr>
<td>Dichromate Cleaning Solution ***</td>
<td>C</td>
</tr>
<tr>
<td>Dimethyl Formamide</td>
<td>A</td>
</tr>
<tr>
<td>Ethyl Acetate**</td>
<td>A</td>
</tr>
<tr>
<td>Ethyl Alcohol**</td>
<td>A</td>
</tr>
<tr>
<td>Formaldehyde, 37%</td>
<td>A</td>
</tr>
<tr>
<td>Formic Acid, 90%</td>
<td>A</td>
</tr>
<tr>
<td>Hydrochloric Acid, 37%</td>
<td>A</td>
</tr>
<tr>
<td>Hydrofluoric Acid, 48%</td>
<td>C</td>
</tr>
<tr>
<td>Hydrogen Peroxide, 28%</td>
<td>A</td>
</tr>
<tr>
<td>Methanol**</td>
<td>A</td>
</tr>
<tr>
<td>Methylpentyl Ketone**</td>
<td>A</td>
</tr>
<tr>
<td>Nitric Acid, 70%</td>
<td>B</td>
</tr>
<tr>
<td>Phenol, 85%</td>
<td>A</td>
</tr>
<tr>
<td>Phosphoric Acid, 85%</td>
<td>A</td>
</tr>
<tr>
<td>Sodium Carbonate, 20%</td>
<td>A</td>
</tr>
<tr>
<td>Sodium Hydroxide, 40%</td>
<td>A</td>
</tr>
<tr>
<td>Sodium Hydroxide, 10%</td>
<td>A</td>
</tr>
<tr>
<td>Sodium Hypochlorite, 5%</td>
<td>A</td>
</tr>
<tr>
<td>Sulfuric Acid, 96%</td>
<td>D</td>
</tr>
<tr>
<td>Sulfuric Acid, 85%</td>
<td>A</td>
</tr>
<tr>
<td>Toluene**</td>
<td>A</td>
</tr>
<tr>
<td>Wrights Blood Stain</td>
<td>A</td>
</tr>
<tr>
<td>Xylene**</td>
<td>A</td>
</tr>
</tbody>
</table>

* Where concentrations are indicated, percentages are by weight.
** Indicates these solvents tested with cotton and jar method.
*** Dichromate cleaning solution is a formula from Lange’s Handbook of Chemistry.

2.9. Laboratory Furniture Performance Requirements:

A. Base Cabinets
   1. Cabinet Load Test
a. A 48” wide standing height combination cupboard and drawer cabinet shall be free-standing with installed countertop. Cabinet shall be capable of supporting a uniformly distributed load of 2,000 lbs. Door and drawer operation shall not be affected by the load.

b. Each adjustable and fixed shelf 4’ and shorter in length shall be capable of supporting a load of 40 lbs. per square foot up to a maximum of 200 lbs. with nominal temporary deflection, but without permanent set.

2. Cabinet Door Test
a. An open door shall withstand a load of 200 lbs. applied directly at the outer edge of the door. Door shall be moved through a 180 degree arc and weight removed. Operation of door after test shall be normal without distortion that will cause binding of the door or hinges that will adversely affect operation of the door catch.

3. Life Cycle Test
a. Door hinge shall operate for 300,000 opening and closing cycles without a failure.

b. Positive door catch shall operate for 300,000 opening and closing cycles without a failure.

c. Drawer shall be tested and operated with a load of 100 lbs. for a minimum of 150,000 opening and closing cycles. After test, drawers shall operate freely without evidence of dragging or scraping.

2.10. Adjustable Open Wall Shelving with Standards

A. General: Provide open shelving on standards where indicated on the Drawings.

B. Shelf: 12” deep x 3/4” thick plywood shelf with select white maple finish to match cabinets.

C. Shelving Upright:
1. Construction: High strength, cold rolled steel
2. Mounting hardware: Per manufacturer’s recommendations
3. Spacing: As indicated on drawings, 32” o.c. if not noted.
4. Product: Kewaunee KF-01740-04
   a. Equal as approved by Architect.

D. Adjustable Shelf Bracket:
1. Construction: High strength, cold rolled steel with turned up lip.
2. Mounting hardware: Per manufacturer’s recommendations
3. Size: 12” Shelf
4. Product: Kewaunee M-0038-AD
   a. Equal as approved by Architect.

2.11. Service Fixtures:

A. General:
1. Provide units complete with washers, locknuts, unions, nipples and other accessories for positive mounted to supporting laboratory units. Include wall and deck flanges, escutcheons, and similar items required.

2. All laboratory service fixtures and safety equipment shall be the product of one service fixture manufacturer to assure uniform appearance and ease of maintenance of the laboratory facility. Remote control valves and fittings furnished with fume hoods shall be the product of the same fixture manufacturer.

B. Finish:
1. General: Laboratory service fixtures (except fittings inside fume hoods) and safety equipment shall have the following finish:
a. Polished Chrome Finish with Clear Epoxy Coating: Fixtures (except fittings inside fume hoods) have a polished chrome plated finish with clear epoxy coating. All exposed surfaces shall be polished and buffed, then electroplated with one layer of nickel and one layer of chrome. Each layer of plating shall completely cover all visible areas. Following plating, surfaces to be coated shall be thoroughly cleaned and degreased. Clear epoxy coating shall then be applied to all exposed surfaces and fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.

2. Fittings inside fume hoods shall have an epoxy finish color-coded to match the fixture service index color. Coating material shall be free flowing epoxy powder with a particle size of 35-70 microns. Surfaces to be coated shall be (a) polished or sandblasted to produce a uniform fine-grained surface and (b) immersed in a phosphoric acid cleaning solution to remove thoroughly all oil, grease and other foreign substances. Following cleaning, coating material shall be electrostatically applied to all exposed surfaces. After application, coating shall be fully baked to permit curing. Surfaces shall have a minimum coating thickness of 2 mils.

C. Finish Performance Requirements:

1. Chemical Resistance: All coating materials shall meet the following tests for chemical resistance:
   "Fume Test: Suspend coated samples in a container at least 6 cubic foot capacity, approximately 12" above open beakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively. After exposure to these fumes for 150 hours, the finish on the samples shall show no discoloration, disintegration or other defects.
   "Direct Application Test: Subject coated samples to the direct action of the reagents and solvents listed below at a temperature of 25 degrees C dropping from a burette at the rate of 60 drops per minutes for ten minutes. Finish on the samples shall not rupture, though slight discoloration or temporary softening is permissible.
   "Acetic Acid (98%) Lactic Acid (10%)
   "Acetone Methanol
   "Ammonium Hydroxide (28%) Methyl Alcohol
   "Amyl Acetate Methyl Ethyl Ketone
   "Amyl Alcohol Methylene Chloride
   "Benzene Mineral Oil
   "Butyl Alcohol Monochlor Benzene
   "Calcium Hypochlorite N-Hexane
   "Carbon Disulfide Naphthalene
   "Carbon Tetrachloride Nitric Acid (70%)
   "Chloroform Perchloric Acid (70%)
   "Chromic Trioxide Acid Phenol
   "Cresol Phosphoric Acid (75%)
   "Crude Oil Sea Water
   "Dioxane Silver Nitrate (30%)
   "Distilled Water Sodium Bichromate
   "Ether (Saturated)
   "Ethyl Acetate Sodium Carbonate (10%)
   "Ethyl Alcohol Sodium Chloride (20%)
   "Ethyl Ether Sodium Hydroxide (50%)
   "Formaldehyde (37%) Sodium Hypochlorite
Formic Acid (90%) Sodium Sulfide
Gasoline Sulfuric Acid (87%)
Glacial Acetic Acid (99.5%) Toluene
Glycerin Trichlorethylene
Hydrochloric Acid (38%) Turpentine
Hydrofluoric Acid (48%) Urea (Saturated)
Hydrogen Peroxide (5%) Xylem
Isopropyl Alcohol Zinc Chloride (Saturated)
Kerosene

D. Water Service Fittings:

1. Water service faucets and valves shall have renewable unit containing all working parts subject to wear, including replaceable stainless steel seat. Unit shall have serrations for position locking into valve body.
2. Gooseneck vacuum breakers: Brass forgings integral with gooseneck, with renewable seat and special design valve member for fine flow control. Vacuum breakers must be ASSE No. 1001 certified.
3. Goosenecks shall have separate 3/8” IPS coupling securely brazed to gooseneck to provide full thread for attachment of anti-splash outlet fittings, serrated tips and filter pumps.
4. All fixtures for water service shall meet the requirements of ANSI/ASME A112.18.1M-1989.
5. Water faucets and valves shall be fully assembled and individually tested at 80 pounds per square inch (PSI) water pressure.

E. Air, Gas, and Vacuum Systems Fittings:

1. Laboratory Ball Valves: Provide units with a forged brass body with removable serrated hose end and oversize lever-type handle. Valves shall have a chrome plated ball with integral stem and molded TFE seals. Ball valves shall be individually factory tested at 125 PSI air pressure and shall be rated to 75 PSI air working pressure. Ball valves shall be certified by the Canadian Gas Association (CGA) to comply with ANSI Z21.15 AND CGA 9.1.

F. Turrets for gas, air, vacuum, steam or water fixtures: “Round” type design, provided with brass shanks, locknuts and washers.

G. Handles for service cocks, faucets and remote controls: All fixtures shall have lever-type handles.

H. Service Outlets Identification: Provide colored plastic index discs with embossed identification letters at each service fixture handle or knob. Secure discs to fixture handles to be virtually tamperproof. Color-code discs as follows:

<table>
<thead>
<tr>
<th>Service</th>
<th>Button Color</th>
<th>Letter Color</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Orange</td>
<td>White</td>
<td>AIR</td>
</tr>
<tr>
<td>Chilled Water</td>
<td>Brown</td>
<td>White</td>
<td>CH</td>
</tr>
<tr>
<td>Cold Water</td>
<td>Green</td>
<td>White</td>
<td>CW</td>
</tr>
<tr>
<td>De-Ionized Water</td>
<td>White</td>
<td>Black</td>
<td>DI</td>
</tr>
<tr>
<td>Distilled Water</td>
<td>White</td>
<td>Black</td>
<td>DW</td>
</tr>
<tr>
<td>Gas</td>
<td>Blue</td>
<td>White</td>
<td>GAS</td>
</tr>
<tr>
<td>Hot Water</td>
<td>Red</td>
<td>White</td>
<td>HW</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Grey</td>
<td>Black</td>
<td>NIT</td>
</tr>
<tr>
<td>Steam</td>
<td>Black</td>
<td>White</td>
<td>STM</td>
</tr>
</tbody>
</table>
I. Laboratory Service Fixture Schedule: Furnish the following where shown or scheduled on Drawings.

1. Deck Mounted Fixtures:

   AIR  Turret with two ground key hose cocks @ 90°:
         L4200-132AWS; Watersaver Faucet Co.
         982-909-957-3KAGVCP; Chicago Faucet
         Equal as approved by Architect.

   CW/HW Gooseneck water mixing faucet with vacuum breaker at sinks:
          L411VB-BH; Watersaver Faucet Co.
          930-317CP; Chicago Faucet
          To match Watersaver fixture; T&S Brass

   GAS  Turret base with two ball valve hose cocks @ 90°:
         L4200-132AWS; Watersaver Faucet Co.
         982-909-957-3KAGVCP; Chicago Faucet
         Equal as approved by Architect.

   VAC  Turret base with two ball valve hose cocks @ 90°:
         L4200-132AWS; Watersaver Faucet Co.
         982-909-957-3KAGVCP; Chicago Faucet
         Equal as approved by Architect.

2. Curb/Panel Mounted Fixtures:

   AIR  Single ground key hose cock with panel flange:
         L4200-158WSA; Watersaver Faucet Co.
         986-WSV909AGVCP; Chicago Faucet
         Equal as approved by Architect.

   GAS  Single ground key hose cock with panel flange:
         L4200-158WSA; Watersaver Faucet Co.
         986-WSV909AGVCP; Chicago Faucet
         Equal as approved by Architect.

   VAC  Single ground key hose cock with panel flange:
         L4200-158WSA; Watersaver Faucet Co.
         986-WSV909AGVCP; Chicago Faucet
         Equal as approved by Architect.

2.12. Electrical Fixtures and Fittings:

   A. Electrical fixtures and fittings: Pedestal type, provided in strict accordance with the current edition of the National Electric Code of the National Fire Protection Association, and with requirements of all local regulatory authorities.

   1. Pedestal housings: Heavy "lustrebrite" corrosion resistant aluminum alloy polished to a chrome-like color.
      a. Pedestals: Provide with integral bases; low design for use on either single- or double-sided units, as indicated on Drawings.

2.13. Glassware Pegboards:

   A. Pegboard glassware drying rack.
1. Provide at locations indicated on Drawings.
2. Size: 30” w x 30” h
3. Board: To match Durcon “Graphite” epoxy resin finished on all exposed surfaces. Bevel exposed edges.
4. Drain Trough: Stainless Steel, No. 4 finish and 36” long PVC draw hose.
5. Pegs: 5” long, gray polypropylene. Do not bond pegs to board.

PART 1 EXECUTION

3.1. Inspection:
   A. Examination of Substrate and Conditions: Examine the substrates and the conditions under which the work of this Section is to be performed, and remedy any unsatisfactory conditions. Do not proceed with work under this Section until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2. Installation Casework:
   A. Install plumb, level, true and straight with no distortions. Securely anchor to building structure. Shim as required, using concealed shims. Where laboratory casework abuts other finished work, scribe and apply filler strips for accurate fit with all fasteners concealed where practicable.
   B. Base Cabinets: Fasten each individual cabinet to floor at toe space, with fasteners spaced 24” o.c. Bolt continuous cabinets together. Secure individual cabinets (where they do not adjoin other cabinets) with not less than two fasteners into floor.
      1. Where required, assemble units into one integral unit with joints flush, tight and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16”.
      2. Provide holes for mechanical and electrical work as shown or directed by trades involved.

3.3. Installation of Tops:
   A. Field Jointing: Where practicable, make in same manner as factory jointing using dowels, splines, adhesives, and fasteners recommended by manufacturer. Locate field joints as shown on accepted shop drawings, factory prepared so that there is no job site processing of top and edge surfaces.
   B. Secure epoxy tops to casework with materials and procedures recommended by the manufacturer.
   C. Workmanship: Abut top and edge surfaces in one true plane, with internal supports placed to prevent any deflection. Provide flush hairline joints in top units using clamping devices.
      1. Where necessary to penetrate tops with fasteners, countersink heads approximately 1/8” and plug hold flush with material equal in chemical resistance, color, hardness, and texture to top surface.
      2. After installation, carefully dress joints smooth, remove any surface scratches, clean and polish entire surface, including all exposed edges.
      3. Provide all holes and cutouts as required for mechanical and electrical service fixtures.
      4. Provide scribe moldings for closures at junctures of top, curb and splash with walls as recommended by manufacturer for materials involved. Use chemical resistant, permanently elastic sealing compound where recommended by manufacturer.
   D. Installation of sinks:
1. Sinks shall be set in chemical-resistant sealing compound, secured and supported per manufacturer’s recommendations.

3.4. Installation of service fixtures and accessories:
   A. Install in a precise manner in accordance with manufacturer’s directions. Turn screws to a flat seat; do not drive. Adjust moving parts to operate freely without excessive bind.

3.5. Adjusting:
   A. Adjust casework and hardware so that doors, drawers and other moving parts operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.6. Cleaning and Protection:
   A. Repair or remove and replace defective work as acceptable to the Architect/Engineer.
   B. Clean all surfaces as recommended by manufacturer.
   C. Touch-up as required and remove or refinish damaged or soiled areas, as acceptable to the Architect/Engineer.
   D. Clean sweep or vacuum the interiors of all drawers and cabinets.
   E. Provide necessary protective measures to prevent damage of casework and equipment from exposure to other construction activity until acceptance of the work by the Owner.

End of Section 12362
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Divisions 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:

1. The work under Division 15, Mechanical Work shall include all labor, services, materials and equipment and performance of all work required for the installation of all mechanical work as shown on the Drawings and herein specified in the following Sections.

2. Should there be any discrepancies or a question of intent, refer the matter to the AOR for decision before ordering any equipment or materials or before starting any related work.

3. Where work connects to that of another trade, or to piping or equipment in place, take measurements in the field to make connecting work come true and line up with the item being connected.

4. Minor items and accessories or devices reasonably inferable as necessary, to the complete and proper installation and operation of any system, shall be provided by the Contractor for such system whether or not they are specifically called for by the Specifications or Drawings.

5. The Drawings and Specifications are to be taken together. Work specified and not shown or work shown and not specified shall be performed or furnished as though mentioned in both Specifications and Drawings. If there is a discrepancy between the Drawings and Specifications as to the quantity or quality to be provided, the greater quantity or the better quality shall be provided.

1.3 DEFINITIONS

A. "Piping" includes, in addition to pipe, all fittings, valves, hangers, and other supports and accessories related to such piping.

B. "Ductwork" includes, in addition to ducts, all fittings, transitions, dampers, hangers and other supports and accessories related to such ductwork.

C. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.

D. "Exposed" means not installed underground or "concealed" as defined above.

E. "Invert Elevations" means the elevation of the inside bottom of pipe or duct.
F. "Mechanical Work" is all of the work in Division 15.

1.4 QUALITY ASSURANCE

A. Each major component of equipment to have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place.

B. Code Ratings, labels or other data which are die-stamped or otherwise affixed to the surface of the equipment shall be in visible location.

C. All equipment provided under Division 15 to perform with the least possible noise and vibration consistent with its duty. Quietness of operation of all equipment is a requirement. Any equipment, as determined by the Owner to be producing objectionable noise or transmitting noise or vibration to the building to be repaired or removed and replaced.

D. All workmanship shall be first class in every respect and shall be performed only by skilled mechanics.

E. Shutdown and Notifications:
   1. It is imperative that service interruptions on the various existing utilities be held to an absolute minimum. Wherever possible provide suitable temporary services or connections, where continuity of service for essential systems can be maintained by this means.
   2. Provide not less than 72 hours advance notice, in writing, that an interruption of service in any system is desired. Such notice shall identify the system or systems involved, and shall be submitted in duplicate, one copy of which will be signed and returned by the Owner's authorized representative stating whether the requested shutdown will be permitted or not.

F. Existing Utilities:
   1. Location of utilities as shown on the drawings has been determined from the best available information and is given for convenience; however, AOR does not assume responsibility in the event that during construction, utilities other than those shown may be encountered, and that the actual location of those which are shown may be different from the location as shown on the plans.
   2. Assume responsibility for interference with or damage to any existing utilities, and repair or replace same with the least possible delay.

G. Notify AOR of broken or open pipes discovered during construction.

H. Layout and establish the lines and levels necessary for work.

I. The following Standards shall be used where referenced by the following abbreviations:
   1. AABC: Associated Air Balance Council
   2. ADC: Air Diffusion Council
   3. AIA: American Institute of AORs
   4. AMCA: Air Moving and Conditioning Association
   5. ANSI: American National Standards Institute
   6. ARI: Air Conditioning and Refrigeration Institute
   7. ASE: Association of Safety AORs
   8. ASHRAE: American Society of Heating, Refrigeration and Air Conditioning AORs
   9. ASME: American Society of Mechanical AORs
10. ASTM: American Society of Testing and Materials
11. AWS: American Welding Society
12. CSA: Canadian Standards Association
13. EPA: Environmental Protection Agency
14. HIS: Hydraulic Institute Standards
15. IRI: Industrial Risk Insurers
16. IBR: Institute of Boiler and Radiator Manufacturers
17. MCAA: Mechanical Contractors' Association of America
18. NIST: National Institute of Standards and Testing
19. NEBB: National Environmental Balancing Bureau
20. NECA: National Electric Contractors Association
21. NEMA: National Electrical Manufacturers Association
22. NFPA: National Fire Protection Association
23. NSC: National Safety Council
24. OSHA: Occupational Safety & Health Administration
25. SBI: Steel Boiler Institute Industry
26. SMACNA: Sheet Metal and Air Conditioning Contractors National Association
27. TIMA: Thermal Insulation Manufacturers Association
28. UL: Underwriters' Laboratories

J. Project Certification:
1. Contractor shall submit a project certification, guaranteeing that this project was constructed and will operate in accordance with the performance requirements of the Drawings and Specifications. This certification shall be signed by a principal of the firm and shall be delivered to the AOR prior to final payment.

K. Drawings:
1. The Drawings are essentially diagrammatic in nature and show general arrangement of the equipment, piping, ductwork, accessories, etc. Because of the small scale of the Drawings, it is not possible to show all offsets, fittings, and accessories, which may be required. Carefully investigate the structural conditions, AORural Drawings, Equipment Drawings, and the finished conditions of the work and arrange such work accordingly, furnish any fittings, pipe accessories that may be required to meet such conditions.
2. Any changes from the plans necessary to make the work conform to building as constructed and to fit work of other trades, or to conform to rules of the governing authorities and regulations, shall be met without extra cost to the Owner.
3. The layout of the piping, ductwork, equipment, etc., as shown on the Drawings shall be checked and exact locations shall be determined by the dimensions of equipment approved and Contractor shall obtain the AOR's approval for revised layout before the apparatus is installed. Consult the AORural, Structural, and Equipment Drawings for the dimensions, locations of partitions, locations and sizes of structural supports, foundations, etc.
4. Refer to the AORural Plans for details and large scale Drawings and to approved Shop Drawing of equipment furnished under other Contracts or Sections of the Specifications for exact location of service connections. The equipment Shop Drawings will be furnished to the Contractor before roughing in. Contractor shall not install any piping or ductwork for said equipment until they have received approved Coordination Drawings for same.

L. Minor Deviations:
1. Where manufacturers’ catalog numbers or types are mentioned in the Specifications or indicated on the Drawings, they are intended to be used as
a guide only and shall not be interpreted as taking precedence over the basic rating and duty specified.

M. Interferences:
1. Before making any installation, the work of the trades must be coordinated and the necessary changes shall be made to avoid interferences or improper effect on work to be performed by any other Section. In the event that interferences develop, the AOR's decision will be final and no additional compensation will be allowed for moving of misplaced piping, ducts, conduit and/or equipment.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Unless otherwise specified, all material and equipment incorporated in the work under the contract shall be new.

B. Material and equipment specified by one or more manufacturer's name, trade name and/or model number does not limit a bidder from bidding on other equipment providing the procedure set forth in the Conditions of the Contract and hereinafter specified is followed.

C. A Contractor who intends to furnish equipment listed as approved equal shall proceed as follows:
   1. Obtain AOR approval of said equipment.
   2. Be fully responsible for said equipment.
   3. Include in the Base Bid, all cost for any changes that may be required in his work and/or work of other trades for the proper installation and functioning of said equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall be responsible for all of his work fitting into place in a satisfactory and neat workmanlike manner acceptable to the AOR.

B. Confer with other Contractors regarding the location and size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, etc., in order that there may be no interference between the installation of the progress of the work of any Contractor on the project.

C. The Drawings are diagrammatic and shall be followed as closely as actual construction of the building and the work of other trade contractors will permit. All changes from Drawings necessary to make the work of the Contractor conform to the building construction and the work of other trade contractors shall be done at the Contractor's expense.

D. Unless explicitly stated to the contrary, Contractor shall furnish and install each item of equipment or material hereinafter specified, complete with all necessary fittings, supports, trim, piping, insulation, etc., as required for a complete and operating installation.
E. All equipment and materials shall be installed according to the manufacturer's instructions unless otherwise specifically directed by the Contract Documents. All piping, valves, connections, and other like items recommended by the manufacturer or required for proper operation shall be provided without additional cost.

F. In general, all piping, ductwork and similar items shall be installed concealed from view above the ceiling, in partitions, shafts, chases, unless otherwise indicated.

G. Locations of items not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site, subject to review.

H. Where pipes are in partitions, furred out spaces and chases, obtain information as to their exact location and size and install work so as to be entirely concealed in the allotted space.

I. Wherever two or more pipes are to be installed in parallel, or parallel to the piping of other trades, the piping shall be installed with sufficient space between pipes to allow for the proper application of pipe covering, painting and servicing.

J. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, and also furnish information and shop drawings necessary to permit installation of other work without delay.

K. Where there is evidence that parts of the Mechanical Work will interfere with other work, assist in working out space conditions and/or the structure, make necessary adjustments to accommodate the work.

L. Mechanical Work installed before coordinating with other work so as to cause interference with other work shall be changed to correct such condition without additional cost to the Owner.

M. In no case shall any pipe, conduit, duct, or item of equipment be installed where it is supported on or suspended from another pipe, conduit, duct or item of equipment.

N. Accessibility:
   1. Install Mechanical work to permit removal (without damage to other parts) of coils, belt guards, sheaves and drives, and other parts requiring periodic replacement or maintenance.
   2. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, traps, starters, motors, dampers, control components, and to clear the openings of swinging and overhead doors and of access panels.
   3. Change dimensions of ductwork when required to meet job conditions but maintain the same equivalent cross-sectional area.
   4. Provide access panels in equipment, ducts, and like items for inspection of interiors and proper maintenance.

End of Section
DIVISION 15 - MECHANICAL

SECTION 15011
GENERAL PROVISIONS FOR PLUMBING WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Divisions 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:

1. The work under Division 15, Plumbing Work shall include all labor, services, materials and equipment and performance of all work required for the installation of all plumbing work as shown on the Drawings and herein specified in the following Sections.

2. Should there be any discrepancies or a question of intent, refer the matter to the AOR for decision before ordering any equipment or materials or before starting any related work.

3. Where work connects to that of another trade, or to piping or equipment in place, take measurements in the field to make connecting work come true and line up with the item being connected.

4. Minor items and accessories or devices reasonably inferable as necessary, to the complete and proper installation and operation of any system, shall be provided by the Contractor for such system whether or not they are specifically called for by the Specifications or Drawings.

5. The Drawings and Specifications are to be taken together. Work specified and not shown or work shown and not specified shall be performed or furnished as though mentioned in both Specifications and Drawings. If there is a discrepancy between the Drawings and Specifications as to the quantity or quality to be provided, the greater quantity or the better quality shall be provided.

1.3 DEFINITIONS

A. "Piping" includes, in addition to pipe, all fittings, valves, hangers, and other supports and accessories related to such piping.

B. "Concealed" means hidden from sight in chases, furred spaces, shafts, hung ceilings, embedded in construction, in crawl spaces or buried.

C. "Exposed" means not installed underground or "concealed" as defined above.

1.4 QUALITY ASSURANCE

A. All workmanship shall be first class in every respect and shall be performed only by skilled mechanics.

B. Shutdown and Notifications:
1. It is imperative that service interruptions on the various existing utilities be held to an absolute minimum. Wherever possible provide suitable temporary services or connections, where continuity of service for essential systems can be maintained by this means.

2. Provide not less than 72 hours advance notice, in writing, that an interruption of service in any system is desired. Such notice shall identify the system or systems involved, and shall be submitted in duplicate, one copy of which will be signed and returned by the Owner's authorized representative stating whether the requested shutdown will be permitted or not.

C. Existing Utilities:
1. Location of utilities as shown on the drawings has been determined from the best available information and is given for convenience; however, AOR does not assume responsibility in the event that during construction, utilities other than those shown may be encountered, and that the actual location of those which are shown may be different from the location as shown on the plans.

2. Assume responsibility for interference with or damage to any existing utilities, and repair or replace same with the least possible delay.

D. Notify AOR of broken or open pipes discovered during construction.

E. Layout and establish the lines and levels necessary for work.

F. The following Standards shall be used where referenced by the following abbreviations:
1. AGA: American Gas Association
2. AIA: American Institute of Architects
3. ANSI: American National Standards Institute
4. ASME: American Society of Mechanical Engineers
5. ASPE: American Society of Plumbing Engineers
7. AWS: American Welding Society
8. AWWA: American Water Works Association
9. CSA: Canadian Standards Association
10. CISPI: Cast Iron Soil Pipe Institute
11. EPA: Environmental Protection Agency
12. NIST: National Institute of Standards and Testing
15. NSC: National Safety Council
16. NSF: National Sanitation Foundation
17. OSHA: Occupational Safety & Health Administration
18. UL: Underwriters' Laboratories

G. Project Certification:
1. Contractor shall submit a project certification, guaranteeing that this project was constructed and will operate in accordance with the performance requirements of the Drawings and Specifications. This certification shall be signed by a principal of the firm and shall be delivered to the AOR prior to final payment.

H. Drawings:
1. The Drawings are essentially diagrammatic in nature and show general arrangement of the equipment, piping, accessories, etc. Because of the small scale of the Drawings, it is not possible to show all offsets, fittings, and accessories, which may be required. Carefully investigate the structural
conditions, AORural Drawings, Equipment Drawings, and the finished conditions of the work and arrange such work accordingly, furnish any fittings, pipe accessories that may be required to meet such conditions.

2. Any changes from the plans necessary to make the work conform to building as constructed and to fit work of other trades, or to conform to rules of the governing authorities and regulations, shall be met without extra cost to the Owner.

I. Minor Deviations:
1. Where manufacturers' catalog numbers or types are mentioned in the Specifications or indicated on the Drawings, they are intended to be used as a guide only and shall not be interpreted as taking precedence over the basic rating and duty specified.

J. Interferences:
1. Before making any installation, the work of the trades must be coordinated and the necessary changes shall be made to avoid interferences or improper effect on work to be performed by any other Section. In the event that interferences develop, the AOR's decision will be final and no additional compensation will be allowed for moving of misplaced piping, ducts, conduit and/or equipment.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Unless otherwise specified, all material and equipment incorporated in the work under the contract shall be new.

B. Material and equipment specified by one or more manufacturer's name, trade name and/or model number does not limit a bidder from bidding on other equipment providing the procedure set forth in the Conditions of the Contract and hereinafter specified is followed.

C. A Contractor who intends to furnish equipment listed as approved equal shall proceed as follows:
1. Obtain AOR approval of said equipment.
2. Be fully responsible for said equipment.
3. Include in the Base Bid, all cost for any changes that may be required in his work and/or work of other trades for the proper installation and functioning of said equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall be responsible for all of his work fitting into place in a satisfactory and neat workmanlike manner acceptable to the AOR.

B. Confer with other Contractors regarding the location and size of pipes, equipment, fixtures, conduit, ducts, openings, switches, outlets, etc., in order that there may be no interference between the installation of the progress of the work of any Contractor on the project.
C. The Drawings are diagrammatic and shall be followed as closely as actual construction of the building and the work of other trade contractors will permit. All changes from Drawings necessary to make the work of this Contractor conform to the building construction and the work of other trade contractors shall be done at the Contractor's expense.

D. Unless explicitly stated to the contrary, Contractor shall furnish and install each item of equipment or material hereinafter specified, complete with all necessary fittings, supports, trim, piping, insulation, etc., as required for a complete and operating installation.

E. All equipment and materials shall be installed according to the manufacturer's instructions unless otherwise specifically directed by the Contract Documents. All piping, valves, connections, and other like items recommended by the manufacturer or required for proper operation shall be provided without additional cost.

F. In general, all piping, ductwork and similar items shall be installed concealed from view above the ceiling, in partitions, shafts, chases, unless otherwise indicated.

G. Locations of items not definitely fixed by dimensions are approximate only and exact locations necessary to secure the best conditions and results shall be determined at the site, subject to review.

H. Where pipes are in partitions, furred out spaces and chases, obtain information as to their exact location and size and install work so as to be entirely concealed in the allotted space.

I. Wherever two or more pipes are to be installed in parallel, or parallel to the piping of other trades, the piping shall be installed with sufficient space between pipes to allow for the proper application of pipe covering, painting and servicing.

J. Furnish advance information on locations and sizes of frames, boxes, sleeves and openings needed for the work, and also furnish information and shop drawings necessary to permit installation of other work without delay.

K. Where there is evidence that parts of the Plumbing Work will interfere with other work, assist in working out space conditions and/or the structure, make necessary adjustments to accommodate the work.

L. Plumbing Work installed before coordinating with other work so as to cause interference with other work shall be changed to correct such condition without additional cost to the Owner.

M. In no case shall any pipe, conduit, duct, or item of equipment be installed where it is supported on or suspended from another pipe, conduit, duct or item of equipment.

N. Accessibility:
   1. Arrange pipes and valves to permit ready access for control and maintenance.

End of Section 15011
DIVISION 15 - MECHANICAL

SECTION 15058
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 1 Specification Sections, apply to this
   Section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. 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 requirements in this Section except when stricter requirements are
   specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. 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: Separate winding for each speed.


F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Class B.

H. Insulation: Class F.

I. 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.

J. 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 15058
DIVISION 15 - MECHANICAL

SECTION 15060
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Divisions 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides the following hangers and supports for plumbing system piping and equipment:

Adjust list below to suit Project.

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe positioning systems.

1.3 DEFINITIONS

Retain abbreviation and terms that remain after this Section has been edited.

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 SUBMITTALS

A. Product Data: For the following:

Adjust list below to suit Project.

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

Adjust list below to suit Project.

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.

1.5 WARRANTY

A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of substantial completion, whichever is longer.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Steel Pipe Hangers and Supports:
   a. Anvil
   b. B-Line Systems, Inc.; a division of Cooper Industries.
   c. Carpenter & Paterson, Inc.

2. Powder-Actuated Fasteners:
   a. Hilti, Inc.
   b. ITW Ramset/Red Head.

3. Mechanical-Expansion Anchors:
   b. Hilti, Inc.
   c. ITW Ramset/Red Head.

4. Thermal-Hanger Shield Inserts:
   a. Carpenter & Paterson, Inc.
   b. PHS Industries, Inc.
   c. Pipe Shields, Inc.

5. Pipe Positioning Systems:
   b. HOLDRITE Corp.; Hubbard Enterprises.
   c. Samco Stamping, Inc.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Corrosion Protection: Hangers and components shall be galvanized or painted with carbo-zinc #11.

C. Threads: All threads shall be UNC unless otherwise specified.

D. Heat Transmission: Supports, guides and anchors shall limit the amount of heat transmitted to the structural steel. Temperature of supporting parts shall be based on a 100°F per inch temperature gradient from the outside pipe surface.

2.3 TRAPEZE PIPE HANGERS

Trapeze pipe hangers in this Article require calculation and detail of each unit.

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.
2.4 FASTENER SYSTEMS

**Verify suitability of fasteners in this Article for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.**

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
   3. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
   4. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   3. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   4. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   5. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   6. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
   7. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
8. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

9. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb (340 kg).
   b. Medium (MSS Type 32): 1500 lb (680 kg).
   c. Heavy (MSS Type 33): 3000 lb (1360 kg).

10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

11. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

12. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

Each trapeze pipe hanger in first paragraph and subparagraphs below requires calculation and detail.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
   3. Trapeze bars shall be tightly secured to structural members at two points with bolts or other similar mechanical fasteners. Hangers from bar joist and fabricated truss members shall be located at the panel points of the structural
members. C-clamp type hangers attached to one side of double-angle bottom members are not allowed. Point loads shall not exceed the lesser of:

a. Manufacturer’s certified recommendation for the component parts.
b. The following maximum point loads, and maximum hanger spacings as herein specified, for structural elements in any direction; except as specifically approved by the Engineer of Record:

<table>
<thead>
<tr>
<th>Structural Element Type</th>
<th>Maximum Hanger Point Load (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal deck without concrete topping</td>
<td>50</td>
</tr>
<tr>
<td>Composite metal deck slab with concrete topping</td>
<td>50</td>
</tr>
<tr>
<td>Steel Beams:</td>
<td></td>
</tr>
<tr>
<td>All channels WF4 through WF8</td>
<td>100</td>
</tr>
<tr>
<td>WF10 through WF14</td>
<td>200</td>
</tr>
<tr>
<td>WF16 through WF24</td>
<td>400</td>
</tr>
<tr>
<td>WF27 through WF36</td>
<td>750</td>
</tr>
<tr>
<td>Reinforced post-tensioned concrete elements</td>
<td></td>
</tr>
<tr>
<td>Slabs up to 6” thick</td>
<td>150</td>
</tr>
<tr>
<td>Slabs over 6” thick</td>
<td>250</td>
</tr>
<tr>
<td>Joists 8” wide</td>
<td>250</td>
</tr>
<tr>
<td>Beam/girders 8” wide</td>
<td>500</td>
</tr>
</tbody>
</table>

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:
   **Verify suitability of fasteners in two subparagraphs below for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick.**
   1. Drive screws, pins, studs, etc., of the type which are secured in place by means of explosive force may be used as a means of securing any of the hangers subject to the following:
      a. The stud, pin or fastener shall be caused to have a velocity not in excess of 300 feet per second when measured 6-1/2 feet from the muzzle of the tool by accepted ballistic test methods.
b. Only workmen qualified by instructions of the manufacturers representative and/or licensed by the state and local authorities shall be assigned to use a powder actuated fastening tool.

c. Where practical, tools of only one manufacturer shall be used on a project.

d. Only cartridges and fasteners supplied by the manufacturer of the tool shall be used to operate that tool.

e. Powder actuated fastening tools shall be handled with the same care as firearms.

f. All safety devices incorporated in the tool by the manufacturer shall be used at all times.

g. Acceptable types of powder actuated fastening tools are:

1) Piston Tool - Low Velocity Type - is a tool utilizing a piston, activated by the power of a blank cartridge furnished by the manufacturer for use with it, to drive a stud, pin or fastener into a work surface.

2) Powder Assisted Hammer Drive Tool - Low Velocity Type - is a tool utilizing a captive piston, activated by a blow from a 4 lb. hammer supplemented by the power of a blank cartridge furnished by the manufacturer for use with the tool, to drive a stud, pin or fastener into a work surface.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 15 Section "Plumbing Fixtures" for plumbing fixtures.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.
a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Insert Material: Length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

End of Section 15060
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General contractor provides:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Equipment supports.

B. Related Sections include the following:
   1. Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
   2. Division 15 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
   3. Division 15 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
   4. Division 15 Section(s) Metal Ducts for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.
B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Pipe stands. Include Product Data for components.
   4. Equipment supports.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.
   4. Carpenter & Paterson, Inc.
   5. Empire Industries, Inc.
   6. ERICO/Michigan Hanger Co.
   7. Globe Pipe Hanger Products, Inc.
   8. Grinnell Corp.
   9. GS Metals Corp.
   11. PHD Manufacturing, Inc.
   12. PHS Industries, Inc.
   13. Piping Technology & Products, Inc.
   14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.
2.3 TRAPEZE PIPE HANGERS
A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS
A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
B. Manufacturers:
   2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
   3. GS Metals Corp.
   5. Thomas & Betts Corporation.
   6. Tolco Inc.
   7. Unistrut Corp.; Tyco International, Ltd.
C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS
A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
B. Manufacturers:
   1. Carpenter & Paterson, Inc.
   2. ERICO/Michigan Hanger Co.
   3. PHS Industries, Inc.
   4. Pipe Shields, Inc.
   5. Rilco Manufacturing Company, Inc.
   6. Value Engineered Products, Inc.
C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS
A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   1. Manufacturers:
      a. Hilti, Inc.
      b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use padded hangers for piping that is subject to scratching.

E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
8. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
9. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
10. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
11. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
12. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
13. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
14. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
15. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
16. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
17. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
18. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
H. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
   a. Light (MSS Type 31): 750 lb.
   b. Medium (MSS Type 32): 1500 lb.
   c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
   a. Horizontal (MSS Type 54): Mounted horizontally.
   b. Vertical (MSS Type 55): Mounted vertically.
   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
   1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
   2. Field fabricates from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Fastener System Installation:
   1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
   2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Stand Installation:
   1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 7 Section "Roof Accessories" for curbs.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

M. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   4. Insert Material: Length at least as long as protective shield.
   5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

End of Section 15062
DIVISION 15 - MECHANICAL

SECTION 15076
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Warning signs and labels.
   2. Pipe labels.
   3. Valve tags.
   4. Sample Schedules

1.3 DEFINITIONS

A. Not applicable.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Follow manufacturer’s recommended installation procedures.

B. Comply with ASME A13.1 “Scheme for the Identification of Piping System” as applicable to the project.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store materials in a dry and secure area on-site and protect against dirt and moisture damage

B. Do not apply or install damaged materials.
1.7 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.8 WARRANTY

A. Not applicable.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Kolbi Manufacturing
   2. Marking Services
   3. Brady Corporation

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.


H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
B. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch or Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass beaded chain.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data. See Sample Valve Tag Schedule at the end of this Specification.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 4 by 7 inches
   2. Fasteners: Reinforced grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 9 Section "Interior Painting"

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
2. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
3. At access doors and similar access points that permit view of concealed piping.
4. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.

C. Pipe Label Color Schedule:
1. Domestic Water Piping:
   a. Background Color: Blue.
2. Domestic Hot Water:
   a. Background Color: Red
   b. Letter Color: White
3. Sanitary Waste and Piping:
   a. Background Color: Black
   b. Letter Color: White

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule. See Sample Valve Tag Schedule at the end of this Specification.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      b. Hot Water: 2 inches round.
   2. Valve-Tag Color:
      b. Hot Water: Natural.
   3. Letter Color:
      b. Hot Water: Black.

3.4 WARNING TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.5 SAMPLE SCHEDULES

A. The following tables are examples of schedules required to be submitted by the Contractor. Examples of the kinds of information to be included are in the first row in these tables.

<table>
<thead>
<tr>
<th>VALVE NUMBER</th>
<th>VALVE TYPE</th>
<th>VALVE SIZE</th>
<th>VALVE LOCATION</th>
<th>NORMAL OPERATING POSITION</th>
<th>REMARKS</th>
</tr>
</thead>
</table>

NEIU# 11-0226-0911 15076 - 4 Identification for Plumbing Piping and Equipment
### EQUIPMENT LABEL SCHEDULE

<table>
<thead>
<tr>
<th>EQUIPMENT IDENTIFICATION</th>
<th>EQUIPMENT LOCATION</th>
<th>SPECIFICATION SECTION</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWBP-1</td>
<td>MECHANICAL ROOM M-215</td>
<td>15xxx</td>
<td>DOMESTIC WATER BOOSTER PUMP</td>
</tr>
</tbody>
</table>

3.6 CLEANING

A. Follow manufacturer’s installation instructions for surface preparation prior to application or installation.

B. Follow Manufacturer’s instructions for cleaning labels and tags.

End of Section 15076
DIVISION 15 - MECHANICAL

SECTION 15077
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Equipment labels.
   2. Warning signs and labels.
   3. Pipe labels.
   4. Duct labels.
   5. Valve tags.
   6. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.


1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.
PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation with room number served or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.
   3. Color: Background color shall match system color. See part 3 for colors.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.


C. Background Color: Black, Blue, Red, White, Yellow. See Part 3.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.
2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
   1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations (both sides) through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.

B. Pipe Label Color Schedule:
1. Chilled-Water Piping:
   a. Background Color: Blue.
2. Condenser-Water Piping:
   a. Background Color: Green.
3. Heating Hot Water Piping:
   a. Background Color: Orange.
4. Refrigerant Piping:
   a. Background Color: Black.
5. Steam Piping:
   a. Background Color: Yellow.
   b. Letter Color: Black.
6. Steam Condensate Piping:
   a. Background Color: Yellow.
   b. Letter Color: Black.
7. Natural Gas Piping:
   a. Background Color: Yellow.
   b. Letter Color: Black
8. Non-Potable / Make-Up Water Piping:
   a. Background Color: Yellow.
   b. Letter Color: White
9. Air Conditioning / Humidification Condensate Piping:
   a. Background Color: Gray.
   b. Letter Color: White
10. Dual Temperature Piping:
    a. Background Color: Magenta.
    b. Letter Color: White
11. Process Water Piping:
    a. Background Color: Red.
    b. Letter Color: White

3.4 DUCT LABEL INSTALLATION

A. Install plastic-laminated duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Red: For hot-air supply ducts.
   3. Orange: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. Yellow: For hazardous material exhaust.

B. Locate labels near points where ducts enter and exit concealed spaces and at maximum intervals of 25 feet in each space where ducts are exposed or concealed by removable ceiling system. Reduce distance to 15 feet in highly congested spaces.
3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering and hose connections. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      c. Refrigerant: 2 inches, round.
      d. Heating Hot Water: 2 inches, round.
      e. Natural Gas: 2 inches, round.
      f. Steam: 2 inches, round.
      g. Non-Potable / Make-Up Water: 2 inches, round.
      h. Steam Condensate: 2 inches, round.
      i. Air Conditioning / Humidification Condensate: 2 inches
      j. Dual Temperature Water: 2 inches
      k. Process Water: 2 inches
   2. Valve-Tag Color:
      b. Condenser Water: Green.
      c. Refrigerant: Natural.
      d. Heating Hot Water: Orange.
      e. Natural Gas: Yellow.
      f. Steam: Yellow.
      g. Non-Potable / Make-Up Water: Yellow.
      h. Steam Condensate: Yellow.
      i. Air Conditioning / Humidification Condensate: Gray.
      j. Dual Temperature Water: Magenta.
   3. Letter Color:
      e. Natural Gas: White.
      f. Steam: White.
      g. Non-Potable / Make-Up Water: White.
      h. Steam Condensate: White.
      i. Air Conditioning / Humidification Condensate: White.

3.6 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

B. Hydronic Flow Diagrams: Provide one full size (30” x 42”) laminated record drawing of each system (chilled water, hot water, steam, air flow diagrams) in the buildings main mechanical room or engineer’s office. Mount laminated diagrams on walls. Coordinate final location with owner.
End of Section 15077
DIVISION 15 - MECHANICAL

SECTION 15082

PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Divisions 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Insulation Materials:
      a. Flexible elastomeric.
      b. Mineral fiber.
   2. Insulating cements.
   3. Adhesives.
   5. Field-applied jackets.
   6. Tapes.
   7. Securements.

1.3 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75 deg F.

D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogeneous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.


1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, Thermal resistance (R Value), thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   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, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
   1. Sample Sizes:
      b. Sheet Form Insulation Materials: 12 inches square.
      d. Sheet Jacket Materials: 12 inches square.
      e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. 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.

E. LEED Submittal Credit EQ 4: Submit certification stating that all adhesives & sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting 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 and inspecting 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.

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 size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

1.9 WARRANTY

A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of preliminary acceptance, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Flexible Elastomeric Insulation:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armaflex.
   c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180

2. Mineral-Fiber, Preformed Pipe Insulation:
   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000(Pipe Insulation.
   c. Owens Corning; Fiberglas Pipe Insulation.

   a. Insulco, Division of MFS, Inc.; Triple I.

4. Flexible Elastomeric and Polyolefin Adhesive:
   a. Aeroflex USA Inc.; Aeroseseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.

5. Mineral-Fiber Adhesive:
   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.

6. Vapor-Barrier Mastic:
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. Marathon Industries, Inc.; 590.
   d. Vimasco Corporation; 749.

7. PVC Jacket:
   a. Johns Manville; Zeston.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

8. Metal Jacket:
   a. Childers Products, Division of ITW; Metal Jacketing Systems.
   b. PABCO Metals Corporation; Surefit.
   c. RPR Products, Inc.; Insul-Mate.

9. ASJ Tape:
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
2.2 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain 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: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Preformed Pipe Insulation:
   1. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.3 INSULATING CEMENTS


B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.4 ADHESIVES

A. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California
Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

B. 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.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.
   5. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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. Adhesive: As recommended by jacket material manufacturer.
   2. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
   3. Color: Color-code jackets based on system.

C. Metal Jacket:
   1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Sheet and roll stock ready for shop or field sizing.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 3-mil thick, heat-bonded polyethylene and kraft paper.

d. Factory-Fabricated Fitting Covers:
   1) Same material, finish, and thickness as jacket.
   2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
   3) Tee covers.
   4) Flange and union covers.
   5) End caps.
   6) Beveled collars.
   7) Valve covers.
   8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.8 SECUREMENTS

A. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

B. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel 0.062-inch soft-annealed, galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. 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.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

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 equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe 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. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. 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.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.
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 beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:
   1. Testing agency labels and stamps.
   2. Nameplates and data plates.
   3. Cleanouts.

3.4 PENETRATIONS

A. 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.
   4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
   1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.
   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating
cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or Sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut Sectional pipe insulation to fit. Butt each Section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or Sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate flanges and unions using a Section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

7. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from Sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from Sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part Section on the vertical center line of valve body.

4. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation Section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut Sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered Sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut Sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer’s recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation Section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer’s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed Sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered Sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed Sections of same material as straight segments of pipe insulation when available.
2. When preformed Sections are not available, install mitered Sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.
3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch 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 o.c. and at end joints.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Underground piping.

3.10 PIPING INSULATION SCHEDULE

A. General: Abbreviations used in the following schedules include:

B. INTERIOR DOMESTIC WATER

<table>
<thead>
<tr>
<th>PIPE SIZES (NPS)</th>
<th>MATERIALS</th>
<th>THERMAL CONDUCTIVITY, K FOR LISTED K</th>
<th>THICKNESS IN INCHES</th>
<th>VAPOR BARRIER REQ'D</th>
<th>FIELD-APPLIED JACKET</th>
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<td>ALL SIZES</td>
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<td>(P)</td>
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<td>1</td>
<td>NO</td>
<td>NONE, (P in exposed locations)</td>
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</tbody>
</table>

NOTE: INCREASE INSULATION THICKNESS 1/2” FOR PIPES > 1-1/2” IN SYSTEMS OPERATING BETWEEN 140F AND 169F. INCREASE INSULATION THICKNESS ½” FOR 1-1/2” AND 2” PIPES OPERATING BETWEEN 170F AND 180F. INCREASE INSULATION THICKNESS 1” FOR PIPES > 2” OPERATING BETWEEN 170F AND 180F.

C. INTERIOR DOMESTIC COLD WATER

<table>
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<tr>
<th>PIPE SIZES (NPS)</th>
<th>MATERIALS</th>
<th>THERMAL CONDUCTIVITY, K FOR LISTED K</th>
<th>THICKNESS IN INCHES</th>
<th>VAPOR BARRIER REQ'D</th>
<th>FIELD-APPLIED JACKET</th>
</tr>
</thead>
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<tr>
<td>1-1/2 TO &lt;4</td>
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<td></td>
<td>FLEXIBLE ELASTOMERIC</td>
<td>.26</td>
<td>1</td>
<td>NO</td>
<td>NONE, (P in exposed locations)</td>
</tr>
</tbody>
</table>

3.11 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. Piping, Exposed:
1. PVC, Color-Coded by System: 30 mils thick.

End of Section 15082
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Insulation Materials:
      a. Calcium silicate.
      b. Flexible elastomeric.
      c. Mineral fiber.
      d. Polyisocyanurate.
   2. Fire-rated insulation systems.
   3. Insulating cements.
   4. Adhesives.
   5. Mastics.
   7. Sealants.
   8. Factory-applied jackets.
   10. Tapes.
   11. Securements.
   12. Corner angles.

1.3 DEFINITIONS

A. Hot Surfaces: Normal operating temperatures of 100 deg F or higher.

B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.

C. Cold Surfaces: Normal operating temperatures less than 75 deg F.

D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogeneous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thermal resistivity (R-value), thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
   1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
   2. Detail attachment and covering of heat tracing inside insulation.
   3. Detail insulation application at pipe expansion joints for each type of insulation.
   4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   5. Detail removable insulation at piping specialties, equipment connections, and access panels.
   6. Detail application of field-applied jackets.
   7. Detail application at linkages of control devices.
   8. Detail field application for each equipment type (ie return fans on roof, AHU plenum/deck dividers).

C. 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.

D. Submit certification stating that all adhesives & sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting 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 and inspecting 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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Containers for Insulation material, coverings, cements, adhesives and coatings shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, maximum use temperature, and fire hazard index.
1.7 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and 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.

1.9 WARRANTY

A. Provide warranty on materials and labor for 18 months starting from date of delivery, or one year from date of, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Flexible Elastomeric:
   a. Aeroflex USA Inc.; Aerocel.
   b. Armacell LLC; AP Armalex.
   c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2. Mineral-Fiber Blanket Insulation:
   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite.
   c. Owens Corning; All-Service Duct Wrap.
   d. Zeston, Inc

3. Mineral-Fiber Board Insulation:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.
   g. Zeston, Inc

4. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating. Products:
5. Mineral-Fiber, Preformed Pipe Insulation:
a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Owens Corning; Fiberglas Pipe Insulation.
e. Zeston, Inc
6. Mineral-Fiber, Pipe and Tank Insulation:
a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.
f. Zeston, Inc
7. Polyisocyanurate:
b. Dow Chemical Company (The); Trymer.
c. Duna USA Inc.; Corafoam.
d. Elliot Company; Elfoam.
8. Fire-Rated Blanket:
a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
d. 3M; Fire Barrier Wrap Products.
9. Mineral-Fiber Insulating Cement:
a. Insulco, Division of MFS, Inc.; Triple I.
10. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement:
a. Insulco, Division of MFS, Inc.; SmoothKote.
c. Rock Wool Manufacturing Company; Delta One Shot.
11. Polyisocyanurate Adhesive:
a. Childers Products, Division of ITW; CP-96.
12. Flexible Elastomeric and Polyolefin Adhesive:
a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.
13. Mineral-Fiber Adhesive:
a. Childers Products, Division of ITW; CP-82.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
14. ASJ Adhesive, and FSK Adhesive:
a. Childers Products, Division of ITW; CP-82.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
15. PVC Jacket Adhesive:
a. Dow Chemical Company (The); 739, Dow Silicone.
c. Speedline Corporation; Speedline Vinyl Adhesive.

16. Vapor-Barrier Mastic:
a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Vimasco Corporation; 749.

17. Lagging Adhesives:
a. Childers Products, Division of ITW; CP-52.
b. Foster Products Corporation, H. B. Fuller Company; 81-42.
c. Vimasco Corporation; 136.

18. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products:
a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Pittsburgh Corning Corporation; Pittseal 444.
d. Vimasco Corporation; 750.

19. Metal Jacket Flashing Sealants:
a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Vimasco Corporation; 750.

20. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
a. Childers Products, Division of ITW; CP-76.

21. PVC Jacket:
a. Johns Manville; Zeston.
c. Proto PVC Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

22. Metal Jacket:
a. Childers Products, Division of ITW; Metal Jacketing Systems.
b. PABCO Metals Corporation; Surefit.
c. RPR Products, Inc.; Insul-Mate.

23. ASJ Tape:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

24. FSK Tape:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

25. PVC Tape:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.

26. Bands:
a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
27. Insulation Pins and Hangers:
   a. AGM Industries, Inc.; CWP-1.
   b. GEMCO; Cupped Head Weld Pin.
   c. Midwest Fasteners, Inc.; Cupped Head.
   d. Nelson Stud Welding; CHP

28. Wire:
   b. Childers Products.
   c. PABCO Metals Corporation.
   d. RPR Products, Inc.

2.2 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain 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: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

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 III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating. Products:

J. Mineral-Fiber, Preformed Pipe Insulation:

K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
1. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
2. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
3. Fabricate shapes according to ASTM C 450 and ASTM C 585.
   a. Pipe Applications: ASJ
   b. Equipment Applications: ASJ

2.3 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by a NRTL acceptable to authority having jurisdiction.

2.4 INSULATING CEMENTS

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.5 ADHESIVES

A. All Adhesives & Sealants: All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

B. 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.

C. Cellular-Glass, Phenolic and Polyisocyanurate Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
F. ASJ Adhesive, and FSK Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.6 MASTICS

A. All Mastics All adhesive and sealants installed in the building interior shall meet the testing and product requirements of of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   2. Service Temperature Range: Minus 20 to plus 180 deg F.

2.7 LAGGING ADHESIVES

A. All Adhesives & Sealants All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

B. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
   2. Service Temperature Range: Minus 50 to plus 180 deg F.

2.8 SEALANTS

A. All Adhesives & Sealants All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

B. Joint Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Permanently flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 100 to plus 300 deg F.

C. Metal Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.

D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
   1. Materials shall be compatible with insulation materials, jackets, and substrates.
   2. Fire- and water-resistant, flexible, elastomeric sealant.
   3. Service Temperature Range: Minus 40 to plus 250 deg F.
2.9 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. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. 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. Adhesive: As recommended by jacket material manufacturer.
   2. Color: Color-code jackets based on system.
   3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
   4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:
   1. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Sheet and roll stock ready for shop or field sizing.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      d. Moisture Barrier for Outdoor Applications: 2.5-mil- thick Polysurlyn.
   2. Factory-Fabricated Fitting Covers:
      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils
   3. Adhesion: 90 ounces force/inch in width. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From
Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.

4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. 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. Width: 2 inches.
2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width. All Adhesives & Sealants (LEED EQ 4): All adhesive and sealants installed in the building interior shall meet the testing and product requirements of the California Department of Health Services Standard for the Testing of Volatile Organic Emissions From Various Sources Using Small Scale Environmental Chambers, including 2004 addenda.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.020 inch thick, 3/4 inch wide with wing or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.
2. 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.
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. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. 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 thick by 1-1/2 inches in diameter.

b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.

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 thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches 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- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and prepare surfaces to be insulated. Remove materials that will adversely affect insulation application. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

B. Coordinate insulation installation with the trade installing heat tracing, if any. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Staples shall not be used

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

D. 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.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
H. All surfaces shall be clean and dry before application of insulation.

I. Keep insulation materials dry during application and finishing.

J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

K. Install insulation with least number of joints practical.

L. 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.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

M. Apply adhesives, mastics, and sealants at manufacturer’s recommended coverage rate and wet and dry film thicknesses.

N. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

O. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

P. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Q. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, and seal patches similar to butt joints.

R. For above ambient services, do not install insulation to the following:
   1. Vibration-control devices.
   2. Testing agency labels and stamps.
3. Nameplates and data plates.
5. Handholes.
6. Cleanouts.

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 below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. 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.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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.
   1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
   1. Duct: Install insulation continuously through floor penetrations that are not fire rated. 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.
   2. Pipe: Install insulation continuously through floor penetrations.
   3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles. Coordinate with drawings for insulation at locations of pipe expansion.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Flanges on high temperature piping shall not be covered. Flanges on low temperature (below 70°F) piping shall be covered. Covering adjacent to high temperature flanges shall be neatly taped with insulating cement to allow bolt removal.
3. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
4. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
5. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
6. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
7. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
8. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
9. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
10. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters
on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated on drawings. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

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.

B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

E. 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 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way and 3 inches 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 from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches 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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. 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 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches space pins 16 inches o.c. each way, and 3 inches 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.
3.8 POLYISOCYANurate Insulation Installation

A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation to pipe with tape or bands and tighten without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o’clock positions on the pipe.
2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.

B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyisocyanurate block insulation of same thickness as pipe insulation.

C. Insulation Installation on Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.

D. Insulation Installation on Valves and Pipe Specialties:

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 from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch 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 at 18-foot 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 2 times the insulation thickness but not less than 3 inches.

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- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
1. Install preformed sections of polyisocyanurate insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch 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.

B. Where Stainless Steel jackets are indicated, install with 2-inch 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 o.c. and at end joints.

3.10 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 Division 7 Section “Through-Penetration Firestop Systems.”

3.11 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ exposed to view only: Paint jacket with paint system identified below and as specified in Division 9 painting Sections. Coordinate with Architect.
   1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.
B. 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 location for each duct system defined in the "Duct Insulation Schedule, General" Article.
   2. Inspect field-insulated equipment, 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 location for each type
of equipment requiring insulation for this project. For large equipment, remove only a portion adequate to determine compliance.

3. Inspect pipe, fittings, strainers, and valves, 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 three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Architect may reject all work if sample work is found to be defective.

3.13 DUCT INSULATION PERFORMANCE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, supply and outdoor air.
   2. Indoor, concealed return located in non-conditioned space.
   3. Indoor, return located in non-conditioned space.
   4. Indoor, kitchen hood exhaust.
   5. Indoor, exhaust between isolation damper and penetration of building exterior.
   6. Outdoor, supply, return and air.

B. Items Not Insulated:
   1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1 2004.
   2. Factory-insulated flexible ducts.
   3. Factory-insulated plenums and casings.
   4. Flexible connectors.
   5. Vibration-control devices.
   6. Factory-insulated access panels and doors.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. INSULATION APPLICATION SCHEDULE
   1. General: Abbreviations used in the following schedules include:

B. DUCT SYSTEMS INSULATION SCHEDULE

<table>
<thead>
<tr>
<th>DUCT LOCATION</th>
<th>OUTSIDE AIR, SUPPLY AIR, EXHAUST AIR (DOWN STREAM OF DAMPER) INSULATION INSTALLED R-VALUE (H-FT²-°F)/BTU</th>
<th>RETURN INSULATION INSTALLED R-VALUE (H-FT²-°F)/BTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXTERIOR OF BUILDING (NOTE 5,6,7)</td>
<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>DOUBLE WALL DUCTWORK (NOTE 8)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>VENTILATED ATTIC (NOTE 5,7)</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>UNVENTED ATTIC ABOVE INSULATED CEILING (NOTE 5,7)</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>UNVENTED ATTIC W/ ROOF INSULATION (NOTE 1,5,7)</td>
<td>3.5</td>
<td>-</td>
</tr>
<tr>
<td>UNCONDITIONED SPACE (NOTE 2,5,6,7)</td>
<td>6.5</td>
<td>6.5</td>
</tr>
<tr>
<td>INDIRECTLY CONDITIONED SPACE (NOTE 3,7)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DUCT LOCATION</th>
<th>OUTSIDE AIR, SUPPLY AIR, EXHAUST AIR (DOWNSTREAM OF DAMPER) INSULATION INSTALLED R-VALUE (H·FT²·°F)/BTU</th>
<th>RETURN INSULATION INSTALLED R-VALUE (H·FT²·°F)/BTU</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEILING CAVITY / SHAFTS / SOFFITS / MECHANICAL SPACES AND ROOMS (NOTE 4,5,6,7)</td>
<td>3.5</td>
<td>-</td>
</tr>
<tr>
<td>EXPOSED LOCATIONS WITHIN CONDITIONED SPACE</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>BURIED</td>
<td>3.5</td>
<td>-</td>
</tr>
</tbody>
</table>

**NOTE 1:** INSULATION R-VALUES, MEASURED IN (H X FT² X F)/BTU, ARE FOR THE INSULATION AS INSTALLED AND DO NOT INCLUDE FILM RESISTANCE. WHERE EXTERIOR WALLS ARE USED AS PLENUM WALLS, WALL INSULATION SHALL BE AS REQUIRED BY THE MOST RESTRICTIVE CONDITION OF ASHRAE 90.1-2004 SECTION 5 OR 6.4.4.2. INSULATION RESISTANCE MEASURED ON A HORIZONTAL PLANE IN ACCORDANCE WITH ASTM C518 AT A MEAN TEMPERATURE OF 75°F AT THE INSTALLED THICKNESS.

**NOTE 2:** INCLUDING CRAWL SPACES (BOTH VENTILATED/NON-VENTILATED), FRAMED CAVITIES IN WALLS, FLOOR AND CEILING ASSEMBLIES WHICH (A) SEPARATE CONDITIONED SPACE FROM UNCONDITIONED SPACE OR OUTSIDE AIR, AND (B) ARE UNINSULATED ON THE SIDE FACING AWAY FROM CONDITIONED SPACE.

**NOTE 3:** RETURN AIR PLENUMS WITH OR WITHOUT EXPOSED ROOFS ABOVE.

**NOTE 4:** CAVITY CONTAINED WITHIN THE INSULATED BUILDING ENVELOPE.

**NOTE 5:** VAPOR BARRIER REQUIRED.
NOTE 6: FIELD APPLIED JACKET (STAINLESS STEEL FOR EXTERIOR APPLICATIONS, PVC FOR INTERIOR EXPOSED LOCATIONS).

NOTE 7: PROVIDE RIGID EXTRUDED URETHANE OR POLYSTYRENE BOARD, OR POLYISOCYANURATE BOARD. INSULATION WITH FIELD APPLIED JACKET (NON-GLOSSY SHEEN SS EXTERIOR, ALL SERVICE INTERIOR) IN EXPOSED LOCATIONS.

NOTE 8: DO NOT PROVIDE EXTERNAL FIELD APPLIED INSULATION ON DOUBLE WALL DUCTWORK. INTERSTITIAL SPACE INSULATION TO BE PROVIDED WITH PRODUCT. SEE 15815.

C. KITCHEN EXHAUST DUCTS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>THICKNESS INCHES</th>
<th>VAPOR BARRIER REQ'D</th>
<th>FIELD-APPLIED JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRE RATED BLANKET</td>
<td>NOTE 1</td>
<td>NO</td>
<td>NONE</td>
</tr>
<tr>
<td>CALCIUM SILICATE BOARD</td>
<td>NOTE 1</td>
<td>NO</td>
<td>(SS) Exposed Duct</td>
</tr>
</tbody>
</table>

NOTE 1: AS REQUIRED FOR A 2 HR RATING.

D. CONVECTION OVEN AND DISHWASHER EXHAUST DUCTS

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>THICKNESS INCHES</th>
<th>VAPOR BARRIER REQ'D</th>
<th>FIELD-APPLIED JACKET</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLASS FIBER BOARD</td>
<td>2</td>
<td>NO</td>
<td>(SS) Exposed Duct</td>
</tr>
<tr>
<td>CALCIUM SILICATE BOARD</td>
<td>2</td>
<td>NO</td>
<td>(SS)</td>
</tr>
<tr>
<td>FIRE RATED BLANKET</td>
<td>NOTE 1</td>
<td>NO</td>
<td>NONE</td>
</tr>
</tbody>
</table>

NOTE 1: AS REQUIRED FOR A 2 HR RATING.

3.15 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that are not factory insulated.

3.16 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.17 PIPING INSULATION SCHEDULE

A. General:
### Abbreviations used in the following schedules include:

1. **Field-Applied Jackets**:  
   - P - PVC,  
   - K - Foil and Paper,  
   - A - Aluminum,  
   - SS - Stainless Steel.

2. **Pipe Sizes**: NPS - Nominal Pipe Size.

3. **Minimum HVAC pipe insulation thickness table**:

#### HEATING SYSTEMS (Steam and Hot Water) **(1)**

<table>
<thead>
<tr>
<th>FLUID TEMPERATURE RANGE (°F)</th>
<th>INSULATION TYPE AND FIELD-APPLIED JACKET</th>
<th>PIPE SIZE AND INSULATION THICKNESS (INCHES) (9)(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GLASS FIBER</td>
<td>POLYISO-CYANURATE</td>
</tr>
<tr>
<td>High pressure/temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium pressure/temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low pressure/temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam Condensate</td>
<td>Any</td>
<td></td>
</tr>
</tbody>
</table>

#### COOLING SYSTEMS **(1)**

<table>
<thead>
<tr>
<th>FLUID TEMPERATURE RANGE (°F)</th>
<th>INSULATION TYPE AND FIELD-APPLIED JACKET</th>
<th>PIPE SIZE AND INSULATION THICKNESS (INCHES) (9)(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GLASS FIBER</td>
<td>POLYISO-CYANURATE</td>
</tr>
<tr>
<td>Chilled water, refrigerant</td>
<td>X(2)(7)(8)</td>
<td>X(2)(3)(8)</td>
</tr>
<tr>
<td>Brine and air conditioning</td>
<td>X(2)(7)(8)</td>
<td>X(2)(3)(8)</td>
</tr>
<tr>
<td>Condensate</td>
<td>X(2)(7)(8)</td>
<td>X(2)(3)(8)</td>
</tr>
</tbody>
</table>

#### Notes:

1. Glass fiber insulation only for hydronic piping
2. (P), (A) or (SS) Field-Applied Jacket on outdoor installations, exposed and concealed
3. For outdoor use only
4. Piping insulation is not required between control valve and coil on runouts when the control valve is within 4ft of the coil and the pipe size is 1" or less.
5. For piping exposed to outdoor air, increase insulation thickness by 1-inch
6. Insulation thickness is based on insulation having a thermal conductivity of 0.22 to 0.25 BTU-inch/(h·ft·°F) on a flat surface at a mean temperature of 75F. See Chicago Energy Conservation Code for insulation thickness adjustments due to different resistivity values.
7. Not used.
8. Vapor barrier.
9. Dual temperature water shall be treated as Low temperature hot water with a vapor barrier.

### 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. Piping, Exposed:

1. PVC, Color-Coded by System: 20 mils thick.
2. Colors should be identified as follows:
   a. Domestic Cold Water – Light Blue
b. Non-Potable Water / Make-up Water – Yellow

c. Storm Water / Sanitary – Gray

d. Domestic Hot Water / Domestic Hot Water Return – Purple

e. Refrigerant Suction / Hot Gas – White

f. Chilled Water – Dark Blue

g. Condenser Water – Green

h. Heating Hot Water – Orange

i. Steam / Condensate – Orange

j. Fire Protection - Red

3.19 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. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches
   1. Stainless Steel, Type 304, Smooth 2B Finish: 0.016 inch thick.

C. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
   1. Stainless Steel, Type 304, Smooth Finish: 0.020 inch thick.

D. Piping, Exposed
   1. Stainless Steel, Type 304 Smooth 2B Finish 0.016 inch thick.

3.20 CLEANING – NOT APPLICABLE

3.21 CONTRACTOR STARTUP AND REPORTING – NOT APPLICABLE

3.22 DEMONSTRATION AND COMMISSIONING – NOT APPLICABLE

End of Section 15083
DIVISION 15 - MECHANICAL

SECTION 15092
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Sleeves.
   2. Sleeve-seal fittings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.
2.3 GROUT


B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.

B. Install sleeves in concrete floors and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
   3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 7 Section “Joint Sealants.”

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7 Section “Through-Penetration Firestop Systems.”

3.2 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs above Grade:

3. Interior Partitions:
   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

End of Section 15092
DIVISION 15 - MECHANICAL

SECTION 15093
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Sleeves.
   2. Stack-sleeve fittings (Not for Use as a Floor Drain).
   3. Sleeve-seal systems.
   4. Sleeve-seal fittings.
   5. Grout.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS (Not for Use as a Floor Drain)

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel or Plastic or Stainless steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, water stop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber water stop collar with center opening to match piping OD.

2.5 GROUT


B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
   2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 7. When Division 7 sealant section is not provided, provide waterproof sealant system recommended by sleeve manufacturer.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7. When not specified in Division 7 provide a complete UL fire closure system.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 7. When not specified in Division 7, provide flashing per manufacturers recommendation.
   3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
   4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 7. When not specified in Division 7 provide a complete UL fire closure system.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION (In slabs on grade and below grade in exterior concrete walls, for a watertight seal around service piping entries into the building. Installation in a sleeve required)

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION (Above and below grade in concrete slabs and in concrete walls for a watertight seal around piping. Sleeve not required)

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves or Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves or Sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Cast-iron wall sleeves or Galvanized-steel wall sleeves or Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      1) For sleeve-seal system, select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system. Not for use with sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system.
      1) For sleeve-seal systems, select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system. Not for use with sleeve-seal fittings.

3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system or Sleeve-seal fittings.
      1) For sleeve-seal systems, select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system. Not for use with sleeve-seal fittings.
   b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system or Galvanized-steel wall sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves with sleeve-seal system or Galvanized-steel-pipe sleeves.
1) For sleeve seal systems, select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system. Not for use with sleeve-seal fittings.

4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves or Stack-sleeve fittings or Sleeve-seal fittings or Molded-PE or -PP sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.

5. Interior Partitions:

End of Section 15093
DIVISION 15 - MECHANICAL

SECTION 15098
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
A. Base Bid: General Contractor provides:
   1. Escutcheons.
   2. Floor plates.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS
A. One-Piece, Cast-Brass Type: With polished, chrome-plated and rough-brass finish and setscrew fastener.
B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
D. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.
E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES
A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with rough-brass finish.
   f. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.

2. Escutcheons for Existing Piping:
   a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
   e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
   f. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

End of Section 15098
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
1. Copper-alloy ball valves.
2. Ferrous-alloy butterfly valves.
4. Ferrous-alloy wafer check valves.
5. Bronze gate valves.
6. Cast-iron gate valves.
7. Bronze globe valves.
8. Cast-iron globe valves.
10. Chainwheel actuators.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:
1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. PTFE: Polytetrafluoroethylene plastic.
5. SWP: Steam working pressure.
6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.7 WARRANTY

A. Written manufacturer’s warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide valves by one of the following:

B. Ball valves:
   2. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.
   5. Neles Jamesbury

C. Ferrous-alloy butterfly valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

D. High Performance Butterfly Valves:
   1. Crane/Flowseal-MS
   2. Crane/XOMAX
   3. Neles-Jamesbury
   4. Milwaukee Valve Company
   5. Bray Controls

E. Bronze check valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

F. Ferrous-alloy wafer check valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   2. NIBCO INC.

G. Bronze gate valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

H. Cast-iron gate valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

I. Bronze globe valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

J. Cast-iron globe valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

K. Cast-iron plug valves:
   1. General Signal; DeZurik Unit.
   2. Grinnell Corporation.

L. Chainwheel actuators:
   1. Babbitt Steam Specialty Co.
   2. Roto Hammer Industries, Inc.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
   1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
   2. Gear Drive: For quarter-turn valves NPS 8 and larger.
   3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Valves in insulated piping shall have 2-inch stem extensions and the following features:
1. Gate valves shall be rising stem type.
2. Ball valves shall have extended operating handle of no-thermal conductive material, protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation, and memory stops that are fully adjustable after insulation is applied.
3. Butterfly valves shall have extended necks.


I. Valve Grooved Ends: AWWA C606.
1. Solder Joint: With sockets according to ASME B16.18.
   a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
2. Threads shall be in accordance with ASME B1.20.1.

J. Valve bypass and drain connections shall follow MSS SP-45.

2.3 BRONZEBALL VALVES

A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
   1. Operator: Steel handwheel.
   2. Stem Extension: For valves installed in insulated piping.
   3. Memory Stop: For operator handles.

2.4 STEAM & STEAM CONDENSATE BALL AND BUTTERFLY VALVES

A. See 3.2.H table 15100-1.

2.5 FERROUS-ALLOY BUTTERFLY VALVES

A. General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated. 200-psi CWP, 150-psi maximum pressure differential, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, wafer, lug, or grooved style:
   1. Disc Type: Nickel-plated ductile iron, Aluminum bronze, elastomer-coated ductile iron or epoxy-coated ductile iron.
   2. Operator for Sizes 2 Inches to 6 Inches: Standard lever handle with memory stop.
   3. Operator for Sizes 8 Inches to 24 Inches: Gear operator with position indicator.
4. Operator for Sizes 8 Inches and Larger, 96 Inches or Higher above Floor: Chain-wheel operator.

2.6 BRONZE CHECK VALVES
   A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:
   B. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

2.7 WAFER CHECK VALVES
   A. Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.

2.8 BRONZE GATE VALVES
   A. Gate Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi cold working pressure (CWP), or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and bonnet, solid- bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

2.9 CAST IRON GATE VALVES
   A. Gate Valves, 3 Inches and Larger: MSS SP-70, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

2.10 BRONZE GLOBE VALVES
   A. Globe Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, bronze, or teflon disc, silicon bronze-alloy stem, teflon-impregnated packing with bronze nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

2.11 CAST-IRON GLOBE VALVES
   A. Globe Valves, 3 Inches and Larger: MSS SP-85, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

2.12 CAST-IRON PLUG VALVES
   A. Plug Valves: MSS SP-78, 175-psi CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Buna N, Viton, or teflon packing, flanged or grooved end connections:
      1. Operator: Lever.
      2. Operator: Worm and gear with handwheel, sizes 6 inches and larger.
3. Operator: Worm and gear with chain wheel, sizes 6 inches and larger, 96 inches or higher above floor.

2.13 CHAINWHEEL ACTUATORS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
   2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly, or gate or plug valves.
   2. Throttling Service: Ball, butterfly, or globe valves.
   4. Drain Valves: Ball valves with hose connection adaptor, cap and chain.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled-Water Piping: Use the following types of valves:
   1. Ball Valves, NPS 2 and Smaller: 600-psig CWP rating, copper alloy.
   2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
   3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
   4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Wafer Check Valves, NPS 2-1/2 and Larger: Single-plate, wafer, Class 125 or 150 ferrous alloy.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

D. Condenser-Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: 600-psig CWP rating, copper alloy.
2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Wafer Check Valves, NPS 2-1/2 and Larger: Single-plate, wafer, Class 125 or 150 ferrous alloy.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

E. Dual Temperature-Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: 600-psig CWP rating, copper alloy.
2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Wafer Check Valves, NPS 2-1/2 and Larger: Single-plate, wafer, Class 125 or 150 ferrous alloy.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

F. Domestic Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

G. Heating Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
7. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
8. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
H. Low-Pressure Steam/Steam Condensate/Feedwater Piping: Use the following types of valves:
1. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
2. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
3. Ball Valves: Table 15100-1.
4. High Performance Butterfly Valves: Table 15100-1.

| Table 15100-1 Steam, Pressure (130 psig maximum), Steam Condensate, and Feedwater |
|----------------------------------|-----------------------------------------------------------------|
| Up to 2”                          | Apollo 77-140-64-04 Series Ball, 150 psig saturated steam, bronze body, full port, 316 SS ball & stem, 250 psig steam trim (MPTFE), 2 1/2” stem extension |
| 2 1/2”                            | Apollo 88A-209-65-MG Ball, Class 150, carbon steel body, full port, carbon steel ball & stem, MPTFE seats & graphite packing, gear operated handwheel |
| 3”                                | Apollo 88A-200-65-MG Ball, Class 150, carbon steel body, full port, carbon steel ball & stem, MPTFE seats & graphite packing, gear operated handwheel |
| 4”                                | Jamesbury 815L-11-2236MT High Performance Butterfly, Class 150, single-flanged lugged, carbon steel body, 316 SS disk & shaft, filled PTFE seat, PTFE seal For use in steam applications |
| 6” & larger                       | Jamesbury 815L-11-2236MT with manual-gear actuator. Provide chain wheel for valves 8’ above the floor |

I. Select valves, except wafer and flangeless types, with the following end connections:
1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water, steam, and steam condensate services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.
G. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 CLEANING – NOT APPLICABLE

3.7 CONTRACTOR STARTUP AND REPORTING – NOT APPLICABLE

3.8 DEMONSTRATION AND COMMISSIONING - NOT APPLICABLE

End of Section 15110
DIVISION 15 - MECHANICAL

SECTION 15112
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Copper-alloy ball valves.
   2. Ferrous-alloy butterfly valves.
   4. Ferrous-alloy wafer check valves.
   5. Bronze gate valves.
   6. Cast-iron gate valves.
   7. Bronze globe valves.
   8. Cast-iron globe valves.
  10. Chainwheel actuators.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. NBR: Acrylonitrile-butadiene rubber.
   4. PTFE: Polytetrafluoroethylene plastic.
   5. SWP: Steam working pressure.
   6. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.7 WARRANTY

A. Written manufacturer’s warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide valves by one of the following:

B. Ball valves:
   2. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.
   5. Neles Jamesbury

C. Ferrous-alloy butterfly valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

D. High Performance Butterfly Valves:
   1. Crane/Flowseal-MS
   2. Crane/XOMAX
   3. Neles-Jamesbury
   4. Milwaukee Valve Company
   5. Bray Controls

E. Bronze check valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.
F. Ferrous-alloy wafer check valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   2. NIBCO INC.

G. Bronze gate valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

H. Cast-iron gate valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

I. Bronze globe valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

J. Cast-iron globe valves:
   1. Crane Co.; Crane Valve Group; Stockham Div.
   3. NIBCO INC.

K. Cast-iron plug valves.
   1. General Signal; DeZurik Unit.
   2. Grinnell Corporation.

L. Chainwheel actuators:
   1. Babbitt Steam Specialty Co.
   2. Roto Hammer Industries, Inc.

2.2 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:
   1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
   2. Gear Drive: For quarter-turn valves NPS 8 and larger.
   3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
5. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.

G. Valves in insulated piping shall have 2-inch stem extensions and the following features:
   1. Gate valves shall be rising stem type.
   2. Ball valves shall have extended operating handle of no-thermal conductive material, protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation, and memory stops that are fully adjustable after insulation is applied.
   3. Butterfly valves shall have extended necks.


I. Valve Grooved Ends: AWWA C606.
   1. Solder Joint: With sockets according to ASME B16.18.
      a. Caution: Use solder with melting point below 840 deg F for angle, check, gate, and globe valves; below 421 deg F for ball valves.
   2. Threads shall be in accordance with ASME B1.20.1.

J. Valve bypass and drain connections shall follow MSS SP-45.

2.3 BRONZEBALL VALVES

A. Ball Valves, 4 Inches and Smaller: MSS SP-110, Class 150, 600-psi CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for 1/2-inch valves and smaller and conventional port for 3/4-inch valves and larger; blowout proof; bronze or brass stem; teflon seats and seals; threaded or soldered end connections:
   1. Operator: Steel handwheel.
   2. Stem Extension: For valves installed in insulated piping.
   3. Memory Stop: For operator handles.

2.4 STEAM & STEAM CONDENSATE BALL AND BUTTERFLY VALVES

A. See 3.2.H table 15100-1.

2.5 FERROUS-ALLOY BUTTERFLY VALVES

A. General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated. 200-psi CWP, 150-psi maximum pressure differential, ASTM A 126 cast-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals, wafer, lug, or grooved style:
   1. Disc Type: Nickel-plated ductile iron, Aluminum bronze, elastomer-coated ductile iron or epoxy-coated ductile iron.
   2. Operator for Sizes 2 Inches to 6 Inches: Standard lever handle with memory stop.
   3. Operator for Sizes 8 Inches to 24 Inches: Gear operator with position indicator.
4. Operator for Sizes 8 Inches and Larger, 96 Inches or Higher above Floor: Chain-wheel operator.

2.6 BRONZE CHECK VALVES

A. Swing Check Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded or soldered end connections:

B. Swing Check Valves, 3 Inches and Larger: MSS SP-71, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged or grooved end connections.

2.7 WAFER CHECK VALVES

A. Class 125, 200-psi CWP, ASTM A 126 cast-iron body, bronze disc/plates, stainless-steel pins and springs, Buna N seals, installed between flanges.

2.8 BRONZE GATE VALVES

A. Gate Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi cold working pressure (CWP), or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and bonnet, solid-bronze wedge, copper-silicon alloy rising stem, teflon-impregnated packing with bronze packing nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

2.9 CAST IRON GATE VALVES

A. Gate Valves, 3 Inches and Larger: MSS SP-70, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

2.10 BRONZE GLOBE VALVES

A. Globe Valves, 2-1/2 Inches and Smaller: MSS SP-80; Class 125, 200-psi CWP, or Class 150, 300-psi CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, bronze, or teflon disc, silicon bronze-alloy stem, teflon-impregnated packing with bronze nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

2.11 CAST-IRON GLOBE VALVES

A. Globe Valves, 3 Inches and Larger: MSS SP-85, Class 125, 200-psi CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, teflon-impregnated packing with cast-iron follower, flanged end connections; and with cast-iron handwheel.

2.12 CAST-IRON PLUG VALVES

A. Plug Valves: MSS SP-78, 175-psi CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Buna N, Viton, or teflon packing, flanged or grooved end connections:
1. Operator: Lever.
2. Operator: Worm and gear with handwheel, sizes 6 inches and larger.
3. Operator: Worm and gear with chain wheel, sizes 6 inches and larger, 96 inches or higher above floor.

2.13 CHAINWHEEL ACTUATORS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
   2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, butterfly, or gate or plug valves.
   2. Throttling Service: Ball, butterfly, or globe valves.
   4. Drain Valves: Ball valves with hose connection adaptor, cap and chain.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Chilled-Water Piping: Use the following types of valves:
   1. Ball Valves, NPS 2 and Smaller: 600-psig CWP rating, copper alloy.
   2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
   3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
   4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Wafer Check Valves, NPS 2-1/2 and Larger: Single-plate, wafer, Class 125 or 150 ferrous alloy.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

D. Condenser-Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: 600-psig CWP rating, copper alloy.
2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Wafer Check Valves, NPS 2-1/2 and Larger: Single-plate, wafer, Class 125 or 150 ferrous alloy.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

E. Dual Temperature-Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: 600-psig CWP rating, copper alloy.
2. Butterfly Valves, NPS 2-1/2 and Larger: Flanged, 150-psig CWP rating, ferrous alloy, with EPDM liner.
3. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
5. Wafer Check Valves, NPS 2-1/2 and Larger: Single-plate, wafer, Class 125 or 150 ferrous alloy.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 150, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

F. Domestic Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
6. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
7. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.

G. Heating Water Piping: Use the following types of valves:
1. Ball Valves, NPS 2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.
2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
4. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
5. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
7. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
8. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
H. Low-Pressure Steam/Steam Condensate/Feedwater Piping: Use the following types of valves:

1. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
2. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
3. Ball Valves: Table 15100-1.
4. High Performance Butterfly Valves: Table 15100-1.

### Table 15100-1 Steam, Pressure (130 psig maximum), Steam Condensate, and Feedwater

<table>
<thead>
<tr>
<th>Size</th>
<th>Type</th>
<th>End Connections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2”</td>
<td>Apollo 77-140-64-04 Series</td>
<td>Ball, 150 psig saturated steam, bronze body, full port, 316 SS ball &amp; stem, 250 psig steam trim (MPTFE), 2 ¼” stem extension</td>
</tr>
<tr>
<td>2 ½”</td>
<td>Apollo 88A-209-65-MG</td>
<td>Ball, Class 150, carbon steel body, full port, carbon steel ball &amp; stem, MPTFE seats &amp; graphite packing, gear operated handwheel</td>
</tr>
<tr>
<td>3”</td>
<td>Apollo 88A-200-65 -MG</td>
<td>Ball, Class 150, carbon steel body, full port, carbon steel ball &amp; stem, MPTFE seats &amp; graphite packing, gear operated handwheel</td>
</tr>
<tr>
<td>4”</td>
<td>Jamesbury 815L-11-2236MT</td>
<td>High Performance Butterfly, Class 150, single-flanged lugged, carbon steel body, 316 SS disk &amp; shaft, filled PTFE seat, PTFE seal</td>
</tr>
<tr>
<td>6” &amp; larger</td>
<td>Jamesbury 815L-11-2236MT with manual-gear actuator. Provide chain wheel for valves 8’ above the floor</td>
<td>For use in steam applications.</td>
</tr>
</tbody>
</table>

I. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water, steam, and steam condensate services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor elevation.
G. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.6 CLEANING – NOT APPLICABLE

3.7 CONTRACTOR STARTUP AND REPORTING – NOT APPLICABLE

3.8 DEMONSTRATION AND COMMISSIONING - NOT APPLICABLE

End of Section 15112
DIVISION 15 - MECHANICAL

SECTION 15140
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 1 Section "Product Requirements"
   2. Division 15 Section "Plumbing Specialties"
   3. Division 15 Section "Valves."
   4. Division 15 Section "Basic Plumbing Materials and Methods."
   5. Division 15 Section "Hangers and Supports."
   6. Division 15 Section "Plumbing Fixtures."

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Domestic water piping inside the building.

1.3 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.


C. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service(s): Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Construction Manager or Owner no fewer than two days in advance of proposed interruption of water service(s).
   2. Do not proceed with interruption of water service(s) without Construction Manager’s or Owner’s written permission.
1.6 DELIVERY, STORAGE AND HANDLING
   A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
   B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
   C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.7 WARRANTY
   A. Provide manufacturer's standard 1-year warranty for materials and labor, commencing on date of substantial completion.

1.8 PERFORMANCE REQUIREMENTS
   A. Provide components and installation capable of producing domestic water piping systems with 125 psig (860 kPa), unless otherwise indicated.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS
   A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 STEEL PIPE AND FITTINGS
   A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A, Schedule 40, galvanized. Include ends matching joining method.
   6. Steel-Piping, Expansion Joints: Compound, galvanized steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

2.3 COPPER TUBE AND FITTINGS
   A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types K and L (ASTM B 88M), water tube, drawn temper.
   2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
   3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.4 VALVES
   A. Bronze and cast-iron, general-duty valves are specified in Division 15 Section "Valves."
   B. Drain valves are specified in Division 15 Section "Plumbing Specialties."

PART 3 - EXECUTION

3.1 EXCAVATION
   A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.2 PIPE AND FITTING APPLICATIONS
   A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
   B. Flanges may be used on aboveground piping, unless otherwise indicated.
   C. Aboveground Domestic Water Piping: Use the following piping materials for each size range:
      1. NPS 3 and smaller: Hard copper tube, Type L, copper pressure fittings; and soldered joints.
      2. NPS 4 to NPS 6: Steel pipe; gray-iron, threaded fittings; and threaded joints.
      3. NPS 8: Ductile iron pipe, mechanical joints.
   D. Non-Potable-Water Piping: Use the following piping materials for each size range:
      1. NPS 3 and smaller: Steel pipe; gray-iron, threaded fittings; and threaded joints.

3.3 VALVE APPLICATIONS
   A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
      1. Shutoff Duty: Use bronze ball valves for piping NPS 2-1/2 and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 3 and larger.
2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 and larger.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2-1/2 and smaller. Use butterfly or gate valves for piping NPS 3 and larger.

C. Install drain valves at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

3.4 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install domestic water piping level without pitch and plumb.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 15 Section "Hangers and Supports." Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.
D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to the following:
   1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
   2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:
   1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
   2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
      a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
B. Test domestic water piping as follows:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.9 CLEANING AND ADJUSTING

A. Clean and disinfect potable and non-potable domestic water piping as follows:
1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

D. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CONTRACTOR STARTUP AND REPORTING

A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.

B. Perform the following steps before putting into operation:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open shutoff valves to fully open position.
   3. Open throttling valves to proper setting.
   4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
   5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
   6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.

D. Check plumbing specialties and verify proper settings, adjustments, and operation.

End of Section 15140
DIVISION 15 - MECHANICAL

SECTION 15145
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 15 Section "Basic Plumbing Materials and Methods"
   2. Division 15 Section "Plumbing Identification."

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides the following domestic water piping specialties:
   1. Vacuum breakers.
   2. Backflow preventers.
   3. Temperature-actuated water mixing valves.
   4. Strainers.
   5. Drain valves.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. NSF Compliance:
   1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver specialties in factory-provided packaging. Maintain packaging through shipping, storage, and handling to prevent damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored specialties from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
1.6 WARRANTY
A. Provide manufacturer’s standard 1-year warranty for materials and labor, commencing on date of substantial completion.

1.7 PERFORMANCE REQUIREMENTS
A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
      a. Reduced-Pressure-Principle Backflow Preventers
         1) FEBCO; SPX Valves & Controls.
         3) Zurn Plumbing Products Group; Wilkins Div.

2.2 VACUUM BREAKERS
A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   4. Inlet and Outlet Connections: Threaded.
   5. Finish: Rough bronze in unfinished back of house areas, chrome plated where exposed to public.

2.3 BACKFLOW PREVENTERS
A. Reduced-Pressure-Principle Backflow Preventers:
   2. Operation: Continuous-pressure applications.
   3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
   4. Size: Same as pipe size.
   5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
   6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   7. Configuration: Designed for horizontal, straight through or vertical inlet, horizontal center section, and vertical outlet flow as applicable.
   8. Accessories:
      a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:
   2. Pressure Rating: 125 psig minimum, unless otherwise indicated.
   5. Inlets and Outlet: Threaded.
   6. Finish: Rough or chrome-plated bronze.
   7. Tempered-Water Setting: 105 deg F.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations, unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.033 inch.
      b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.

2.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
   2. Pressure Rating: 400-psig minimum CWP.
   4. Body: Copper alloy.
   5. Ball: Chrome-plated brass.
   8. Inlet: Threaded or solder joint.

B. Stop-and-Waste Drain Valves:
   1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
   2. Pressure Rating: 200-psig minimum CWP or Class 125.
   5. Drain: NPS 1/8 side outlet with cap.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

D. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

C. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:
   1. Test each reduced-pressure-principle backflow preventer, according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.4 CLEANING AND ADJUSTING

A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

3.5 CONTRACTOR STARTUP AND REPORTING

A. Before startup, perform the following checks:
   1. System tests are complete.
   2. Damaged and defective specialties and accessories have been replaced or repaired.
   3. Clear space is provided for servicing specialties.

B. Before operating systems, perform the following steps:
   1. Close drain valves, hydrants, and hose bibbs.
   2. Open general-duty valves to fully open position.
   3. Remove and clean strainers.
   4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
C. Adjust operation and correct deficiencies discovered during startup.

End of Section 15145
DIVISION 15 - MECHANICAL

SECTION 15150
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 15 “Basic Materials and Methods”.
   2. Division 15 “Hangers and Supports”.
   3. Division 15 “Valves”.
   4. Division 15 “Plumbing Specialties”.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Soil, waste, and vent piping inside the building.
   2. Pipe, tube, and fittings.
   3. Special pipe fittings.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

C. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sewer Service(s): Do not interrupt sewer service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Construction Manager or Owner no fewer than two days in advance of proposed interruption of sewer service(s).
   2. Do not proceed with interruption of sewer service(s) without Construction Manager’s or Owner’s written permission.
1.7 WARRANTY
A. Provide manufacturer’s standard 1-year warranty for materials and labor, commencing on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
   1. Pressure Pipe Couplings:
      b. Dresser, Inc.; DMD Div.
      c. EBAA Iron Sales, Inc.
      d. JCM Industries, Inc.
   2. Expansion Joints:
      a. EBAA Iron Sales, Inc.
      b. Romac Industries, Inc.
      c. Star Pipe Products; Star Fittings Div.
   3. Wall-Penetration Fittings:
      a. SIGMA Corp.
      b. Romac Industries, Inc.

2.2 PIPING MATERIALS
A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS
A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum.

2.4 STEEL PIPE AND FITTINGS
A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.
B. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
C. Pressure Fittings:
2.5 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, drawn temper.
   3. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   4. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.6 SINGLE-WALL PIPE AND FITTINGS

A. PP Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion- and mechanical-joint ends.
   1. Manufacturers. Subject to compliance with requirements, provide products by one of the following:
      a. IPEX Inc.
      b. Orion Fittings, Inc.; a division of Watts Water Technologies, Inc.
      c. Sloane, George Fischer Inc.
      d. Town & Country Plastics, Inc.
      e. Watts Industries (Canada) Inc.
      f. Zurn Plumbing Products Group; Chemical Drainage Systems.

B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.

2.7 JOINING MATERIALS

A. Couplings: Assemblies with combination of clamps, gaskets, sleeves, and threaded or flanged parts; compatible with piping and system liquid; and made by piping manufacturer for joining system piping.

B. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, gaskets, and threaded or flanged parts; compatible with piping and system liquid; and made for joining different piping materials.

C. Flanges: Assemblies of companion flanges and gaskets complying with ASME B16.21 and compatible with system liquid, and bolts and nuts.

2.8 PIPING SPECIALTIES

A. Corrosion-Resistant Traps:
   1. Type: P-trap or drum trap.
   2. Size: NPS 1-1/2 or NPS 2 (DN 40 or DN 50), as required to match connected piping.
   3. PP: ASTM D 4101, with mechanical-joint pipe connections.
   4. PVDF: ASTM D 3222, with mechanical-joint pipe connections.

B. PP Sink Outlets:
1. Description: NPS 1-1/2 (DN 40), with clamping device, stopper, and 7-inch-(178-mm-) high overflow fitting.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 3 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.
   2. Steel pipe, drainage fittings, and threaded joints.
   3. Copper tube, copper drainage fittings, and soldered joints.

C. Aboveground, soil and waste piping NPS 4 and larger shall be the following:
   1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.

D. Aboveground, vent piping NPS 3 and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.
   2. Steel pipe, drainage fittings, and threaded joints.
   3. Copper tube, copper drainage fittings, and soldered joints.

E. Aboveground, vent piping NPS 4 and larger shall be the following:
   1. Service class, cast-iron soil pipe and fittings; lead and oakum joints.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

D. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
E. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

F. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

G. Lab-Waste Piping:
   1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
   2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
   3. Flanges may be used on aboveground piping unless otherwise indicated.
   4. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
   5. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
   6. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
   7. Install fittings for changes in direction and branch connections.
   8. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
      a. New Piping:
         1) Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
         2) Insulated Piping: One-piece, stamped-steel type with spring clips.
         3) Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
         4) Bare Piping at Ceiling Penetrations in Finished Spaces One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
         5) Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
         6) Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type
   9. Sleeves are not required for core-drilled holes.
   10. Permanent sleeves are not required for holes formed by removable PE sleeves.
   11. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
   12. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
      a. Cut sleeves to length for mounting flush with both surfaces.
         1) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
b. Install sleeves in new walls and slabs as new walls and slabs are constructed.

c. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1) Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
2) Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum board partitions.
3) Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
4) Seal space outside of sleeve fittings with grout.

13. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

14. Verify final equipment locations for roughing-in

H. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."


C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

E. Chemical-Waste Piping:
1. Plastic-Piping Electrofusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:
1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.
   4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

3.8 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   2. Sanitary Sewer, Force-Main Piping: 100 psig.

3.9 CLEANING AND ADJUSTING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.
3.10 CLEANING – LABORATORY WASTE

A. Use procedures prescribed by authorities having jurisdiction or, if not prescribed, use procedures described below:
   1. Purge new piping and parts of existing piping that have been altered, extended or repaired before using.
   2. Clean piping by flushing with potable water.

End of Section 15150
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 1 Section "Product Requirements."
   2. Division 15 Section "Plumbing Identification."
   3. Division 15 Section "Basic Plumbing Materials and Methods."

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides the following drainage piping specialties:
   1. Cleanouts.
   2. Through-penetration firestop assemblies.
   3. Miscellaneous drainage piping specialties.
   4. Flashing materials.

1.3 DEFINITIONS


B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.6 DELIVERY, STORAGE AND HANDLING.

A. Deliver specialties in factory-provided packaging. Maintain packaging through shipping, storage, and handling to prevent damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored specialties from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.7 WARRANTY

A. Provide manufacturer’s standard 1-year warranty for materials and labor, commencing on date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Exposed Metal Cleanouts
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Cast Iron Cleanouts
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Cast-Iron Wall Cleanouts
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Zurn Plumbing Products Group; Specification Drainage Operation.

2.2 CLEANOUTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers listed in paragraph 2.1.

B. Applicable Standard: ASME A112.21.1M

C. Body Material: Cast iron.

D. Seepage Flange: Required.

E. Clamping Device: Required.
F. Outlet: Bottom.

G. Top of Body and Strainer Finish: Polished brass.

H. Top Shape: Round.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
   2. Size: Same as connected soil, waste, or vent stack.
   3. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2.4 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Open Drains:
   1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
   2. Size: Same as connected waste piping with increaser fitting of size indicated.

2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
   2. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Applications: 12 oz./sq. ft. (3.7 kg/sq. m or 0.41-mm thickness).
   2. Pipe Flashing: 8 oz./sq. ft. (2.5 kg/sq. m or 0.27-mm thickness).

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch (1.01-mm) minimum thickness, unless otherwise indicated. Include G90 (Z275) hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil (1.01-mm) minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

G. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

H. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

I. Install wood-blocking reinforcement for wall-mounting-type specialties.

J. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.
B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.6 CONTRACTOR STARTUP AND REPORTING

A. Perform the following final checks before startup:
   1. Verify that specified tests of piping systems are complete.

3.7 DEMONSTRATION AND COMMISSIONING – NOT REQUIRED

End of Section 15155
DIVISION 15 - MECHANICAL

SECTION 15183

REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Divisions 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Refrigerant piping used for air-conditioning applications.

1.3 DEFINITIONS

A. Not applicable.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
   1. Thermostatic expansion valves.
   2. Solenoid valves.
   3. Hot-gas bypass valves.
   4. Filter dryers.
   5. Strainers.
   6. Pressure-regulating valves.

B. Shop Drawings: Show layout (fabrication drawings) of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment. Shop drawing shall be created in AutoCAD latest edition. Copies of design drawings are not acceptable.
   1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).
   2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Record Drawings: Show corrected layout (fabrication drawings) of actual refrigerant piping and specialties installation, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment. Record drawings shall be created in AutoCAD latest edition. Copies of design drawings are not acceptable. Provide both paper copy and electronic AutoCAD files.
1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).

D. Field quality-control test reports.
1. Submit written reports documenting the activities required to be performed in Part 3. These reports are to be submitted two weeks after the startup is completed.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE
B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 DELIVERY STORAGE AND HANDLING
A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION
A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7.

1.8 PERFORMANCE REQUIREMENTS
A. Refrigerant R-22: Shall not be allowed
B. Line Test Pressure for Refrigerant R-134a:
C. Line Test Pressure for Refrigerant R-407C:
D. Line Test Pressure for Refrigerant R-410A:

1.9 WARRANTY
A. Written manufacturer’s warranty covering parts and labor for a period of one year from substantial completion, or eighteen months from shipment, whichever is longer.
PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, provide refrigerants by one of the following manufacturers:
   1. Refrigerants:
      a. Atofina Chemicals, Inc.
      b. DuPont Company; Fluorochemicals Div.
      c. Honeywell, Inc.; Genetron Refrigerants.
      d. INEOS Fluor Americas LLC.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube:  ASTM B 280, Type ACR or type K complying with ASTM B88 or ASTM B819.

B. Wrought-Copper Fittings:  ASME B16.22.

C. Wrought-Copper Unions:  ASME B16.22.

D. Brazing Filler Metals:  AWS A5.8.

E. Flexible Connectors:
   2. End Connections:  Socket ends.
   3. Offset Performance:  Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
   5. Maximum Operating Temperature:  250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
   1. Body and Bonnet:  Forged brass or cast bronze; globe design with straight-through or angle pattern.
   3. Operator:  Rising stem and hand wheel.
   5. End Connections:  Socket.
   7. Maximum Operating Temperature:  275 deg F.

B. Packed-Angle Valves:
   1. Body and Bonnet:  Forged brass or cast bronze.
   2. Packing:  Molded stem, back seating, and replaceable under pressure.
   3. Operator:  Rising stem.
   5. Seal Cap:  Forged-brass or valox hex cap.
   8. Maximum Operating Temperature:  275 deg F.

C. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: forged brass, or cast bronze; or brass hex plug.
6. End Connections: Socket
7. Maximum Opening Pressure: 0.50 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
4. End Connections: Copper spring.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 115-V ac coil.
7. Maximum Operating Temperature: 240 deg F.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
6. Maximum Operating Temperature: 240 deg F.

G. Straight-Type Strainers:
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
5. Maximum Operating Temperature: 275 deg F.

H. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
6. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
5. End Connections: Socket or flare.
7. Maximum Operating Temperature: 240 deg F.

J. Replaceable-Core Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Rated Flow: <Insert tons (kW).>
9. Maximum Operating Temperature: 240 deg F.

K. Permanent Filter Dryers: Comply with ARI 730.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Rated Flow: <Insert tons (kW).>
9. Maximum Operating Temperature: 240 deg F.

L. Mufflers:
2. End Connections: Socket or flare.
4. Maximum Operating Temperature: 275 deg F.

M. Receivers: Comply with ARI 495.
1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket.
7. Maximum Operating Temperature: 275 deg F.

N. Liquid Accumulators: Comply with ARI 495.
2. End Connections: Socket.
4. Maximum Operating Temperature: 275 deg F.
2.4 REFRIGERANTS

A. ASHRAE 34, R-22: Monochlorodifluoromethane.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 REFRIGERANT R-22 – SHALL NOT BE ALLOWED

3.2 PIPING APPLICATIONS FOR REFRIGERANT R-134a

A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines:
   1. Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.3 PIPING APPLICATIONS FOR REFRIGERANT R-407C

A. Suction Lines for Conventional Air-Conditioning Applications: Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed joints.

3.4 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Suction Lines NPS 3-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR or K, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines: Copper, Type ACR or K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Safety-Relief-Valve Discharge Piping: Copper, Type ACR or K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.5 VALVE AND SPECIALTY APPLICATIONS

A. Install packed-angle valves in suction and discharge lines of compressor.
B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install packed-angle valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.6 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 15 for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 8 if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.

P. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 7.

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 7 for materials and methods.
V. Identify refrigerant piping and valves according to Division 15.

3.7 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
   1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
   2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.8 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 15.

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   2. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   3. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   4. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.

E. Support multifloor vertical runs at least at each floor.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
B. Tests and Inspections:
1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.10 SYSTEM CHARGING
A. Charge system using the following procedures:
1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.11 ADJUSTING
A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.
D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

End of Section 15183
DIVISION 15 - MECHANICAL

SECTION 15195
NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Pipes, tubes, and fittings.
   2. Piping specialties.
   3. Piping and tubing joining materials.
   4. Valves.
   5. Pressure regulators.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:
   1. Piping and Valves: 100 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Piping specialties.
   2. Corrugated, stainless-steel tubing with associated components.
   3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   4. Pressure regulators. Indicate pressure ratings and capacities.
   5. Dielectric fittings.
B. Shop Drawings: For facility natural-gas piping layout fabrication drawings. Include plans, piping layout and elevations, connections to equipment, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops. Shop drawing shall be created in AutoCAD latest edition. Copies of design drawings are not acceptable.

1. Shop Drawing Scale: 1/4 inch per foot.

C. Record Drawings: For facility shop drawings corrected for actual installation showing natural-gas piping layout. Include plans, piping layout and elevations, connections to equipment, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops. Shop drawing shall be created in AutoCAD latest edition. Copies of design drawings are not acceptable. Provide both paper copy and electronic AutoCAD files.

1. Shop Drawing Scale: 1/4 inch per foot.

D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

E. Field quality-control reports.

F. Operation and Maintenance Data: For gas valves, pressure regulators, and service meters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
1. Notify Architect / Owner no fewer than five days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Architect's / Owner's written permission.

1.9 COORDINATION

A. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B. (ABOVE GROUND APPLICATIONS ONLY)
   4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
      b. End Connections: Threaded or butt welding to match pipe.

2.2 PIPING SPECIALTIES

A. Appliance Flexible Connectors:
   2. Operating-Pressure Rating: 0.5 psig.
   5. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
   1. Copper-alloy convenience outlet and matching plug connector.
   2. Nitrile seals.
   3. Hand operated with automatic shutoff when disconnected.
   4. For indoor or outdoor applications.
   5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
2.3 JOINTING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.


2.4 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
   1. CWP Rating: 125 psig.
   3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
   4. Tamperproof Feature: Locking feature for valves in locations accessible to the public.
   5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
   6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
   7. Above ground applications only.

B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Lyall, R. W. & Company, Inc.
      d. Perfection Corporation; a subsidiary of American Meter Company.
   3. Ball: Chrome-plated bronze.
   4. Stem: Bronze; blowout proof.
   5. Seats: Reinforced TFE; blowout proof.
   6. Packing: Threaded-body packnut design with adjustable-stem packing.
   7. Ends: Threaded, flared, or socket.
   8. CWP Rating: 600 psig.
   9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
   10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
   11. Above ground applications only.

2.5 PRESSURE REGULATORS

A. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Actaris.
b. American Meter Company.
c. Eclipse Combustion, Inc.
d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
e. Invensys.
f. Maxitrol Company.
g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Canadian Meter Company Inc.
   b. Eaton Corporation; Controls Div.
   c. Harper Wyman Co.
   d. Maxitrol Company.
   e. SCP, Inc.
5. Seat Disc: Nitrile rubber.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Central Plastics Company.
d. Jomar International Ltd.
e. Matco-Norca, Inc.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Description:
   b. Pressure Rating: 125 psig minimum at 180 deg F.
   c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      b. Central Plastics Company.
      c. Matco-Norca, Inc.
      d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      e. Wilkins; a Zurn company.
   2. Description:
      b. Factory-fabricated, bolted, companion-flange assembly.
      c. Pressure Rating: 125 psig minimum at 180 deg F.
      d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

   B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

   A. Renovations & Additions: Close equipment shutoff valves before turning off natural gas to premises or piping section.
B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

O. Connect branch piping from top of horizontal piping.

P. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

Q. Do not use natural-gas piping as grounding electrode.
R. Install pressure gage upstream and downstream from each line regulator.

S. Install sleeves for piping penetrations of walls, ceilings, and floors.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.4 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:
   1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
   2. Cut threads full and clean using sharp dies.
   3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
   4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
   5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 15 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
   3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.

3.6 CONNECTIONS

A. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

B. Install piping adjacent to appliances to allow service and maintenance of appliances.

C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

A. Comply with requirements in Division 15 Section "Mechanical Identification" for piping and valve identification.
3.8 PAINTING
   A. Comply with requirements in Division 9 painting Sections for painting interior natural-gas piping.

3.9 FIELD QUALITY CONTROL
   A. Perform tests and inspections.
   B. Tests and Inspections:
      1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
   C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
   D. Prepare test and inspection reports.

3.10 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG
   A. Aboveground, branch piping NPS 1 and smaller shall be the following:
      1. Steel pipe with malleable-iron fittings and threaded joints.
   B. Aboveground, distribution piping shall be one of the following:
      1. Steel pipe with malleable-iron fittings and threaded joints (2" and smaller pipe).
      2. Steel pipe with wrought-steel fittings and welded joints.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE
   A. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:
      1. Two-piece, full-port, bronze ball valves with bronze trim.

End of Section 15195
1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
   A. Base Bid: General Contractor provides the following:
      1. Compressed Air piping and specialties operating at 50 to 100 psig.
      2. Vacuum piping and specialties.
   B. Related Sections include the following:
      1. Division 12 Section "Metal Laboratory Casework" for gas outlets in metal casework.
      2. Division 12 Section "Plastic-Laminate Laboratory Casework" for gas outlets in plastic-laminate casework.

1.3 DEFINITIONS
   A. CR: Chlorosulfonated polyethylene synthetic rubber.
   B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 SUBMITTALS
   A. Product Data: For the following:
      1. Tubes and fittings.
      2. Valves.
   B. Shop Drawings: Diagram power, signal, and control wiring.
   C. Qualification Data: For Installer and testing agency.
   D. Brazing certificates.
   E. Field quality-control test reports.
   F. Operation and Maintenance Data: For specialty gas piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE
   A. Installer Qualifications:
B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

1.6 PROJECT CONDITIONS

A. Interruption of Existing Specialty Gas Service(s): Do not interrupt specialty gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
   1. Notify Construction Manager or Owner no fewer than two days in advance of proposed interruption of specialty gas service(s).
   2. Do not proceed with interruption of specialty gas service(s) without Construction Manager's or Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Copper Gas Tube: ASTM B 819, Types K and L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for gas service.
   1. Wrought-Copper Fittings: MSS SP-73, with dimensions for brazed joints.
   2. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
   3. Press-Type Fittings:
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Viega; Plumbing and Heating Systems.
      b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
   4. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory-alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Smart Technology, Inc.

2.2 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.3 VALVES

A. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
      a. Amico Corporation.
      b. Conbraco Industries, Inc.
      c. NIBCO INC.
   2. Pressure Rating: 300 psig (2070 kPa) minimum.
3. Ball: Full-port, chrome-plated brass, or stainless steel where exposed.
4. Seats: PTFE or TFE.
5. Handle: Lever.
6. Stem: Blowout proof with PTFE or TFE seal.

B. Check Valves: In-line pattern, bronze.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
      a. Amico Corporation.
      b. Conbraco Industries, Inc.
   2. Pressure Rating: 300 psig (2070 kPa) minimum.

C. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.

2.4 SLEEVES
A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.5 ESCUTCHEONS
A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
C. One-Piece, Cast-Brass Escutcheons: With set screw.
   1. Finish: Polished chrome-plated and rough brass.
D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated and rough brass.
E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.
G. One-Piece, Floor-Plate Escutcheons: Cast iron.
H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.
2.6 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Non-healthcare, Specialty Gas Piping: As Indicated on drawings.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

E. Install piping adjacent to equipment and specialties to allow service and maintenance.

F. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.

G. Install piping to permit valve servicing.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.

K. Install unions, in copper tubing adjacent to each valve and at final connection to each piece of equipment and specialty.

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to gas laboratory equipment and specialties.
B. Install check valves to maintain correct direction of gas flow from laboratory gas supplies.

3.4 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Threaded Joints: Apply appropriate tape to external pipe threads.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.

D. Pressure-Sealed Joints: Join copper tube and press-type fittings with tools recommended by fitting manufacturer.

E. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.

3.5 SLEEVE INSTALLATION

A. Sleeves are not required for core-drilled holes.

B. Permanent sleeves are not required for holes formed by removable PE sleeves.

C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe.
   1. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
   2. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

D. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   1. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
   2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
      a. Seal space outside of sleeve fittings with grout.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

3.6 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated.
d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
e. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.
f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 15 Section "Hangers and Supports" for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or 42, clamps.

C. Individual, Straight, Horizontal Piping Runs:
   1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
   2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 15 Section "Hangers and Supports" for trapeze hangers.

E. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

F. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
   3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
   4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
   5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
   6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
   7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

3.8 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Division 15 Section "Mechanical Identification."

End of Section 15216
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides the following plumbing fixtures and related components:
   1. Faucets for sinks.
   2. Protective shielding guards.
   3. Drench hose emergency wash fixture.
   4. Water-tempering equipment for use with emergency plumbing fixtures.

1.3 DEFINITIONS

B. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
D. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
E. PMMA: Polymethyl methacrylate (acrylic) plastic.
F. PVC: Polyvinyl chloride plastic.
G. Tepid: Moderately warm.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
C. Warranty: Special warranty specified in this Section.
1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.


D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for sink faucets:
   1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
   3. Hose-Connection Vacuum Breakers: ASSE 1011.

G. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1.6 WARRANTY

A. Provide manufacturer's standard 1-year warranty for materials and labor, commencing on date of substantial completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Protective Shielding Pipe Covers:
   1. McGuire Manufacturing Co., Inc.
   2. Plumberex Specialty Products Inc.
   3. TRUEBRO, Inc.

B. Drench Hose Fixture:
   2. Guardian Equipment Co.

C. Water-Tempering Equipment:

2.2 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.3 DRENCH HOSE EMERGENCY WASH FIXTURE

A. Eye/Face Wash Equipment,
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings:
   2. Description: Plumbed, deck mounted eye/face drench wash fixture.
      a. Capacity: Deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.
      b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
      c. Control-Valve Actuator: Hand-held squeeze valve lever handle.
   3. Compliance: Drench hose shall have been tested to and comply with ANSI Z358.1-2004.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers’ written instructions.

B. Install fixtures level and plumb according to roughing-in drawings.

C. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

D. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

E. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

F. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

G. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

H. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

I. Install traps on fixture outlets.

J. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Connect water supply piping to plumbed emergency plumbing fixtures.

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

3.6 CLEANING AND ADJUSTING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

C. Adjust water pressure at faucets to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

End of Section 15410
DIVISION 15 - MECHANICAL

SECTION 15510
HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
A. Base Bid: General Contractor provides:
   1. Pipes, fittings, and specialties
   2. Special-duty valves
   3. Hydronic specialties

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 15.

1.3 SUBMITTALS
A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, accessories, and installation instructions for each hydronic specialty and special-duty valve specified.
   1. Submit flow and pressure drop curves for diverting fittings and calibrated plug valves, based on manufacturer’s testing.

C. Shop Drawings detailing pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops.

D. Field test reports indicating and interpreting test results for compliance with performance requirements specified in Part 3 of this Section.

E. Maintenance data for hydronic specialties and special-duty valves to include in the operation and maintenance manual specified in Division 1.

F. Shop Drawings, drawn to scale not smaller than 1/8” = 1’-0” (Produced using Autocad latest version) showing layout of hydronic piping, specialties, and fittings, including pipe sizes, flow capacities, valve arrangements and locations, wall and floor penetrations and equipment connection details. Show interface and special relationship between piping and equipment. Copies of design drawings are not acceptable.

1.4 QUALITY ASSURANCE
A. ASME Compliance: Comply with the following provisions:
1. ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

2. Welding Standards: Qualify welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

1.5 COORDINATION

A. Coordinate layout and installation of piping with equipment and with other installations.

B. Coordinate pipe sleeve installation for foundation wall penetrations.

C. Coordinate pipe fitting pressure classes with products specified in related Sections.

D. Coordinate installation of pipe sleeves for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Firestopping" for fire and smoke wall and floor assemblies.

1.6 EXTRA MATERIALS

A. Water Treatment Chemicals: Furnish sufficient chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grooved Mechanical-Joint Fittings and Couplings:
   a. Grinnell Supply Sales Co.
   b. Victaulic Company of America.

2. Calibrated Plug Valves:
   a. Armstrong Pumps, Inc.
   c. Gerand Engineering Co.
   d. ITT Fluid Technology Corp.; ITT Bell & Gossett.
   e. Taco, Inc.

3. Pressure-Reducing Valves:
   a. Armstrong Pumps, Inc.
   b. Grinnell Supply Sales Co.
   c. ITT Hoffman; ITT Fluid Handling Div.

4. Safety Relief Valves:
   a. Armstrong Pumps, Inc.
   b. Conbraco Industries, Inc.
   c. ITT Fluid Technology Corp.; ITT McDonnell & Miller.

5. Automatic Flow-Control Valves:
   a. Griswold Controls.
   b. As allowed in specification 17130.

2.2 PIPE AND TUBING MATERIALS
A. General: Refer to Part 3 "Pipe Applications" Article for identifying where the following materials are used.

B. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

C. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

D. Steel Pipe, 2-Inch NPS and Smaller: ASTM A 53, Type S (seamless), Grade A, Schedule 40, plain ends.

E. Steel Pipe, 2-1/2- to 12-Inch NPS: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, plain ends.


2.3 FITTINGS

A. Wrought-Copper Fittings: ASME B16.22.


C. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125, 150, and 300.


E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.

F. Cast-Iron Threaded Flanges: ASME B16.1, Classes 125 and 250; raised ground face, bolt holes spot faced.


H. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
   2. End Connections: Butt welding.
   3. Facings: Raised face.

I. Grooved Mechanical-Joint Fittings: Where allowed, ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47 (ASTM A 47M), Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.

J. Grooved Mechanical-Joint Couplings: Where allowed, consist of ductile- or malleable-iron housing, a synthetic rubber gasket of a central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

K. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig minimum working pressure, 250 deg F maximum operating temperature. Connectors shall have flanged or threaded end connections to match equipment connected and shall be capable of 3/4-inch misalignment.
L. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body, steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F and pressures up to 150 psig. Provide control rods or cables as required.

M. Packed, Slip, Expansion Joints: 150-psig minimum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, packing ring, packing, limit rods, flanged ends, and chrome-plated finish on slip-pipe telescoping section.

2.4 JOINING MATERIALS


B. Brazing Filler Metals: AWS A5.8, Classification BAg 1 (silver).

C. Welding Materials: Comply with Section II, Part C of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

D. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.5 VALVES

A. Globe, check, ball, and butterfly valves are specified in Division 15 Section "Valves."

B. Refer to Part 3 "Valve Applications" Article for specific uses and applications for each valve specified.

C. Calibrated Plug Valves: 125-psig working pressure, 250 deg F maximum operating temperature, bronze body, plug valve with calibrated orifice. Provide with connections for portable differential pressure meter with integral check valves and seals. Valve shall have integral pointer and calibrated scale to register degree of valve opening. Valves 2-inch NPS and smaller shall have threaded connections and 2-1/2-inch NPS valves shall have flanged connections.

D. Pressure-Reducing Valves: Diaphragm-operated, cast-iron or brass body valve, with low inlet pressure check valve, inlet strainer removable without system shutdown, and noncorrosive valve seat and stem. Select valve size, capacity, and operating pressure to suit system. Valve shall be factory set at operating pressure and have capability for field adjustment.

E. Safety Relief Valves: Brass or bronze body with brass and rubber, wetted, internal working parts; to suit system pressure and heat capacity; according to ASME Boiler and Pressure Vessel Code, Section IV.

F. Brass, Automatic Flow-Control Valves: 150-psig cold working pressure (CWP), 250 deg F maximum operating temperature, brass housing, stainless-steel operating parts; for soldered, threaded, or compression connections. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating-pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and flow rate.

G. Cast-Iron, Automatic Flow-Control Valves: Class 150, cast-iron housing, stainless-steel operating parts; threaded connections for 2-inch NPS and smaller, flanged
connections for 2-1/2-inch NPS and larger. Factory set to automatically control flow rates within plus or minus 5 percent design, while compensating for system operating-pressure differential. Provide quick disconnect valves for flow measuring equipment. Provide metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and flow rate.

### 2.6 HYDRONIC SPECIALTIES

A. **Manual Air Vent:** Bronze body and nonferrous internal parts; 150-psig working pressure, 225 deg F operating temperature; manually operated with screwdriver or thumbscrew; with 1/8-inch NPS discharge connection and 1/2-inch NPS inlet connection.

B. **Automatic Air Vent:** Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure, 240 deg F operating temperature; with 1/4-inch NPS discharge connection and 1/2-inch NPS inlet connection.

C. **Chemical Feeder:** Bypass-type chemical feeders of 5-gal. capacity, welded steel construction; 125-psig working pressure; complete with fill funnel and inlet, outlet, and drain valves.

   1. **Chemicals:** Specially formulated to prevent accumulation of scale and corrosion in piping system and connected equipment, and based on a water analysis of makeup water.

D. **Diverting Fittings:** 125-psig working pressure, 250 deg F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.

E. **Y-Pattern Strainers:** 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2-inch NPS and larger, threaded connections for 2-inch NPS and smaller, bolted cover, perforated Type 304 stainless-steel basket, and bottom drain connection. Provide ball valve for blow-down application.

F. **Basket Strainers:** 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged end connections, bolted cover, perforated Type 304 stainless-steel basket, and bottom drain connection.

G. **T-Pattern Strainers:** 750-psig working pressure; ductile-iron or malleable-iron body, grooved end connections, Type 304 stainless-steel strainer basket with 57 percent free area; removable access coupling and end cap for strainer maintenance.

### PART 3 - EXECUTION

#### 3.1 PIPE APPLICATIONS

A. **Hot Water, 2-Inch NPS and Smaller:** Aboveground, use Type L drawn-temper copper tubing with soldered joints or steel pipe with threaded joints.

B. **Hot Water, 2-1/2-Inch NPS and Larger:** Steel pipe with welded joints.

#### 3.2 VALVE APPLICATIONS

A. **General-Duty Valve Applications:** Unless otherwise indicated, use the following valve types:

   1. **Shutoff Duty:** Use ball or butterfly valves.
2. Throttling Duty: Use globe and butterfly valves.

B. Install shutoff-duty valves at each branch connection to supply mains, at supply connections to each piece of equipment, and elsewhere as indicated.

C. Install throttling-duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

D. Install calibrated plug valves on the outlet of each heating or cooling element and elsewhere as required to facilitate system balancing.

E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.

F. Install check valves on each pump discharge and elsewhere as required to control flow direction.

G. Install pressure-reducing valves as required to regulate system pressure.

3.3 PIPING INSTALLATIONS

A. Install piping according to Division 15 Section "Basic Mechanical Materials and Methods."

B. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

C. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch NPS ball valve, and short 3/4-inch NPS threaded nipple and cap.

D. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

F. Install branch connections to mains using tee fittings in main with takeoff out bottom of main, except for up-feed risers with takeoff out top of main line.

G. Install unions in pipes 2-inch NPS and smaller, adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not required at flanged connections.

H. Install flanges on valves, apparatus, and equipment having 2-1/2-inch NPS and larger connections.

I. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.

J. Install strainers on supply side of each control valve, pressure-reducing valve, pressure-regulating valve, solenoid valve, in-line pump, and elsewhere as indicated. Install 3/4-inch NPS nipple and ball valve in blow-down connection of strainers 2-inch NPS and larger.

K. Anchor piping to ensure proper direction of expansion and contraction.

3.4 HANGERS AND SUPPORTS
A. General: Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." Conform to requirements below for maximum spacing of supports.

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.
   2. Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal runs 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
   5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
   6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
   7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
   8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
   2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
   3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
   5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

E. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Refer to Section 15050 - Basic Mechanical Materials and Methods for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

B. Mechanical Joints: Assemble joints according to fitting manufacturer's written instructions.

3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in system, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points in system, heat-transfer coils, and elsewhere as required for system air venting.
C. Install in-line air separators in pump suction lines. Run piping to compression tank with a 2 percent upward slope toward tank. Install drain valve on units 2-inch NPS and larger.

D. Install shot-type chemical feeders in each hydronic system where indicated; in upright position with top of funnel not more than 48 inches above floor. Install feeder in bypass line, off main using globe valves on each side of feeder and in the main between bypass connections. Pipe drain, with ball valve, to nearest equipment drain.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Piping size for supply and return shall be same size as equipment connections.

B. Install control valves in accessible locations close to equipment.

C. Install bypass piping with globe valve around control valve. Where multiple, parallel control valves are installed, only one bypass is required.

D. Install pressure gage at coil inlet connections.

3.8 FIELD QUALITY CONTROL

A. Testing Preparation: Prepare hydronic piping according to ASME B31.9 and as follows:
   1. Leave joints, including welds, uninsulated and exposed for examination during test.
   2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
   3. Flush system with clean water. Clean strainers.
   4. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.
   5. Install relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Testing: Test hydronic piping as follows:
   1. Use ambient temperature water as testing medium, except where there is risk of damage due to freezing. Another liquid may be used if it is safe for workers and compatible with piping system components.
   2. Use vents installed at the high points of system to release trapped air while filling system. Use drains installed at low points for complete removal of liquid.
   3. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low-pressure filling lines are disconnected.
   4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. The design pressure is 125 psig. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Check to verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, Code for Pressure Piping, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components as appropriate, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

3.9 ADJUSTING AND CLEANING

A. After completing system installation, including outlet fittings and devices, inspect finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Cleaning, flushing and treating hydronic piping systems.

3.10 FIELD QUALITY CONTROL

A. Fill system and perform initial chemical treatment.

B. Check expansion tanks to determine that they are not air bound and that system is completely full of water.

C. Perform these steps before operating the system:
   1. Open valves to fully open position. Close coil bypass valves.
   2. Set automatic fill valves for required system pressure.
   3. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or bleed air completely (manual type).
   4. Set temperature controls so all coils are calling for full flow.
   5. Check operation of automatic bypass valves.

End of Section 15510
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 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Floor-mounted air conditioners, 5 tons (18 kW) and smaller.

1.3 DEFINITION

A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For air conditioners. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: For power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, using input from Installers of the items involved.

B. Seismic Qualification Certificates: For air conditioners, 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. Field quality-control reports.
D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air conditioners to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fan Belts: One set(s) for each belt-driven fan.
   2. Filters: One set(s) of filters for each unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.9 COORDINATION

A. Coordinate layout and installation of air conditioners and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of air conditioners with access flooring Installer.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

D. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air conditioners that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
   2. Warranty Period for Humidifiers: Manufacturer's standard, but not less than three years from date of Substantial Completion.
3. **Warranty Period for Control Boards:** Manufacturer’s standard, but not less than three years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 FLOOR-MOUNTED UNITS 5 TONS (18 kW) AND SMALLER**

**A. Basis-of-Design Product:** Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Airflow Company; a division of The McClain Company, Inc.
2. Carrier Corporation; a United Technologies company.
3. Compu-Aire, Inc.
4. Data Aire Inc.
5. Liebert Corporation.
7. Stulz-ATS.

**B. Description:** Self-contained, factory assembled, prewired, and prepiped; consisting of cabinet, fan, filters, and controls; for vertical floor mounting in upflow configuration.

**C. Cabinet and Frame:** Welded tubular-steel frame with removable steel panels with baked-enamel finish, insulated with 1-inch- (25-mm-) thick duct liner.

1. **Finish of Interior Surfaces:** Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

**D. Supply-Air Fan:** Forward curved, centrifugal, and with adjustable V-belt drive.

**E. Refrigeration System:**

1. **Compressor:** Hermetic, with oil strainer, internal motor overload protection, resilient suspension system, and crankcase heater.
2. **Refrigeration Circuit:** Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.
3. **Refrigerant:** R-407C or R-410A.
4. **Refrigerant Evaporator Coil:** Direct-expansion coil of seamless copper tubes expanded into aluminum fins, with two circuits, each with solenoid valve.
   a. **Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral dual float switch, pump-motor assembly, and condensate reservoir.**
5. **Remote Air-Cooled Refrigerant Condenser:** Integral, copper-tube aluminum-fin coil with propeller fan, direct driven.
6. **Split system shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.**
7. **Provide Hot gas bypass.**

**F. Electric-Resistance Heating Coil:** Finned-tube electric elements with contactor and high-temperature-limit switches.

**G. Filter:** 2-inch- (50-mm-) thick, disposable, glass-fiber media.

1. **Merv (ASHRAE 52.2):** 7

**H. Infrared Humidifier:** High-intensity quartz lamps mounted above stainless-steel evaporator pan, serviceable without disconnecting water, drain, or electrical
connections; prepiped and located in bypass airstream; with flush-cycle timer and solenoid drain valve.

I. Disconnect Switch: Nonautomatic, molded-case circuit breaker with handle accessible when panel is closed and capable of preventing access until switched to off position.

J. Control System: Unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature- and humidity-control modules, humidity contactor, time-delay relay, heating contactor, and high-temperature thermostat. Provide solid-state, wall-mounted control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.

K. Microprocessor-Control System: Continuously monitors operation of process cooling system; continuously displays room temperature and room relative humidity; sounds alarm on system malfunction and simultaneously displays problem. If more than one malfunction occurs, system displays fault in sequence with room temperature and continues to display fault when malfunction is cleared until system is reset.

1. Malfunctions:
   a. Power loss.
   b. Loss of airflow.
   c. Clogged air filter.
   d. High room temperature.
   e. Low room temperature.
   f. High humidity.
   g. Low humidity.
   h. Smoke/fire.
   i. Water under floor.
   j. Supply fan overload.
   k. Compressor No. 1 - Overload.
   l. Compressor No. 1 - Low Pressure.
   m. Compressor No. 1 - High Pressure.
   n. Compressor No. 2 - Overload.
   o. Compressor No. 2 - Low Pressure.
   p. Compressor No. 2 - High Pressure.

2. Digital Display:
   a. Control power on.
   b. Humidifying.
   c. Dehumidifying.
   d. Compressor No. 1 - Operating.
   e. Compressor No. 2 - Operating.
   f. Heat operating.
   g. Economy cooling.

3. Push buttons shall stop and start process cooling system, silence audible alarm, test indicators, and display room's relative humidity.

4. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms. For future tie in to Honeywell BAS.
   a. Hardwired Points (future capability):
      1) Monitoring: On-off status, common trouble alarm, space temperature, space relative humidity.
      2) Control: On-off operation, space temperature set-point adjustment, space relative humidity set-point adjustment.
   b. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit.
Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

2.2 FAN MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for hydronic piping systems to verify actual locations of piping connections before equipment installation.
C. Examine walls, floors, and roofs for suitable conditions where air conditioners will be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install air conditioners level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.
B. Air-Conditioner Mounting: Install using elastomeric mounts. Comply with requirements for vibration isolation devices specified in Spec Section "Vibration and Seismic Controls for HVAC."
   1. Minimum Deflection: 1/4 inch (6 mm).
C. Air-Cooled Refrigerant Condenser Mounting: Install using elastomeric pads restrained spring isolators. Comply with requirements for vibration isolation devices specified in Spec Section "Vibration and Seismic Controls for HVAC."
   1. Minimum Deflection: 1/4 inch (6 mm).

3.3 CONNECTIONS

A. Piping installation requirements are specified in other heating, ventilating, and air-conditioning Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to machine to allow service and maintenance.
C. Water and Drainage Connections: Comply with applicable requirements in Section 15140 "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Refrigerant Piping: Comply with applicable requirements in Section 15183 "Refrigerant Piping." Provide shutoff valves and piping.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
   2. After installing air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
   3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air conditioners will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

F. After startup service and performance test, change filters and flush humidifier.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 6 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air conditioners.

End of Section 15734
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
1. Rectangular ducts and fittings.
2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.

B. Related Sections include the following:
1. Division 15

1.3 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
2. Joints: Joints include girth joints; branch and sub-branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SUBMITTALS

A. Shop Drawings: AutoCAD-generated and drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts. Copies of design drawings are not acceptable.
1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevations of top and bottom 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 and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.
B. Coordination Drawings: Signed by each trade, reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, access panels, and special moldings.

C. Field quality-control test reports.

D. Record Drawings: Indicate actual routing, fitting details, reinforcement, support, and installed accessories and devices. Record drawings shall be provided in both hard copy and electronic format (Autocad latest edition) to the owner. Scanned copies of design drawings or shop drawings will not be accepted.

1.5 QUALITY ASSURANCE


B. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials delivered to the site must be coordinated with the site supervisor prior to delivery.

B. All materials shall be stored in a designated area and protected from the environment.

C. All materials shall be secured so as not to be a hazard during the construction process.

D. All materials must be free of all dirt, debris and moisture during the installation process.

1.7 WARRANTY

A. Minimum one year warranty on all material and labor from substantial completion date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Ductmate Industries, Inc.
   2. Lindab
   3. Lockformer
   4. McGill Airflow
5. Nexus Inc.
6. Semco, Inc.

2.2 SHEET METAL MATERIALS

A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M, Type 316, and having No. 20 finish for concealed ducts.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

E. 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.

F. Insulated Flexible Ducts: Flexible ducts wrapped with flexible glass fiber insulation, enclosed by seamless aluminum pigmented plastic vapor barrier jacket; maximum 0.23 K value at 75 degrees F.

2.3 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: 6 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.

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 (2500 Pa), 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.
10. VOC: Maximum 75 g/L (less water).

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.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
2. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

2.5 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
   1. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
   2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.6 ROUND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Duct Joints:
   1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
   2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
   3. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

D. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

E. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

F. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
   1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
   2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
      a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
      b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
   3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
      a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
      b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.

5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.

10. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

11. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
   1. Supply Ducts (before Air Terminal Units): +2".
   2. Supply Ducts (after Air Terminal Units): +0.5".
   3. Return Ducts (Negative Pressure): -2".
   4. Exhaust Ducts (Negative Pressure): -2".
   5. Fume Hood Exhaust Duct (Negative Pressure): -4".

B. Acid-Resistant (Fume-Handling) Ducts: Type 316, stainless-steel sheet with No. 2 Finish continuously welded.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7.


3.3 SEAM AND JOINT SEALING

A. Seal all duct seams and joints to the most severe requirement between the latest Chicago Building Code and SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

B. Utilize sealant designed for outdoor use with ductwork exposed to the outdoors.

C. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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 4-1 (Table 4-1M), "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) 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 (5 m).

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.

G. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

H. Support vertical ducts at maximum intervals of 16 feet and at each floor.

I. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

J. For concrete structure installations: Install concrete inserts before placing concrete.

K. For concrete structure installations: Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
   1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test
entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.

4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.7 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
   2. Disconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems 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. Coils and related components.
   4. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
   5. Supply-air ducts, dampers, actuators, and turning vanes.

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 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.

F. Cleanliness Verification:
   1. Visually inspect metal ducts for contaminants.
   2. Where contaminants are discovered, re-clean and reinspect ducts.
G. Mark position of dampers and air-directional mechanical devices before cleaning, and restore to their marked position on completion.

H. 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 the outside, use filtration to contain debris removed from HVAC system, and locate exhaust down wind and away from air intakes and other points of entry into building.

I. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housing, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Coils and related components.
4. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
5. Supply-air ducts, dampers, actuators, and turning vanes.
6. Dedicated exhaust and ventilation components and makeup air systems.

J. 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 operative drainage system for washdown procedures.
7. Biocidal Agents and Coatings: Apply biocidal agents if fungus is present. Apply biocidal agents according to manufacturer’s written instructions after removal of surface deposits and debris.

K. Cleanliness Verification:
1. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
2. Visually inspect metal ducts for contaminants.
3. Where contaminants are discovered, re-clean and reinspect ducts.

L. Verification of Coil Cleaning: Cleaning must restore coil pressure drop to within 10 percent of pressure drop measured when coil was first installed. If original pressure drop is not known, coil will be considered clean only if it is free of foreign matter and chemical residue, based on thorough visual inspection.

End of Section 15815
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Backdraft dampers.
   2. Volume dampers.
   3. Manual volume damper cable operator
   4. Fire dampers.
   5. Smoke dampers.
   6. Combination fire smoke dampers.
   7. Duct silencers.
   8. Turning vanes.
   9. Duct-mounting access doors.
  10. Pressure relief access doors.
  11. Flexible connectors.
  12. Flexible ducts.
  13. Duct accessory hardware.

1.3 DEFINITIONS – NOT APPLICABLE

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Backdraft dampers.
   2. Volume dampers.
   3. Fire dampers.
   4. Manual volume damper cable operator
   5. Smoke dampers.
   6. Combination fire smoke dampers.
   7. Duct silencers.
   8. Turning vanes.
   9. Duct-mounting access doors.
  10. Pressure relief access doors.
  11. Flexible connectors.
  12. Flexible ducts.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Special fittings.
   2. Backdraft dampers.
   4. Manual volume damper cable operator locations
   5. Motorized-control damper installations.
6. Fire-damper, smoke-damper, and combination fire- and smoke-damper installations, including sleeves and duct-mounting access doors.
7. Duct silencers.
8. Duct mounted access doors.
9. Pressure relief access doors.
10. Flexible connectors.
11. Flexible ducts.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

1.5 QUALITY ASSURANCE


1.6 DELIVERY, STORAGE AND HANDLING

A. Materials delivered to the site must be coordinated with the site supervisor prior to delivery.
B. All materials shall be stored in a designated area and protected from the environment.
C. All materials shall be secured so as not to be a hazard during the construction process.
D. All materials must be free of all dirt, debris and moisture during the installation process.

1.7 WARRANTY

A. Minimum one year warranty on all material and labor from substantial completion date.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Backdraft Dampers:
      a. Greenheck
      b. Ruskin
      c. Vent Products Company
   2. Volume Dampers
      a. Nailor
      b. Ruskin
      c. Vent Products Company
   3. Manual Volume Damper Cable Operator
      a. Metropolitan Air Technology
      b. Approved Equal
   4. Fire Dampers
a. Greenheck  
b. Ruskin  
c. Vent Products Company

5. Smoke Dampers  
a. Greenheck  
b. Ruskin  
c. Vent Products Company

6. Combination Fire and Smoke Dampers  
a. Greenheck Fan Corporation.  
b. Ruskin Company.  
c. Vent Products Company

7. Duct Silencers  
a. Industrial Acoustics Co. (IAC)  
b. Ruskin  
c. Vibro-Acoustics  
d. Price

8. Duct-Mounting Access Doors  
a. CESCO Products  
b. Ductmate Industries  
c. Greenheck

9. Pressure Relief Access Door  
a. Ductmate Industries  
b. Greenheck  
c. KEES, Inc

10. Flexible Connectors  
a. Ductmate Industries  
b. Ventfabrics, Inc.  
c. Ward Industries

11. Flexible Ducts  
a. Flexmaster USA  
b. Hart & Cooley, Inc.  
c. McGill Airflow Corp.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Stainless Steel: ASTM A 480/A 480M Type 304 (specify Type 314 as required by the application).

D. Aluminum Sheets: ASTM B 209 alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.


F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
G. 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 DAMPERS
A. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
B. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.
C. Blades: 0.050-inch thick aluminum sheet.
D. Blade Seals: Neoprene.
E. Blade Axles: Galvanized steel.
F. Tie Bars and Brackets: Galvanized steel.
G. Return Spring: Adjustable tension.

2.4 VOLUME DAMPERS
A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
6. Blade Axles: Galvanized steel. Drive shaft will be the full length of the blade.
8. Tie Bars and Brackets: Aluminum.
C. Low-Leakage Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.

3. Aluminum Frames: 0.10-inch thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

4. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.

5. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.

6. Blade Axles: Galvanized steel. Drive shaft will be the full length of the blade.

7. Bearings: Stainless-steel sleeve thrust or ball.


10. Tie Bars and Brackets: Aluminum.

D. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

F. Manual Volume Damper Cable Operator: Heavy duty universal damper drive, cable, termination, mounting brackets and mini ceiling cup (1” diameter). Similar to Metropolitan Air Technology (Round Ducts: MAT RT-250 with RT-WGA and RT-CCM, Rectangular Ducts: MAT-RT-200 with RT-WGA and RT-CCM) with mounting bracket and miniature ceiling cup. Hex nut driven.

2.5 FIRE DAMPERS

A. Fire dampers shall be labeled according to UL 555.

B. Fire Rating: Insert rating as required by application hours.

C. Frame: Curtain type with blades outside airstream fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.

D. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

E. Mounting Orientation: Vertical or horizontal as indicated.

F. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.
G. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

H. Fusible Links: Replaceable, 165 deg F rated.

I. Fire dampers in ductwork serving natatorium / locker / toilet / shower areas shall be aluminum or 316 stainless steel construction.

2.6 SMOKE DAMPERS

A. General Requirements: Label according to UL 555S by an NRTL.

B. Smoke Detector: Integral, factory wired for single-point connection.

C. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded, interlocking, gusseted or mechanically attached corners and mounting flange.

D. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.034-inch-thick, galvanized sheet steel.

E. Leakage: Class I.

F. Rated pressure and velocity to exceed design airflow conditions.

G. Mounting Sleeve: Factory-installed, 0.039-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

H. Damper Motors: two-position action.

I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15055.
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
   2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 15.
   3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
   4. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in x lbf and breakaway torque rating of 150 in x lbf.
   5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

J. Accessories:
   1. Auxiliary switches for signaling and position indication.
   2. Test and reset switches, damper mounted.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
B. Closing rating in ducts up to 8-inch wg static pressure class and minimum 4000-fpm> velocity.

C. Fire Rating: 1-1/2 and 3 hours. See life safety drawings for assembly wall and floor ratings.

D. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded, interlocking, gusseted or mechanically attached corners and mounting flange.

E. Heat-Responsive Device: Resettable, 212 deg F rated, fire-closure device.

F. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

G. Smoke Detector: Integral, factory wired for single-point connection.

H. Blades: Roll-formed, horizontal, interlocking, overlapping, 0.063-inch thick, galvanized sheet steel.

I. Leakage: Class I.

J. Rated pressure and velocity to exceed design airflow conditions.

K. Mounting Sleeve: Factory-installed, 0.039-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

L. Master control panel for use in dynamic smoke-management systems.

M. Damper Motors: two-position action.

N. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15055

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.


3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Spring-Return Motors: Equip with an integral spiral-spring mechanism. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.


O. Accessories:

1. Auxiliary switches for signaling and position indication.

2. Test and reset switches, damper mounted.
2.8 DUCT SILENCERS

A. General Description: Factory-fabricated and -tested, round or rectangular silencers with performance characteristics and physical requirements as indicated.

B. Fire Performance: Adhesives, sealants, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame-spread index and 50 for smoke-developed index when tested according to ASTM E 84.

C. Rectangular Units: Fabricate casings with a minimum of 0.034-inch-thick, solid galvanized sheet metal for outer casing and 0.022-inch-thick, ASTM A 653/A 653M, G90 perforated galvanized sheet metal for inner casing. Inner casing shall match ductwork material.

D. Round Units:
   1. Outer Casings:
      b. Up to 24 Inches in Diameter: 0.034 inch thick.
      c. 26 through 40 Inches in Diameter: 0.040 inch thick.
      d. 42 through 52 Inches in Diameter: 0.052 inch thick.
      e. 54 through 60 Inches in Diameter: 0.064 inch thick.
      f. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.
   2. Interior Casing, Partitions, and Baffles:
      b. At least 0.034 inch thick and designed for minimum aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

F. Packless

G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
   1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.
   2. Lock form and seal or continuously weld joints.
   3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
   4. Reinforcement: Cross or trapeze angles for rigid suspension.

H. Source Quality Control:
   1. Acoustic Performance: Test according to ASTM E 477.
   2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.
   3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.9 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

D. Turning vane material shall match the associated ductwork the vanes are installed in (i.e. aluminum ducts shall have aluminum turning vanes, etc.).

2.10 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
   1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   2. Provide number of hinges and locks as follows:
      a. Less Than 12 Inches Square: Secure with two sash locks.
      b. Up to 18 Inches Square: Two hinges and two sash locks.
      c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
      d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
   1. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.
   1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

E. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

F. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

G. Duct mounted access door material shall match the associated ductwork the doors are installed in (i.e. aluminum ducts shall have aluminum doors, etc.).

2.11 FLEXIBLE CONNECTORS

A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 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. Select metal compatible with 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.

D. Hood exhaust system shall be rated for good resistance to acid/chemical exposure.
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.

2.12 FLEXIBLE DUCTS

A. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; 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

B. Flexible Duct 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.

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 APPLICATION AND 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. Provide 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. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Balancing dampers may not be shown in all locations on the drawings. The contractor shall provide manual balancing dampers in all supply / return / exhaust / outside air ductwork at all diffusers, registers, grilles, at outside air connections to fan coil units, at fan coil unit / fan powered box supply discharge (after the ductwork has expanded but before the first duct take-off), at all floor mains, at all duct branches and as required to balance all systems (Note: Not all dampers are shown on the drawings) while meeting the project LEED sound requirements.

E. Provide remote cable operator for manual balancing dampers located above drywall/plaster/metal ceilings/walls. Cable length as required to install in accessible location coordinated with all items in ceilings and walls. Terminate with ceiling/wall paintable mini cup cap (flush to surface) to hide hex nut driver. Custom color as selected by architect.
F. Provide test holes at fan inlets and outlets and elsewhere as indicated.

G. Provide fire dampers / smoke dampers / fire smoke dampers where indicated on the drawings and as required to comply with City of Chicago drawing notes (Note: Not all dampers are shown on the drawings). See architectural drawings for fire ratings of walls/floors/ceilings/shafts/soffits. Fire dampers / smoke dampers / combination fire smoke dampers shall be installed in accordance with UL approved written instructions.

H. Install smoke dampers and combination fire smoke dampers according to manufacturer's UL approved written instructions.

I. Install duct silencers rigidly to ducts.

J. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:
   1. On both sides of duct coils. On terminal units coordinate upstream coil access door with equipment supplier.
   2. Downstream from volume dampers, turning vanes, and duct mounted equipment.
   3. Adjacent to fire dampers, providing access to reset or reinstall fusible links.
   4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot spacing.
   5. On sides of ducts where adequate clearance is available.
   6. As required or indicated on plans.
   7. Upstream and downstream of ducted fans.

K. Label access doors according to Division 15 Section "Mechanical Identification."

L. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

M. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to low pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

Q. Install duct test holes where indicated and required for testing and balancing purposes.

R. Provide turning vanes in all short radius / square elbows (>45 degrees) and tees when duct velocity exceeds 800 FPM.

S. Provide washable lint filter upstream of all laundry exhaust fans. Provide duct access doors upstream and downstream of filter. Size air filter for a maximum of 400 feet per minute across filter face.
3.2 ADJUSTING

A. Adjust duct accessories for proper settings.
B. Adjust fire and smoke dampers for proper action.
C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

3.3 CLEANING – NOT APPLICABLE

3.4 CONTRACTOR STARTUP AND REPORTING – NOT APPLICABLE

3.5 DEMONSTRATION AND COMMISSIONING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the duct accessories.
   1. Train Owner's maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining duct accessories. The training will occur after testing and balancing. The trainer will provide two (2) Installation and Operations manuals for the use of the owners personnel during training.
   2. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data." All required and recommended maintenance will be reviewed as well as operational trouble shooting. If the IOM does not include a written trouble shooting guide one will be provided.
   3. Schedule training with Owner, through Architect, with at least seven days' advance notice.

B. Demonstrate proper operation of duct accessories to commissioning agent or designated owners personnel. The scope of the demonstration will include functional performance requirements under both stand alone and building automation control (when identified in control documents) as well as any commissioning requirements in Division 1 or 15.
   1. For all fire dampers or access doors for fire dampers installed on this project the Contractor will demonstrate that any fire dampers selected by the owner can be dropped and reset using the provided access doors.

End of Section 15820
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Airfoil centrifugal fans.
   2. Backward-inclined centrifugal fans.
   3. Forward-curved centrifugal fans.

1.3 DEFINITIONS – NOT APPLICABLE

1.4 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
   1. Certified fan performance curves with system operating conditions indicated.
   2. Certified fan sound-power ratings.
   3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
   4. Material thickness and finishes, including color charts.
   5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.
1.5 QUALITY ASSURANCE
   A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
   C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.6 DELIVERY, STORAGE, AND HANDLING
   A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
   B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.
   C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7 PERFORMANCE REQUIREMENTS
   A. Project Altitude: Base fan performance ratings on sea level.
   B. Operating Limits: Classify according to AMCA 99.

1.8 COORDINATION
   A. Coordinate size and location of structural-steel support members.
   B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.
   C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.9 EXTRA MATERIALS
   A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide one set of belts for each belt-driven unit.

1.10 WARRANTY
   A. Provide manufacturer's standard form in which manufacturer agrees to replace components of fans that fail in materials or workmanship within one year after date of substantial completion or 18 months from date of delivery, whichever is longer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Airfoil Centrifugal Fans:
      1. Howden Fan Co.
2.2 AIRFOIL CENTRIFUGAL FANS

A. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

B. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.
   1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
   2. Spun inlet cone with flange.
   3. Outlet flange.

C. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate; hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate; and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

D. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
   1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
   2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
   1. Ball-Bearing Rating Life: ABMA 9, L50 in excess of 200,000 hours.
   2. Roller-Bearing Rating Life: ABMA 11, L50 in excess of 200,000 hours.

F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor Size: 1.5.
   2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.


G. Accessories:
1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
5. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

H. Motors: Comply with requirements in Division 15 Section "Motors."
1. Enclosure Type: Totally enclosed, fan cooled.

2.3 BACKWARD-INCLINED CENTRIFUGAL FANS

A. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

B. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
2. Spun inlet cone with flange.
3. Outlet flange.

C. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

D. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
1. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
E. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
   1. Ball-Bearing Rating Life: ABMA 9, L50 in excess of 200,000 hours.
   2. Roller-Bearing Rating Life: ABMA 11, L50 in excess of 200,000 hours.

F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor Size: 1.5.
   2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

G. Accessories:
   1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
   2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
   3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
   4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   5. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
   6. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
   7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
   8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

H. Motors: Comply with requirements in Division 15 Section "Motors."
   1. Enclosure Type: Totally enclosed, fan cooled.

2.4 FORWARD-CURVED CENTRIFUGAL FANS

A. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.

B. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
   1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
   2. Spun inlet cone with flange.
3. Outlet flange.

C. Forward-Curved Wheels: Black-enameled or galvanized steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

D. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.
   1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
   2. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

E. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
   1. Ball-Bearing Rating Life: ABMA 9, L50 in excess of 200,000 hours.
   2. Roller-Bearing Rating Life: ABMA 11, L50 at 200,000 hours.

F. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
   1. Service Factor Based on Fan Motor Size: 1.5.
   2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
   3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.
   4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
   5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

G. Accessories:
   1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
   2. Cleanout Door: Bolted gasketed door allowing access to fan scroll, of same material as housing.
   3. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.
   4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   5. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
   6. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
   7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
   8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
H. Motors: Comply with requirements in Division 15 Section "Motors."
   1. Enclosure Type: Totally enclosed, fan cooled.

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Support floor-mounting units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 15 Section "Mechanical Vibration Controls."

C. Install floor-mounting units on concrete bases.

D. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 15 Section "Mechanical Vibration Controls."

E. Install units with clearances for service and maintenance.

F. Label fans according to requirements specified in Division 15 Section "Mechanical Identification."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."
3.3 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.4 CONTRACTOR STARTUP AND REPORTING

A. Perform the following field tests and inspections and prepare test reports:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
   5. Adjust belt tension.
   6. Adjust damper linkages for proper damper operation.
   7. Verify lubrication for bearings and other moving parts.
   8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
   9. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
  10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Refer to Division 15 Section "Building Automation System."

3.5 DEMONSTRATION AND COMMISSIONING

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 1 Section "Demonstration and Training."

End of Section 15837
DIVISION 15 - MECHANICAL

SECTION 15855
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Related Sections:
   1. All Division 15 Sections.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Diffusers
   2. Registers
   3. Grilles

1.3 DEFINITION

A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in
   the ceiling and comprised of deflecting members discharging supply air in various
   directions and planes and arranged to promote mixing of primary air with secondary
   room air.

B. Grille: A louvered or perforated covering for an opening in an air passage, which can
   be located in a sidewall, ceiling, or floor.

C. Register: A combination grille and damper assembly over an air opening.

1.4 SUBMITTALS

A. Submit the following according to the conditions of the Contract and Division 1
   Specification Sections.
   1. Schedule of diffusers, registers, and grilles indicating drawing designation,
      room location, number furnished, model number, size, and accessories
      furnished.
   2. Data sheet for each type of diffusers, registers, and grilles, and accessory
      furnished; indicating construction, finish, and mounting details.
   3. Performance data for each type of diffusers, registers, and grilles furnished,
      including aspiration ability, temperature and velocity traverses, throw and
      drop, and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of
   diffusers, registers, and grilles, indicating materials and methods of assembly of
   components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for
   finishes, and spare parts lists. Include this data, product data, and shop drawings in
   maintenance manuals; in accordance with requirements of Division 1.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of diffusers,
registers, and grilles of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:
1. ARI Compliance: Test and rate diffusers, registers, and grilles in accordance with ARI 650 "Standard for Diffusers, registers, and grilles".
2. ASHRAE Compliance: Test and rate diffusers, registers, and grilles in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate diffusers, registers, and grilles in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide diffusers, registers, and grilles bearing ADC Certified Rating Seal.
5. NFPA Compliance: Install diffusers, registers, and grilles in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver diffusers, registers, and grilles wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store diffusers, registers, and grilles in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DIFFUSERS/REGISTERS/GRILLES

A. As scheduled on drawings.

B. Manufacturers: Subject to compliance with requirements, provide diffusers by one of the following:
   1. Titus Products Div.
   2. Tuttle and Bayley.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which diffusers, registers, and grilles are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install diffusers, registers, and grilles in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to
interface installation of diffusers, registers, and grilles with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling modules. Where architectural features or other items conflict with installation, notify Architect for determination of final location.

1. Furnish and install diffusers of types, neck sizes, noise criteria and patterns as indicated on drawings and as described herein.
2. Each diffuser shall be installed with an adjustable multi-blade volume control damper, key operated from face side.
3. Each diffuser shall be installed with air equalizing grid located in branch supply duct at its intersection with duct connecting to ceiling diffuser neck.
4. Ceiling diffusers shall be round, rectangular or square to match in appearance existing diffusers in the adjacent area.
5. Ceiling diffusers are to be of baked white enamel finish.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

End of Section 15855
DIVISION 15 - MECHANICAL

SECTION 15930
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   2. Lab Air Valve

1.3 SUBMITTALS

A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each model indicated. Include a schedule showing drawing designation, room location, number furnished, model number, size, and accessories furnished.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

C. Maintenance Data: List of parts for each type of air terminal and troubleshooting maintenance guide to include in the maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
   1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

B. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

C. Comply with NFPA 70 for electrical components and installation.

PART 2 - PRODUCTS

2.1 SINGLE-DUCT VARIABLE AIR VOLUME TERMINAL

A. Manufacturers: The following is a list of manufacturers' names of material and equipment that are acceptable.
   1. Titus
   2. Krueger
   3. Tuttle and Bailey
B. General: Provide single duct direct digitally controlled volume terminal units with inlet flow sensors and NEMA 1 electrical enclosure for controls of sizes, capacities, types and arrangements as indicated on the Drawings, and as hereinafter specified.

C. Casings: 22 gauge galvanized steel casing.

D. Casing Lining: Internally lined with 1-1/2 pound density fiberglass insulation which complies with U.L.-181 and NFPA 90A. All exposed edges of the fiberglass lining and insulation shall be sealed from the air stream using metal brackets. Use of adhesive or adhesive backed tape is not acceptable. The supplier of the terminal device must submit a sample of the box construction prior to acceptance by the Engineer. Minimum of 1-inch thick, dual density fibrous-glass insulation complying with NFPA 90A requirements and UL 181 erosion requirements. Secure lining to prevent delamination, sagging, or settling.

E. Plenum Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.

F. Plenum Air Outlets: S-slip and drive connections.

G. Access: Removable panels to permit access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.

H. Volume Damper: The damper shall be of heavy gauge construction with blades pivoted in Delrin self-lubricating bearings. The blades shall seal with less than 2% leakage at 3 inches SP.

I. Hot-Water Heating Coil: All reheat units shall contain integrally mounted hot water coils of sizes and capacities as indicated on the Drawings.

J. Controls: Provide a multipoint center averaging flow sensor. All other controls shall be provided under spec 15975.

2.2 EXHAUST AIR VALVE (EAV/HV)

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. TSI
   2. Triatek
   3. Price
   4. Phoenix Controls Corporation.

B. The critical airflow system provider shall be an entity that designs, develops, manufactures and sells products and services to control the environment and airflow of critical spaces using a Quality Management System registered to ISO 9001:2000.

C. Warranty shall commence upon the date of shipment and extend for a period of 36 months, whereupon any defects in materials or critical airflow control system performance shall be repaired by the supplier at no cost to the owner.

D. The critical airflow control system shall maintain specific airflow (±5% of signal within one second of a change in duct static pressure) regardless of the magnitude of the pressure change, airflow change or quantity of airflow control devices on either the supply air or exhaust air manifold (within 0.6" to 3.0" wc). Low-pressure devices may be used as an alternative for 0.3" to 3.0" wc.
E. The critical airflow control system shall maintain specific airflow (±5% of signal) with a minimum 16 to 1 airflow turndown to ensure accurate pressurization at low airflow and assure maximum energy efficiency.

F. In the event of a power failure, airflow control devices shall fail to the last position and continue to maintain flow control within ±5% of signal within one second of a change in duct static pressure.

G. Airflow Control Device – General
1. The airflow control device shall be a Venturi valve.
3. The airflow control device shall be pressure independent over its specified differential static pressure operating range. An integral pressure-independent assembly shall respond and maintain specific airflow within one second of a change in duct static pressure regardless of the magnitude of pressure (from 0.6 in wg to 3.0 in wg) and/or flow change or quantity of airflow controllers on a manifolded system.
4. The airflow control device shall maintain accuracy within ±5% of signal over an airflow turndown range of no less than 16 to 1.
5. No minimum entrance or exit duct diameters shall be required to ensure accuracy and/or pressure independence.
6. The airflow control device shall be constructed of one of the following types:
   a. Class A - The airflow control device for non-corrosive airstreams, such as supply and general exhaust, shall be constructed of 16-gauge aluminum. The device's shaft and shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of aluminum. The pressure-independent springs shall be a spring-grade stainless steel. All shaft-bearing surfaces shall be made of a Teflon, polyester or PPS (polyphenylene sulfide) composite.
   b. Sound attenuating devices used in conjunction with general exhaust or supply airflow control devices shall be constructed using 24-gauge galvanized steel or other suitable material used in standard duct construction. No sound absorptive materials of any kind shall be used.
   c. Class B - The airflow control device for corrosive airstreams, such as fume hoods and biosafety cabinets, shall have a baked-on, corrosion-resistant phenolic coating. The device's shaft shall be made of 316 stainless steel with a Teflon coating. The shaft support brackets shall be made of 316 stainless steel. The pivot arm and internal mounting link shall be made of 316 or 303 stainless steel. The pressure-independent springs shall be a spring-grade stainless steel. The internal nuts, bolts and rivets shall be stainless steel. All shaft-bearing surfaces shall be made of a Teflon or PPS (polyphenylene sulfide) composite.
7. Certification
   a. Each airflow control device shall be factory characterized using NIST-traceable air stations and instrumentation having a combined error no greater than ±1% of signal over the entire range of measurement. Electronic airflow control devices shall be characterized to ±5% of signal at a minimum of 48 different airflows across the full operating range of the device. All flow data for any given device shall be stored at the factory and be available on presentation of a serial number within 24 hours. Flow data for all valves shall be stored at a location away from the factory for disaster recovery purposes.
b. Each airflow control device shall be marked with the room number, tag number, serial number, and model number. All information shall be stored by the manufacturer for use with as-built documentation.

H. Exhaust and Supply Airflow Device Controller (See plans for locations and quantity)
   1. One controller shall be supplied for both the supply airflow control device and the corresponding exhaust air control device. The controller shall be a microprocessor-based design and use closed-loop control to linearly regulate airflow based on a digital control signal. The device shall generate a digital feedback signal that represents its airflow.
   2. In flow tracking applications where an exhaust device is tracking a supply device, flow data for each device shall be downloaded to the controller in the factory.
   3. The airflow control device shall store its control algorithms in non-volatile, rewritable memory. The device shall be able to stand alone or to be networked with other room-level digital airflow control devices through an industry standard protocol.
   4. Room-level flow tracking control functions shall be embedded in and executed by one controller mounted on one of the airflow devices.
   5. The room-level control network shall communicate by using the LonTalk protocol. The controller must be a LonMark certified device utilizing the Space Comfort Controller, Variable Air Volume (SCC-VAV Object type 8502) profile.
   6. The airflow control device shall use 24 Vac power, the industry standard.
   7. The airflow control device shall be able to connect a notebook PC commissioning tool. Every node on the network shall be accessible from any point in the system.
   8. The airflow control device shall have integral input/output for the following functions: temperature control, occupancy control, emergency control and non-network sensor switches and control devices. At a minimum, the airflow controller shall have:
      a. Three universal inputs capable of accepting 0 to 10 Vdc, 4 to 20 mA, 0 to 65 K ohms, or Type 2 or Type 3, 10 K ohm @ 25 degree C, thermistor temperature sensors to be available for space temperature, set point lever adjust and discharge air temperature.
      b. One digital input capable of accepting a dry contact or logic level signal input to be used for occupancy override via a local room-level sensor.
      c. Two analog outputs capable of developing either a 0 to 10 Vdc or 4 to 20 mA linear control signal to be available for duct reheat and ancillary room heat (i.e., fin tube radiation, radiant heat panels, each with its own independent PID control loops).
      d. One Form C (SPDT) relay output capable of driving up to 1 A @ 24 Vac/Vdc to be available for local audio/visual alarms.
   9. The airflow control device shall meet FCC Part 15 Subpart J Class A and be UL 916 listed.

2.3 SOURCE QUALITY CONTROL

A. Testing Requirements: Test and rate air terminals according to ARI 880, "Industry Standard for Air Terminals."

B. Identification: Label each air terminal with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminals level and plumb, according to manufacturer's written instructions, rough-in drawings, original design, and referenced standards; and maintain sufficient clearance for normal service and maintenance.

B. Connect ductwork to air terminals according to Division 15 ductwork Sections.

3.2 AIR VALVE INSTALLATION

A. Contractor shall coordinate active and passive cont5rolled air valves quantity and locations.
   1. The BAS contractor shall install any required routers and repeaters in an accessible location in or around the designated critical room.
   2. The BAS shall install an appropriately sized and fused 24 Vac transformer suitable for NEC Class II wiring.
   3. All cable and conduit shall be furnished and installed by the BAS contractor. The BAS contractor shall terminate and connect all cables as required. The BAS shall utilize cables specifically recommended by the critical airflow controls supplier.
   4. The mechanical contractor shall install all airflow control devices in the ductwork and connect all airflow control valve linkages.
   5. The mechanical contractor shall provide and install all reheat coils, reheat coil valves and duct transitions.
   6. The mechanical contractor shall provide and install insulation as required.
   7. Each pressurization zone shall have either a dedicated, single-phase primary circuit or a secondary circuit disconnect.

3.3 CONNECTIONS

A. Install piping adjacent to air terminals to allow service and maintenance.

B. Hot-Water Piping: In addition to requirements in Division 15 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Electrical wiring and connections are specified in Division 16 Sections.

D. Control wiring and connections associated with the Energy Management System are specified in Section 17135.

3.4 FIELD QUALITY CONTROL

A. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Verify that installation of each air terminal is according to the Contract Documents.

C. Check that inlet duct connections are as recommended by air terminal manufacturer to achieve proper performance.

D. Check that controls and control enclosure are accessible.
3.5 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel as specified below:
   1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
   2. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
   3. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

3.7 AIR VALVE SYSTEM START-UP AND TRAINING

A. System start-up shall be provided by a factory-authorized representative of the critical airflow control system manufacturer. Start-up shall also provide electronic verification of airflow, supply, make-up, general exhaust, system programming and integration to BAS (when applicable).

B. The balancing contractor shall be responsible for final verification and reporting of all airflows.

C. The critical airflow control system supplier shall furnish a minimum of eight hours of owner training by factory trained and certified personnel. The training will provide an overview of the job specific airflow control components, verification of initial fume hood monitor calibration, general procedures for verifying airflows of air valves and general troubleshooting procedures.

D. Operation and maintenance manuals, including as-built wiring diagrams and component lists, shall be provided for each training attendee.

End of Section 15930
PART 1 - GENERAL

1.1 DESCRIPTION

A. This specification is to cover a complete Variable Frequency Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

B. The drive manufacturer shall supply the drive and all necessary controls as herein specified.

C. Source Limitations: Obtain VFDs of a single type through one source from a single manufacturer unless otherwise indicated in specifications.

1.2 RELATED DOCUMENTS

A. Related Sections include the following:
   1. Section 15838 – Power Ventilators
   2. Section 15975 – Temperature Controls
   3. Division 16 – Electrical Specifications

1.3 DEFINITIONS

A. Acronyms:
   1. EMS:  Energy Management System.
   2. IGBT: Integrated gate bipolar transistor.
   3. LAN:  Local area network.
   4. PID:  Control action, proportional plus integral plus derivative.
   5. PWM: Pulse-width modulated.
   6. VFD:  Variable frequency drive.
   7. AFD:  Adjustable frequency drive
   8. VFC:  Variable frequency controller
   9. AFC:  Adjustable frequency controller

B. The terms VFD, AFD, VFC, and AFC all refer to the same devices.

1.4 SUBMITTALS

A. Schedule: Provide a schedule of VFDs that include the following:
   1. Unit tags (VFD-1, VFD-2, etc, if shown on schedule)
   2. Device or equipment being controlled (AHU1-SF, CHWP-2, etc.)
   3. Design voltage (from schedules) and rated voltage of VFD from manufacturer
   4. Design amperage (from schedules) and rated amperage of VFD from manufacturer
   5. Design horsepower (from schedules) and rated horse power of VFD from manufacturer
   6. Manufacturer's technical data on features, electrical ratings, characteristics, and finishes.
   7. BAS interface protocol (see “Coordination with BAS” below)
B. Letter of Coordination with the BAS Provider (see “Coordination with BAS” below)

C. Physical Data: For each size of VFD include the following information:
1. Dimensional drawings including electronic bypass and any other accessories
2. Mounting arrangements
3. Location for conduit entries
4. Shipping and operating weights
5. Required clearances and service space around equipment.

D. Wiring Diagrams: For each size of VFD include the following information:
1. Power schematic wiring
2. Control schematic wiring

E. List of VFD features, technical data, capabilities,

F. Qualification Data: Include the following information (described in greater detail in section “Quality Assurance” below):
1. Manufacture’s qualifications
2. Testing agency qualifications
3. Compliance with NFPA, UL, and IEEE guidelines

G. Operation and Maintenance Data: In addition to standard O&M manuals, include the following:
1. Routine maintenance requirements for VFDs and all installed components.
2. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.

H. Field quality-control test reports (not part of initial submittal)

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: It is required that the drive manufacturer:
1. Maintain, within 100 miles (160 km) of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
2. Have an existing sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
3. Have an existing independent service organization.
4. Have been engaged in the production of this type of equipment for a minimum of ten years

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency’s Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. UL Listed: VFDs and options shall be UL listed as a complete assembly. VFDs that require the customer to supply external fuses for the VFD to be UL listed are not acceptable.

E. Components and Installation: For projects located within City of Chicago limits, comply with the City of Chicago Building Code.


1.6 DELIVERY, STORAGE, AND HANDLING

A. Store VFDs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFDs from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover VFDs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside drives; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: 32°F to 104°F.
   2. Relative Humidity: Less than 90% (non-condensing).
   3. Altitude: Not exceeding 3,300 feet.

B. Outdoor Conditions: Winter -10°F DB, Summer 95°F DB / 75°F WB.

1.8 COORDINATION

A. Coordinate layout and installation of VFDs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features, accessories, and functions of each VFD and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.9 COORDINATION WITH BAS

A. The VFDs are required to be interfaced with the Building Automatic System (BAS). Provide all devices, hardware, programming, startup and commissioning required to establish this interface.

B. Prior to submitting in accordance with Part 1 of this section:
   1. Establish communication via phone call or e-mail with BAS provider
   2. Determine an interface protocol (BACnet/IP, BACnet/Ethernet, BACnet/MS/TP, LonWorks, Modbus, etc.) that is mutually acceptable to both you and the BAS provider. Note: If an interface protocol cannot be determined that is acceptable to both you and the BAS provider, make this fact known through proper channels.
3. Include a written statement entitled “Coordination of Interface Protocol with BAS Provider” documenting:
   a. BAS provider (company name)
   b. Person at the BAS provider with whom the coordination took place
   c. Time and date of coordination
   d. Interface protocol that was mutually agreed upon

C. Provide a startup technician on-site during the establishment of the interface. Coordinate this activity with the BAS installer.

1.10 WARRANTY

A. The VFD shall be warranted by the manufacturer for a period of 36 months from date of shipment.

B. The warranty shall include parts, labor, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following (Note: As noted above, all drives on the project shall be provided by a single manufacturer):
   1. ABB Power Distribution, Model ACH550
   2. Danfoss North America, Model VLT-HVAC-FC100
   3. Yaskawa Electric America, Model P7

2.2 VARIABLE FREQUENCY DRIVES

A. Description: NEMA ICS 2, IGBT, PWM, VFD; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
   1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

D. Unit Operating Requirements:
   1. Input AC Voltage Tolerance: plus or minus 10 % or as indicated on equipment schedules
   2. Input Frequency Tolerance: 50/60 Hz, plus or minus 6 %.
   3. Minimum Efficiency: 96 percent at 60 Hz, full load.
   4. Minimum Displacement Primary-Side Power Factor: 96 %.
   5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
   6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.

E. Internal Adjustability Capabilities:
   1. Minimum Speed: 5 to 25 percent of maximum rpm
   2. Maximum Speed: 80 to 100 percent of maximum rpm
   3. Acceleration: 2 to a minimum of 22 seconds
   4. Deceleration: 2 to a minimum of 22 seconds
   5. Current Limit: 50 to a minimum of 110 percent of maximum rating

F. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors
   2. Under-voltage trip
   3. Over-voltage trip
   4. Inverter over-temperature trip
   5. Inverter over-current trips
   6. Inverter overload trips
   7. Motor Overload Relay:
      a. Adjustable and capable of NEMA ICS 2, Class 10 performance
   8. Notch Filter:
      a. To prevent operation of the drive-motor-load combination at a natural frequency of the combination
   9. Instantaneous line-to-line and line-to-ground overcurrent trips
   10. Loss-of-phase protection
   11. Reverse-phase protection
   12. Short-circuit protection
   13. Motor over-temperature fault

G. Control Features:
   1. Automatic Reset/Restart: Attempts three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to drive, motor, or load.
   2. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
   3. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

H. Local Control Panel (LCP):
   1. The front of the VFD shall have a local control panel (LCP) that will function as a complete interface for operation and programming of the VFD.
   2. The LCP shall be detachable, and the VFD shall continue to function when the LCP has been detached.
   3. Through the use of an extension cable, the LCP shall be able to be mounted remotely.
   4. Operating programming data shall be displayed on an LCD screen. During normal operation, the LCD shall display up to three (3) operating values simultaneously. The following information shall be available:
      a. Output frequency (Hz).
      b. Motor speed (rpm).
      c. Motor status (running, stop, fault).
d. Motor current (amperes).
e. Motor torque (percent).
f. Fault or alarming status (code).
g. PID feedback signal (percent).
h. DC-link voltage (VDC).
i. Set-point frequency (Hz).
j. Motor output voltage (V).

5. LED status lights shall display the following parameters:
   a. VFD Power ON
   b. VFD Warning
   c. VFD Alarm

6. The LCP shall have HAND/OFF/AUTO buttons for direct control of the VFD.

I. Control Signal Inputs:
   1. Discrete Inputs: Provide a minimum of 6 programmable discrete inputs.
   2. Analog Inputs: Provide a minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) with the capability to accept any of the following speed-setting input signals from the BAS or other control systems:
      a. 0-5, 0-10, or 2-10 VDC
      b. 0-20 or 4-20 mA
      c. Keypad display for local hand operation

J. Control Signal Outputs:
   1. Analog Outputs: A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
      a. Output frequency (Hz)
      b. Output current (load)
      c. DC-link voltage (VDC)
      d. Motor torque (percent)
      e. Motor speed (rpm)
      f. Set-point frequency (Hz)
   2. Discrete Outputs: A minimum of 2 dry circuit relay outputs (120-VAC, 1 amp) for remote indication of the following:
      a. VFD general alarm
      b. Over temperature alarm
      c. Over current alarm
      d. VFD run status
      e. Motor run status
      f. Set-point speed reached
      g. PID high- or low-speed limits reached
   3. Safety Circuit: Provide a digital input, separate from the enable input, requiring a contact closure before allowing the VFD to start.

K. Integral Disconnecting Means: NEMA AB 1, molded-case switch with lockable handle.

L. Bypass and Disconnect Switch:
   1. Provide manual or electronic 3-contactor bypass consisting of:
      a. Door interlocked main fused disconnect padlockable in the OFF position
      b. Built-in motor starter
      c. Four position DRIVE/OFF/BYPASS/TEST switch controlling three contactors.
      1) In the DRIVE position, the motor is operated at an adjustable speed from the VFD.
2) In the OFF position, the motor and VFD are disconnected.
3) In the BYPASS position, the motor is operated at full speed from the AC power line and power is disconnected from the VFD so that service can be performed.
4) In the TEST position, the motor is operated at full speed from the AC line power while power is applied to the input of the VFD. This allows the VFD to be given an operational test while continuing to run the motor at full speed in bypass.

2. In case of an external safety fault, a customer supplied normally closed dry contact shall be able to stop the motor whether in DRIVE or BYPASS mode.
3. Service personnel shall be able to defeat the main power disconnect and open the bypass enclosure without disconnecting power.
   a. This shall be accomplished through the use of a specially designed tool and mechanism while meeting all local and national code requirements for safety.

2.3 ENCLOSURES

A. Indoors: Provide NEMA 250, Type 1

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFDs for compliance with requirements, installation tolerances, and other conditions affecting performance.
B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFD installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each VFD to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, drive, and load.
B. Select horsepower rating of drives to suit motor controlled.

3.3 COORDINATION WITH BAS

A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

3.4 INSTALLATION

A. Anchor each VFD assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.

3.5 CONTROL WIRING INSTALLATION

A. Install wiring between VFDs and remote devices according to Division 16
B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
   1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
   2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.6 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 16

3.7 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed drive element, bus, and component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

B. Reports: Prepare written reports certified by testing organization of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records of repairs and adjustments made. Harmonic compliance shall be verified with onsite field measurements of both the voltage and current harmonic distortion at the input terminals of the harmonic mitigating equipment with and without the equipment operating. A recording type Fluke 41 or equivalent harmonics analyzer displaying individual and total harmonic currents and voltages must be utilized.

C. Manufacturer’s Field Service: Engage a factory-authorized service representative to perform the following:
   1. Inspect drives, wiring, components, connections, and equipment installation. Test and adjust drives, components, and equipment.
   2. Assist in field testing of equipment including pretesting and adjusting of solid-state drives.

D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
   1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.8 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.
3.9 CLEANING

A. Remove paint splatters and other spots, dirt and debris. Touch up scratches and mars of finish to match original finish. Clean devices internally using methods and materials as recommended by manufacturer.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency drives. Refer to Division 1 Section "Testing and Inspection."

End of Section 15965
DIVISION 15 – MECHANICAL

SECTION 15975
TEMPERATURE CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Divisions 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Temperature control systems

1.3 GENERAL REQUIREMENTS

A. Provide a complete and operational system to perform all sequences of operations stated within the sequences as shown in Part 4 of this section

B. The work under this Section shall include all materials and equipment, labor and services to perform all work required for the installation of the temperature controls as herein specified and as otherwise required to provide a complete and operating system according to standard industry practices.

C. Note that the drawings and specifications are complementary to one another, meaning that what is called for on one is to be considered called for in both. Where conflicts exist between the specifications and/or drawings, the more stringent or inclusive requirement shall apply.

D. Code requirements are considered a minimum standard. Where materials shown on the drawings or indicated in the specifications exceed code requirements, the plans and specifications shall govern.

E. Minor controls items, accessories, devices, or program features reasonably inferable as necessary, to the complete and proper installation and operation of any system, shall be provided by the Temperature Controls Contractor for such system whether or not they are specifically called for by these specifications or drawings.

F. If there are any questions concerning the nature, extent or intent of the temperature controls work to be performed after examining all drawings and documents pertaining to this project, the contractor installing the temperature controls shall be responsible for obtaining clarification to those questions from the Engineer prior to submitting project bid. Once a contract is awarded, claims of ignorance of the project requirements will not be considered.

G. Where work specified under other Sections of these Specifications connects to equipment or systems which are a part of this Section, provide proper connection(s) to such equipment including trade coordination.

H. Provide labor to coordinate with the contractor performing Test and Balance work.
I. Provide startup, programming, testing, and owner instruction as specified herein.

1.4 SPECIFIC REQUIREMENTS

A. Direct Digital Control: The air terminal unit controllers for the constant volume reheat boxes shall be fully Direct Digital Control (DDC) as defined herein. The controllers shall not be integrated with a BAS at this time.

B. Communication Protocol: any future controller-to-controller communication will take place over open protocol networks that comply with the following industry standard(s):
   1. BACnet

C. Commissioning: This Section specifies equipment or systems, which may be commissioned as part of the construction process. The contractor will be required to provide documentation and testing of these systems and shall work in cooperation with the Commissioning Authority (CxA) to ensure compliance.

D. Warranty: The warranty shall conform to this specification as detailed below and shall be for the following duration:
   1. One (1) year from date of acceptance

E. Test and Balance: This project will be tested and balanced by a Test & Balance Contractor. Provide labor to coordinate with the contractor performing Test and Balance work

1.5 DEFINITIONS & ABBREVIATIONS:

A. Abbreviations:
   1. AI Analog Input
   2. AO Analog Output
   3. ASC Application-Specific Controller
   4. BI Binary Input
   5. BO Binary Output
   6. CHW Chilled Water
   7. CA or CxA Commissioning Authority
   8. CW Condenser Water
   9. DAT Discharge-Air Temperature
   10. DDC Direct Digital Control
   11. DHW Domestic Hot Water
   12. DP Differential Pressure
   13. DPS Differential Pressure Switch
   14. DPT Differential Pressure Transmitter
   15. ELC Enterprise-Level Controller
   16. EMS Energy Management System
   17. HW Hot Water
   18. IT Information Technology
   19. LEED Leadership in Energy and Environmental Design
   20. MAT Mixed-Air Temperature
   21. N/A Not Applicable
   22. OAH Outside-Air Relative Humidity
   23. OAT Outside-Air Temperature
   24. PC Personal Computer
   25. POT Portable Operator Terminal
   26. RAH Return-Air Humidity
B. Definitions:
1. BACnet: The communication standards that comply with ASHRAE/ANSI standard 135-1995 and all current revisions, and are certified as such by the governing organization.
2. Control Dampers: Dampers whose operation is described in the sequence of operation of this specification, shown on a damper schedule (see mechanical drawings), or which are shown on BAS drawings.
3. Control Valves: Valves whose operation is described in the sequence of operation of this specification, shown on a valve schedule (see mechanical drawings), or which are shown on BAS drawings.
4. Furnish: The term “furnish” means to purchase and supply the part, piece or equipment.
5. Interoperability: The ability of control system components from different manufacturers to work together to provide coordinated control via real-time two-way data exchange through a common communications data exchange protocol. Interoperability shall extend to the operators workstation software which shall support user interaction with all control system components. Methods of interoperability include: BACnet SPC-135, LonMark/LonTalk.
6. Provide: The term "provide" means "provide complete in place", that is, furnished and installed and ready for operation and use.

1.6 COORDINATION WITH OTHER TRADES

A. The following will be provided under this specification section:
1. Installation of temperature controls as specified in this section.
2. Furnishing all control dampers and actuators including installation of the actuator.
3. Furnishing all control valves and actuators.
4. Providing power wiring to all BAS panels from spare or designated circuits in electrical panels. See electrical drawings for panels and locations.
5. Providing miscellaneous temperature controls and field control wiring per wiring diagrams submitted by the contractor providing the equipment and control devices.

B. The following will be provided under the related division 15 sections:
1. Installation of all control dampers and necessary blank-off plates per the direction of the contractor installing the temperature controls.
2. Installation of all control valves including reducers and accessories per the direction of the contractor installing the temperature controls.
3. Furnishing wiring diagrams for any devices that require field wiring to manufacturer-provided control panels.

C. Work provided under division 16:
1. Provide circuits at the electrical panels for powering all controllers.
2. Power wiring for all mechanical equipment.
3. All hardware necessary to interface manufacturer-provided controls with the temperature controls. This includes all startup time and programming information necessary to affect the interface. This interface can either be a
communication or hardwire interface; see this specification for details of the interfaces required.

D. Products furnished but not installed under this section:
1. Hydronic Piping:
   a. Control valves
   b. Flow switches
   c. Pressure and temperature sensor wells and sockets
   d. Flow meters
2. Ductwork Accessories:
   a. Automatic control dampers
   b. Air-flow measuring stations
3. Electrical:
   a. Variable frequency drives

1.7 APPROVED SYSTEM INTEGRATORS AND MANUFACTURERS

A. Compliance: Acceptable contractors and manufacturers will be determined based upon compliance with the terms of the specifications.

B. Contractor Requirements: The acceptable contractor will meet the following requirements.
1. Experience: Have a minimum of five (5) years experience in the installation and service of BAS comparable in size and scope to the system to be installed on this project.
2. Quality Assurance: Meet all of the requirements of the Quality Assurance section of Part 1 of this specification and document this compliance in a Technical Proposal as described in Part 1 of this specification if requested by the Owner, Architect or Engineer.
3. References: Submit a list of reference projects as noted in the Quality Assurance section of Part 1 of this specification if requested by the Owner, Architect or Engineer.
4. Documentation: Provide documentation of training received by proposed project personnel on the installation, servicing, programming and designing of open protocol systems using BACnet that is applied to this project. This training documentation will include any certification received from the governing body of the open standard or designated entity of the governing body.

C. Manufacturer Requirements: The acceptable manufacturer will meet the following requirements.
1. Compliance with all applicable sections of this specification.
2. Letter of compliance with the governing body of the open protocol used by the manufacturer.
3. Listing of a product or manufacturer does not in and of itself imply or suggest that the product or manufacturer meets the applicable requirements of the specification.

1.8 CODES AND STANDARDS

A. All work, materials and equipment shall comply with rules and regulations of all codes and ordinances of the local, state and federal authorities. Such codes, when more restrictive, shall take precedence over these plans and specifications. As a minimum, the installation shall comply with the current editions of the following codes that were in effect 30 days prior to receipt of bids:
1. National Electric Code (NEC)
2. Uniform Building Code (UBC)
3. Uniform Mechanical Code
4. City of Chicago Building Code
5. Chicago Energy Code

B. Provide electrical products which have been tested, listed and labeled by UL.

C. Comply with NEMA standards pertaining to components and devices for electric control systems.

D. Comply with NFPA 90A “Standard for the Installation of Air Conditioning and Ventilating Systems” where applicable to controls and control sequences.

E. All BAS central equipment shall be UL916 listed.

F. All electronic equipment shall conform to the requirements of FCC regulation Part 15, Section 15 governing radio frequency electromagnetic interference and be so labeled.

1.9 SUBMITTALS

A. General:
1. All submittals to be done in accordance with the requirements of the submittals section of Division 0 of this specification.
2. Contractor to provide shop drawings and all other submittal information on all hardware, software and installation to be provided.
3. No work may begin on any segment of this project until submittals have been successfully reviewed for conformity with the drawings, specifications, and design intent.
4. All drawings shall be prepared on a CAD system that produces drawing files compatible with AutoCAD release 12 or higher and be provided minimum 11”X17” sheets.

B. Cut Sheets/Data Sheets:
1. Submit a cut sheet or data sheet for each device referenced in the shop drawings.
   a. When a manufacturer’s cut sheet or data sheet applies to a product series rather than a specific product, the data specifically applicable to the device used on the project shall be indicated by an arrow pointing at that data on the cut sheet or data sheet.
   b. If ordering options are indicated on a cut sheet or data sheet, and one or more of those options are being provided on the device for this project, clearly mark those options with an arrow or circle the data on the data sheet or cut sheet.
2. Cut sheets section of the submittal must have numbered or labeled tabs separating different sections.
   a. No tabbed section shall have more than 20 pages, unless a single product data sheet itself exceeds 20 pages.
   b. Tabbed separation of the cut sheet / data sheet section shall be done in a logical manner. For example, all temperature and humidity sensors in one tab, pressure switches and transmitters in one tab, DDC controllers in one or more tabs, etc. Note: no more than 20 pages per tab.
3. Cut sheets section of the submittals shall have a table of contents. Include the following information in the cut sheet / data sheet table of contents:
   a. Name of manufacturer (example – Veris)
   b. Full manufacturer’s product number, including options if applicable (example – Hawkeye 708)
   c. Short description of device (example – Solid core adjustable current status sensor)
   d. Tab under which the cut sheet or data sheet can be found (example – Tab 7)
   e. HVAC equipment tag that the device is applied to (example – AHU-1, 2, 3)
   f. Quantity of device used on this project (example – Quantity 6)

C. Shop Drawings – Submit job specific shop drawings, the drawings shall include the following as a minimum:
   1. Floor Plan Diagrams(s)
   2. Equipment Schematics
   3. Wiring Diagrams
   4. Bill of Materials
   5. Valve Schedule
   6. Sequences of Operation

D. Floor Plans – Include floor plan diagrams showing the following:
   1. General outline of building and rooms. Include room numbers if a device is located in that room.
   2. Location of major HVAC equipment controlled by the BAS
   3. Location of control panels connected via communications buses
   4. Location of application specific controllers not located in a control panel
   5. Location of computers, servers, gateways, router, hubs, Ethernet switches, etc. that are not located in a control panel
   6. Location of power feed for each control panel
   7. Actual path of communications buses
   8. Each segment of each communication bus shall be clearly identified as to type of communication (e.g. LonWorks, MS/TP proprietary, BACnet/Ethernet, ArcNet, etc.)

E. Equipment Schematics – Include equipment schematic diagrams showing the following:
   1. Major components in the HVAC equipment being represented. For example, an AHU would show, as a minimum (as applicable):
      a. Supply and return fans, VFDs
      b. Heating and cooling coils
      c. Valves, dampers, actuators
      d. Temperature, pressure, and humidity sensors
      e. Filter differential pressure switches/sensors
      f. Any miscellaneous items such as, but not limited to, freeze stats, high/low pressure safeties, smoke detectors,
   2. DDC points in the HVAC equipment being represented. Include the following information:
      a. Point name
      b. Controller address
      c. Point number on controller
   3. Direction of airflow, water flow, as applicable
   4. Normal / failsafe positions of dampers and valves.

F. Wiring Diagrams – Include wiring schematic diagrams showing the following:
1. DDC Controllers with I/O terminals, power terminals, and communication terminals
2. Any expansion modules connected to main DDC controller
3. Devices being controlled by DDC controller or expansion modules
4. Control power transformers
5. Any terminal strips used in the point-to-point wiring
6. Actual point-to-point wiring between controller and device
7. Terminal numbers on external devices
8. Any wiring between devices (hardwired interlocks)

G. Bill of Materials— Include Bill of Materials showing the following:
   1. Point name
   2. Point tag as used in programming (if different from common point name)
   3. Point description
   4. HVAC unit being controlled
   5. Signal type (thermistor, RTD, 4-20 mA, 0-10 vdc, dry contact, etc.)
   6. Field device description
   7. Field device manufacturer
   8. Field device model number
   9. Quantity

H. Control Valve Schedule – Include control valve schedule showing the following:
   1. Valve Tag
   2. System
   3. Service
   4. Piping System Pressure Rating
   5. Pipe Size
   6. Body Pattern (e.g. straight thru mixing, diverting)
   7. Load (coil) Flow Rate (in GPM or lbs/hr)(actual from submittals)
   8. Load (coil) Pressure Drop (in PSI) (actual from submittals)
   9. Desired Valve Pressure Drop
   10. Calculated Valve Cv
   11. Selected Valve Cv
   12. Actual Valve Pressure Drop (in PSI)
   13. Manufacturer
   14. Part Number
   15. Body Style (e.g. globe, butterfly, ball)
   16. Pressure rating of valve body
   17. Size (in inches)
   18. Operating/Dynamic pressure rating of valve
   19. Pipe Connections (sweat, screwed, flanged)
   20. Fail Position Flow Pattern (de-energized)(e.g. open, closed, last position, thru coil, bypass coil)
   21. Actuator Model Number
   22. Actuator Working Range (in volts, mA or psi as applicable)
   23. Actuator Close-Off Pressure (against system)

I. Sequence of Operation – Include sequence of operation showing the following:
   1. Detailed sequence of operation showing all modes of operation and algorithms.

J. Miscellaneous – Include the following items:
   1. Descriptions of methods for performing field quality control during the installation process.
   2. Description of methods of testing and verifying integrity of installation after it has been completed, as well as checklists and report formats that will be
used to comply with the “Demonstration and Acceptance” portion of Part 3 of this specification.

3. An alarm schedule noting (for each alarm in the system): description, operator action required, priority, time delay, auto/manual reset, limit levels (Analog Alarms), whether the operator can disable the alarm, paging code.

1.10 WARRANTY

A. All components, parts and assemblies supplied by the Contractor shall be guaranteed against defects in materials and workmanship for a period of time as defined above in Specific Requirements.

B. The Contractor shall respond to the owner’s request for warranty service within 24 hours during normal business hours. If a malfunction of a component covered by the warranty causes an issue, failure, etc. that requires immediate attention (e.g. no heat to the building), then the contractor will be required to respond within 4 hours and cover all costs for premium time.

C. Labor to troubleshoot, repair, or replace system components shall be furnished by the Contractor at no charge to the Owner during the construction and warranty period.

D. At the end of the final start-up, testing, and commissioning phase, if equipment and systems are operating satisfactorily to the Engineer, the Engineer shall sign certificates certifying that the control system’s operation has been tested and accepted in accordance with the terms of this specification. The date of acceptance shall be the start of warranty.

E. Exception: The Contractor shall not be required to warrant reused devices, except for those that have been rebuilt and/or repaired. The Contractor shall warrant all installation materials and labor, however, and shall demonstrate that all reused devices are in operating condition at the time of acceptance by the Engineer.

F. If the owner receives substantial use of a phase of the project prior to completion of the entire project, the Contractor can request that the portion being used receive a phased acceptance. If the Engineer and owner agree, then the warranty period for this phase of the project will begin at the date of phased acceptance. However, this does not relieve the Contractor of fully commissioning this phase of the work, and if, during the final phase of commissioning, demonstration or acceptance, an error is found in the phase of the installation under substantial use, and this error is attributable to the installation by the Contractor, then the Contractor will correct this error at no cost to the owner regardless of the status of the warranty for that phase of work.

1.11 OWNERSHIP OF PROPRIETARY MATERIAL

A. All project-developed software and documentation shall become the property of the owner. These include, but are not limited to:

   1. Record drawings
   2. All documentation

PART 2 - PRODUCTS

2.1 MATERIALS
A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations. This installation shall not be used as a test site for any new products unless explicitly approved by the owner’s representative in writing.

B. Spare parts shall be available for at least five years after completion of the contract.

2.2 SENSOR ACCURACIES

A. See the tables below for information about sensor accuracies. Provide calibration certificates for all sensors documenting compliance with specified accuracy and repeatability. Calibration shall, at a minimum, address 0%, 50% and 100% of signal range, and in both rising and falling of signal.

B. TABLE 1 - Reporting Accuracy

<table>
<thead>
<tr>
<th>Measured Variable</th>
<th>Reported Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Temperature</td>
<td>±0.3°F</td>
</tr>
<tr>
<td>Ducted Air Temperature</td>
<td>±0.3°F</td>
</tr>
<tr>
<td>Outside Air Temperature</td>
<td>±0.3°F</td>
</tr>
<tr>
<td>Water Temperature</td>
<td>±0.3°F</td>
</tr>
<tr>
<td>ΔT</td>
<td>±0.25°F</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>±2%Rh</td>
</tr>
<tr>
<td>Airflow (Terminal)</td>
<td>±3% Of Full Scale</td>
</tr>
<tr>
<td></td>
<td>(10% To 100% Of Scale)</td>
</tr>
<tr>
<td>Air Pressure (Ducts)</td>
<td>±0.1 In. W.G.</td>
</tr>
<tr>
<td>Air Pressure (Spaces)</td>
<td>±0.01 In. W.G.</td>
</tr>
<tr>
<td>Electrical (A, V, W, Power Factor)</td>
<td>±5% Of Reading</td>
</tr>
<tr>
<td></td>
<td>(Except Utility Meters)</td>
</tr>
<tr>
<td>Carbon Monoxide And Dioxide</td>
<td>±5% Of Reading</td>
</tr>
</tbody>
</table>

C. TABLE 2 - Control Stability and Accuracy

<table>
<thead>
<tr>
<th>Controlled Variable</th>
<th>Control Accuracy</th>
<th>Range Of Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pressure</td>
<td>±0.2 In. W.G.</td>
<td>0 To 6 In. W.G.</td>
</tr>
<tr>
<td></td>
<td>±0.01 In. W.G.</td>
<td>-0.1 To 0.1 In. W.G.</td>
</tr>
<tr>
<td>Airflow</td>
<td>±3% Of Full Scale</td>
<td></td>
</tr>
<tr>
<td>Space Temperature</td>
<td>±0.5°F</td>
<td></td>
</tr>
<tr>
<td>Duct Temperature</td>
<td>±0.5°F</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>±5%Rh</td>
<td></td>
</tr>
</tbody>
</table>

2.3 TEMPERATURE SENSORS

A. Temperature sensors shall be Resistance Temperature Detector (RTD) type, or 10,000 Ω thermistors.

1. Accuracy of the sensor is to include all inaccuracies of the sensor, transmitter (if used), line losses, input resolution, A to D converter, and conversion equations.

2. Itemize all of these accuracies in submittals (see the Submittals section of part 1 of this specification for details).

B. Room Temperature Sensors:

1. Room temperature sensors shall be platinum RTD or thermistor type.
2. Accuracy shall be ±0.5°F
3. Temperature range shall be 35°F to 140°F
4. Provide with the following options as called for per plans and /or sequence of operation:
   a. RJ-11 socket for connection to BAS MS/TP communication bus
   b. Digital display and local set point adjustment buttons (typical for private areas)
   c. Momentary setback override button (typical for private areas)
   d. Blank commercial type finished plate with no setpoint adjustment (typical for public areas)
5. Limits to adjustment shall be adjustable from the workstation.

C. Duct Temperature Sensors – Single Point:
1. Duct single point temperature sensors shall be Platinum RTDs or thermistor type
2. Temperature range shall be -30°F to 240ºF.
3. Accuracy shall be ±0.5°F.
4. The sensor shall include a utility box and gasket to prevent air leakage and vibration noise.
5. Provide with insertion measuring probe 6” to 48” long.

2.24 LIGHT LEVEL SWITCHES

2.25 CONTROL VALVES AND ACTUATORS

A. Size all valves and actuators for the appropriate application and submit this information on a valve schedule as noted in the Submittals section of part 1 of this specification.

B. Provide factory-fabricated electronic control valves of type, body material and pressure class indicated. Where type or body material is not indicated, provide selection as determined by manufacturer for installation requirements and pressure class, based on maximum pressure and temperature rating of piping system. Except as otherwise indicated, provide valves which mate and match material of connecting piping. Equip control valves with control valve motors, and with proper shutoff ratings for each individual application.
   1. All automated control valves shall be characterized control, ball, globe or butterfly as specified. Piping geometry correction factors (Fp) must be used when sizing ball valves. The Cv or corrected Cv rating of all valves shall be stated on the submitted valve schedule. The flow type for all two-way valves shall be equal percentage or modified equal percentage. Flow type for three-way valves shall be linear. All valves shall have a minimum resolution of 80:1.
   2. Unless otherwise stated, two position steam valves shall be sized for 10% of the available pressure and two position water valves for 2 PSI or less. Use line size valves if the pressure is not known. Modulating water valves shall be sized to provide a maximum 5 PSI pressure drop across the valve.
   3. Butterfly valves are acceptable for all two position applications, for modulating larger flow applications (3” or larger), or where the close-off rating of other valves does not meet the design requirements. A Cv factor of sixty (60) degrees shall be used for sizing modulating butterfly valves and ninety (90) degrees for two (2) position butterfly valves.
   4. Provide individual valve tagging of up to 45 characters (location/service/unit, etc.) on each valve. Valve tags shall be documented on the approved valve schedule.
5. The manufacturer shall warranty all valve assemblies for a period of 5 years from date of manufacture or as stated elsewhere in the specifications.
6. The manufacturer’s recommendations shall be followed with regard to mounting, locating insulation, and applying the products.
7. All electronic valve assemblies including the valve body and respective valve actuator shall be as manufactured or assembled by Belimo, Invensys or pre-approved equals.

C. Characterized Control Valves-All Water Services
1. Characterized Control Valves (CCV) shall be used for all water applications where sizing permits.
2. A tefzel® flow-characterizing disc shall be installed in the inlet of 2-way and in the control port of 3-way valves. The valve trim shall utilize a stainless steel ball and stem for all water or glycol solutions up to 50%. Valve bodies shall be nickel-plated, forged brass with female NPT threads. Bodies to 1 ¼" shall be rated at 600 psi and sizes 1 ½ to 2” at 400 psi with a temperature range of 0 to 250 deg F. The maximum allowable pressure differential shall be 150 psi for on/off and 50 psi for modulating service.
3. CCVs shall have a self-aligning, blowout proof, bronze stem with a dual EPDM O-ring packing design. Fiberglass reinforced Teflon® seats and seals shall be used.
4. The valves shall have a four bolt mounting flange and provide a 4 position, field changeable, electronic actuator mounting arrangement. A non-metallic, coupling shall provide a direct, mechanical, connection between the valve body and actuator. The coupling shall be designed to provide thermal isolation and eliminate stem forces. A vent hole shall be provided to reduce condensation build-up.

D. Electronic Globe Control Valves - All Services:
1. Two and Three Way Screwed Valves: Valves 1/2 inch through two inches shall be bronze body, NPT screw type, and shall be rated for ANSI Class 250 working pressure. The operating temperature range shall be 20 to 250 deg F. Valve stems shall be stainless steel. Valve plugs shall be brass or bronze for water service and stainless steel for steam service, depending on temperature and pressure requirements. Stem packing shall be EPDM O-ring, TFE or EP-V rings or EPT. All valves shall be rated for a maximum water differential of 100 PSI.
2. Two and Three Way Flanged Valves: Valves 2-½ inch and above shall be cast iron or cast carbon steel, flanged, and shall be rated for ANSI Class 125 working pressure. The operating temperature range shall be 32 to 250 degrees F. Valve stems shall be stainless steel. Valve plugs shall be brass or bronze for water service. All valves shall be rated for a maximum water differential of 100 PSI.

E. Electronic Ball Control Valves - All Services:
1. Ball valves may in all applications where sizing dictates a 2-way valve 3" or less or a 3-way valve 2" or less. Standard ball valve sizes and Cv ratings must be stated and determined based on actual port sizes. Ball valves that approximate Cv ratings by mechanically limiting port openings or stroke are unacceptable. Three-way ball valves may be used in either mixing or diverting applications.
2. Ball valves shall be furnished with a stainless steel ball and stem. All ball valves shall have reinforced Teflon seats and packing and female NP threads. Two-way bodies up to 3" shall be rated for 600 PSI WOG, cold, non-shock, service. Three-way bodies up to 2" shall be rated for 400 PSI WOG, cold, non-shock, service. The valves shall have a self aligning,
blowout proof, stem design with a glass-reinforced Teflon thrust seal washer, and a stuffing box ring with minimum rating of 400 PSI. Each valve shall be tested by the manufacturer, air under water, at each end of travel. The valve shall be re-packable and the stem packing gland shall be adjustable to compensate for wear.

3. All ball valves shall incorporate either an anti-condensation thermal break cap in the stem or be designed to reduce heat transfer to the actuator. Bodies will be rated for continual use at greater than 350 degrees. Additional thermal separators shall be provided between the mounting bracket and actuator to allow complete free air movement and minimize heat transfer to the actuator.

4. Rubatex insulation casings will be provided for chilled water ball valves up to 2.5" in size. Installation shall be by the mechanical contractor.

F. Electronic Butterfly Control Valves:
1. Valve bodies shall be the full lug-wafer style, drilled and tapped. The body shall feature and extended neck allowing sufficient clearance for flanges and piping insulation. Assemblies shall have a minimum resolution of 40 to 1. The disc shall be aluminum/bronze or SS for low pressure steam applications.

2. The disk shall have full 360 degree concentric seating. A torque plug shall provide a positive leak-proof connection of the disc to the stem. The seat shall be heavy duty with molded-in O-rings creating a positive seal between flange face and valve body. No gaskets shall be required between the valve and flange faces. The resilient seat shall provide bubble tight shutoff in either direction with the disc closed. The seat shall be field replaceable.

G. Valve Motor Actuators: Size each motor to operate valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified.
1. Low torque, electronic valve actuators (defined as less than 300 in-lb. of Torque) shall be NEMA 2 rated, fully proportional (4-20 mA or 2-10 VDC), pulse width, floating/tri-state, two position, or as required. Upon loss of control signal, a proportional, non-spring return, valve actuator shall fail open or closed based on the desired zero position. Upon loss of power, a non-spring return, actuator shall maintain the last position. When required, valves shall operate in sequence with other devices by using programmable, multifunction technology (MFT) or built-in sequencing devices. Manual override handles shall be provided for all non-spring return actuators. Valves used for terminal equipment such as re-heat coils, radiant panels, radiation, cabinet and unit heaters, etc. and coils not directly exposed to outside air shall use non-spring return actuators unless otherwise specified. All heating coils such as preheat coils, air handling unit heating coils, unit ventilators, fan coils, etc. exposed directly to outdoor air, shall use power failure, spring return, safety actuators. Chilled water coils using a glycol mix to prevent freezing shall use non-spring return actuators.

2. For power failure/safety applications, where specified, valves shall require either a mechanical spring return or a battery back up located near the control panel. Low torque actuators using internal chemical energy storage, batteries or capacitors are not acceptable. All low Torque, spring return actuators shall be capable of CW or CCW rotation by changing the mounting orientation.

3. Proportional low Torque actuators shall be positive positioning, responding to a 2-10 VDC or 4-20 mA signal, shall include a visual valve position indicator, a built in direction of rotation reversing switch, and an actuator generated 2-10 VDC electronic feedback signal, independent of the input signal. This signal will provide a DDC input signal or drive another actuator. Low Torque
actuators incapable of tandem operation are not acceptable. Low Torque actuators shall have the capability of adding auxiliary switches if required. Power shall be 24 VAC or VDC for proportional actuators and 24 or 120 VAC for 2 position spring return actuators. Power consumption shall not exceed 15 VA per actuator. A 3-foot cable shall be provided for easy installation to a junction box. Actuators requiring removal of the cover for wiring terminations are unacceptable.

4. All actuator(s) shall provide minimum torque required for valve close off with an approximate run time of 2 minutes for full rotation. The close off minimums shall be, 200 PSI for Characterized Control valves, 75 PSI for ball valves, 25 PSI for globe valves, and 50 PSI for butterfly valves. Low Torque actuators shall be designed with current limiting, digital motor rotation sensing circuits or adjustable end of travel switches to provide motor protection. Tandem actuators shall be used as required. Actuators using a single bolt or a single set screw fastening techniques are not acceptable.

5. Modulating, non-spring return actuators shall have a direction of rotation switch, conduit fittings, and a release button to allow for manual override. All low Torque actuators shall be capable of being mechanically or electrically paralleled to increase torque if required.

6. Low Torque valve actuators shall be minimum NEMA 2 rated and as manufactured by Belimo Air Controls, Delta Control Products, Siebe, Dodge Engineering or as approved equal.

7. Valves requiring over 300 in-lb. of Torque, or for high close-offs, shall be furnished with tandem low Torque actuators or may be furnished with an industrial high Torque actuator by Belimo Aircontrols, Raymond Control Systems (RCS), Delta Control Products, or Dodge Engineering and shall include the following:
   a. Resolution of the modulating motor of 1%.
   b. A pre-wired 6’ pigtail.
   c. Field changeable, printed circuit boards to provide either 2-position or modulating operation. Modulating versions shall include an onboard digital controller with an LCD display capable of programming input and output signals, shaft rotation, and direct or reverse action.
   d. The actuator shall have a resolution of 80:1 and a running time of 30 to 60 seconds per 90 degrees.
   e. 24 or 120 VAC (50/60 Hz) power supply options. Two SPDT auxiliary switches shall be provided.
   f. Torque ratings as required for the application. The standard housing shall have a NEMA 4 rating. Optional housings with NEMA 7 or 9 ratings will be available.
   g. A permanently attached, manual override hand wheel shall be provided for use in the event of power failure or malfunction. When in manual, electrical power will be interrupted. Override handles requiring the use of a wrench or push to override mechanisms are not acceptable.
   h. Provide a built in thermostat and heater to prevent condensation.

2.6 AIR TERMINAL UNIT / CONSTANT AIR VOLUME (CAV) BOX CONTROLLERS:

A. Air terminal unit / constant air volume boxes shall be furnished and installed under specification Division 15 Section 15845.

B. Direct digital controller and actuator shall be furnished and mounted under this section.
C. Two way heating control valves for these boxes where required shall fail to last position. The actuators shall conform to specifications of this section.

D. The ATU/CAV controller shall be Titus Alpha series controller with control inputs and outputs capable of performing the sequence of operation specified herein.
   1. All programming shall be accomplished through the wall mounted space sensor interface with no additional software or hardware required.
   2. Access to the programming capabilities shall be password protected.
   3. The controller shall have a LCD digital display
   4. The controller shall have the ability to reside on a BACnet MS/TP communication bus and be capable to be integrated to a BACnet BAS in the future.

2.7 VARIABLE FREQUENCY DRIVES:

A. Provide variable frequency drives (VFDs) for variable air volume fans and pumps as shown on plans and defined in Responsibility Matrix above.

B. See Specification Section 15965 for specification of variable frequency drives.

2.8 TRANSFORMERS AND POWER SUPPLIES

A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

B. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand a 150% current overload for at least 3 seconds without trip-out or failure.
   1. Unit shall operate between 32°F and 120°F. EM/RF shall meet FCC Class B and VDE 0871 for Class B and MIL-STD 810C for shock and vibration.
   2. Line voltage units shall be UL recognized and CSA approved.

PART 3 - EXECUTION

3.1 GENERAL

A. The Building Automation System (BAS) shall be designed, installed, and commissioned in a turnkey fully implemented and operational manner; including all labor not noted in the Description of Work and Additional Work paragraphs of Part I of this Specification, and not noted in other Sections of this Specification.

B. Install equipment, piping, and wiring/raceway parallel to building lines (i.e. horizontal, vertical, and parallel to walls) wherever possible.

C. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability and compatibility and be executed in strict adherence to local codes and standard practices.

3.2 EXAMINATION

A. The project plans shall be thoroughly examined for control device and equipment locations. Report any discrepancies, conflicts, or omissions to the Engineer for resolution before rough-in work is started.

B. The Contractor shall inspect the site to verify that equipment may be installed as shown. Report any discrepancies, conflicts, or omissions to the Engineer for resolution before rough-in work is started.

C. The Contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate-or if any discrepancies occur between the plans and the Contractor’s work and the plans and the work of others-the Contractor shall report these discrepancies to the Engineer and shall obtain written instructions for any changes necessary to accommodate the Contractor’s work with the work of others. Any changes in the work covered by this specification made necessary by the failure or neglect of the Contractor to report such discrepancies shall be made by-and at the expense of-this Contractor.

3.3 PROTECTION

A. The Contractor shall protect all work and material from damage by his/her work or employees and shall be liable for all damage thus caused.

B. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested, and accepted. The Contractor shall protect any material that is not immediately installed. The Contractor shall close all open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

C. The Contractor is made aware through this specification that work will occur in existing building areas that will remain occupied. All work will proceed with full protection of existing spaces and with minimal disruption of building tenants and employees. The Contractor shall be liable for any damage caused by their installation. The building staff will be responsible for normal housekeeping.

D. Coordinate and schedule all work with the owner’s representatives. Provide a weekly schedule that notes the progress of the prior week, and projects the progress of the next three weeks to allow for the coordination of work areas and to give the management staff ample time to notify tenants and employees.

3.4 COORDINATION

A. Site

1. Where the mechanical work will be installed in close proximity to, or will interfere with, work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs his/her work before coordinating with other trades, so as to cause any interference with work of other trades, the Contractor shall make the necessary changes in his/her work to correct the condition without extra charge.
2. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.

B. Submittals. Refer to Submittals in Part 1 of this specification for requirements.

3.5 FIELD QUALITY CONTROL

A. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state and federal codes and ordinances as identified in Part 1 of this specification.

B. Contractor shall continually monitor the field installation for code compliance and quality of workmanship, and shall submit method for performing this monitoring in accordance with Submittals as discussed in Part 1 of this specification.

C. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.

3.6 CONTROL PANELS

A. Install control panels where shown and as indicated in documentation. Provide panels with hinged doors and NEMA classification appropriate for the application.

B. All power supplies, points and interface devices for a given system that are not located at or on the equipment to be controlled shall be contained within a single control panel.

C. Label all control panel devices and terminal strips in accordance with article Identification of Hardware and Wiring as discussed in Part 3 of this specification. Provide plastic, engraved labels on the panel cover identifying the system controlled and the node number of the system as a minimum. If any manual reset devices are located with a given control panel, a plastic, engraved label shall indicate the device is present within the panel.

D. Where sequences require audio or visual notification, the horn, strobe, or other similar device shall be mounted on the control panel and labeled with a plastic, engraved label indicating the equipment in alarm and whether the alarm is manual or automatic reset.

E. A copy of as-built information associated with the panel shall be included in the panel in a pocket or folder attached to the inside of the front cover of the panel.

F. Where existing panels are to be reused, replace any panel covers that have abandoned devices installed through the panel cover.

3.7 WIRING

A. All power wiring and control wiring shall be properly supported, and shall be run in approved raceway in a neat and workmanlike manner according to CCBC, Division 16 requirements, and the requirements of this specifications or BAS drawings. All wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals. All wiring pertaining to the BAS shall be color-coded or number coded and appropriately identified for servicing of the TC wiring system.
B. Where wiring is run in public areas, use surface mounted raceway with color selected by the Architect. In all other areas, wiring will be run in conduit. See Division 16 for conduit specifications. In no case is wiring to be run exposed.

C. The Contractor shall be responsible for all electrical installation required for a fully functional system and not shown on the electrical plans or required by the electrical specifications. All wiring shall conform to all local and national codes. All electronic wiring shall be minimum #20 AWG minimum and shielded if required.

D. All low-voltage wiring shall meet CCBC Class 2 requirements. Low-voltage power circuits shall be sub-fused when required to meet Class 2 current limit.

E. Install category 5 cable from each ELC panel to the server room.

F. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g. relays and transformers).

G. All wire-to-device connections shall be made at a terminal block or terminal strip. All wire-to-wire connections shall be at a terminal block.

H. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.

I. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the Contractor shall provide step-down transformers.

J. All wiring shall be installed as continuous lengths, with no splices permitted between termination points.

K. Maintain fire rating at all penetrations.

L. Size of raceway and size and type of wire shall be the responsibility of the Contractor in keeping with the manufacturer’s recommendations and CCBC requirements, except as noted elsewhere.

M. Include one pull string in each raceway 1 in. or larger.

N. Use coded conductors throughout with conductors of different colors.

O. Control and status relays are to be located in designated enclosures only. These enclosures include package equipment control panel enclosures unless they also contain Class 1 starters.

P. Conceal all raceways, except within mechanical, electrical, or service rooms. Install raceway to maintain a minimum clearance of 6 in. from high temperature equipment (e.g. steam pipes or flues).

Q. Secure raceways with raceway clamps fastened to the structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.

R. Adhere to applicable building code requirements where raceway crosses building expansion joints.
S. Install insulated bushings on all raceway ends and openings to enclosures. Seal top end of all vertical raceways.

T. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams at the job site with terminations identified.

U. Flexible metal raceways and liquid-tight, flexible metal raceways shall not exceed 3 ft. in length and shall be supported at each end. Flexible metal raceway less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways shall be used.

V. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

W. Do not run temperature control wiring in conduits installed by other trades unless expressed permission is granted, in writing, by the Contractor and the Engineer.

3.8 COMMUNICATION WIRING

A. The Contractor shall adhere to the items listed in Wiring as discussed in Part 3 of this specification, including requirement that all wiring be run in conduit.

B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer’s installation recommendations for all communication cabling.

C. Do not install communication wiring in raceway and enclosures containing Class 1 wiring. The exceptions to this are control panels where the layout of the control panel shall be such that communication wiring does not have to cross any Class 1 wiring.

D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable. Submit testing procedures in accordance with Submittals as discussed in Part 1 of this specification.

F. When a cable enters or exits a building, a lightning arrester must be installed between the lines and ground. The lightning arrester shall be installed according to the manufacturer’s instructions.

G. All runs of communication wiring shall be un-spliced length when that length is commercially available. All runs over commercially available lengths must be continued and connected in accordance with the manufacturer’s requirements.

H. All communication wiring shall be labeled to indicate origination and destination data.

I. Grounding or coaxial cable shall be in accordance with NEC regulation article on “Communications Circuits, Cable, and Protector Grounding.”

3.9 INSTALLATION OF SENSORS

A. Install sensors in accordance with manufacturer’s recommendations.
B. Mount sensors rigidly and adequately for the environment within which the sensor operates.

C. Room temperature sensors installed in new walls shall be installed on concealed junction boxes properly supported by the wall framing.
   1. Sensors in classrooms will have stainless steel cover plate.
   2. Sensors in gymnasiums, cafeterias, corridors and other common areas shall have either stainless steel cover plate or appropriately sized plastic or metal wire, locking guard.
   3. Locate sensor such that computers, water coolers, and other heat generating equipment are not operating near the sensor.
   4. For sensors installed inside walls, provide insulation in the box that seals the sensor from the conduit connected to the box.

D. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.

E. Averaging sensors and low-limit switches
   1. Sensors used in mixing plenums, hot and cold decks, energy recovery applications or ducts over 48" any direction shall be of the averaging type.
   2. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
   3. Low limit sensors shall be mounted in a serpentine manner, horizontally across duct in accordance with manufacturers recommended installation procedures.
   4. Provide 1 ft of sensing element for each 1 ft2 of coil area.
   5. For large duct areas where the sensing element does not provide full coverage of the air stream, additional sensors or switches shall be provided as required to provide full protection of the air stream.
   6. Wire one pole of the low-limit switch to the supply and return fan starters, one pole to an BAS input, and one pole to interrupt power to the associated unit heating valves and economizer dampers.

F. All pipe-mounted temperature sensors shall be installed in wells. Use conductive compound in all wells to provide good heat transfer.

G. Install aspirated enclosure containing outdoor air temperature and humidity sensors on north wall at designated locations. They shall be located so as to avoid effects of sun, reflected sun, exhaust air, radiant heat from building materials, etc. Location to be approved by Engineer.

H. Pressure sensors and switches.
   1. Provide accessories as required to dampen input signal to transducers and reduce fluctuations in the signal.
   2. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
   3. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
   4. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.
I. Low-limit sensors and other safeties shall have at least two poles; one hard wired to fan starter, and one wired to EMS. Low limit sensors will have an additional pole to interrupt power to the associated unit heating valves and economizer dampers.

J. For water level switches, if a separate manufacturer’s panel is not provided, then provide a separate panel including all power sources, relays to provide alarm notification as well as BAS input notification, alarm bell, silence switch, and panel labeling as noted in this specification.

K. Damper end-switches for combustion air applications will be mounted directly to the damper blade. Switches integral to the actuator, or that monitor only the actuator position will not be acceptable.

L. Smoke detectors are to be installed with sampling tube, and in a section of ductwork as noted by the manufacturer. One N.C. contact will be wired to shut down the supply and return fans; the other shall be N.O. and provide an input to the BAS.

3.10 INSTALLATION OF ACTUATORS

A. Mount and link control damper actuators according to the manufacturer’s instructions.
   1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5º open position, manually close the damper, and then tighten the linkage.
   2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
   3. Provide all mounting hardware and linkages for actuator installation.

B. Electric/Electronic
   1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5º available for tightening the damper seals. Actuators shall be mounted following manufacturer’s recommendations.
   2. Valves: Actuators shall be connected to valves by the manufacturer. New valves that require field mounting of actuator will not be accepted. Valves schedule designates the control panel to which the valve actuator is to be terminated.

3.11 WARNING LABELS

A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC system.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows:

   CAUTION
   This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to “Off” position before servicing.

B. Permanent warning labels shall be affixed to all motor starters and all control panels that are connected to multiple power sources utilizing separate disconnects.
   1. Labels shall use white lettering (12-point type or larger) on a red background.
   2. Warning labels shall read as follows:
3.12 IDENTIFICATION OF HARDWARE AND WIRING

A. All wiring and cabling, including that within factory-fabricated panels, shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.

B. Permanently label or code each point of field terminal strips to show the instrument or item serviced.

C. Identify control panels with minimum 1 cm (1/2 in.) letters on engraved plastic nameplates. Nameplate shall include systems controlled and node number of controller contained within the panel.

D. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.

E. Identify room sensors relating to the terminal box or valves with nameplates. For stainless steel cover plate sensors, identifier shall be on inside of plate.

F. Manufacturer’s nameplates and UL or CSA labels are to be visible and legible after equipment is installed.

G. Identifiers shall match record documents.

3.13 START-UP AND COMMISSIONING

A. The Contractor shall completely check out, calibrate and test all connected hardware and software to insure that the system performs in accordance with the approved specifications and Sequences of Operation submitted. This work shall be completed prior to notifying the Engineer that the system is ready for acceptance.

B. The Contractor is to take primary responsibility of start-up of all equipment and coordinate with other contractors and equipment manufacturers as necessary. The Contractor shall provide all labor and necessary test apparatus required to calibrate and prepare for service all of the instruments, controls and accessory equipment furnished under this specification.

C. The contractor installing the BAS shall test all control wiring and devices prior to start-up. This includes verifying that all wiring is properly connected and free of all shorts and ground faults. Verify that all connections are tightened appropriately. Calibrate each device as required by the manufacturer’s recommendations.

D. Verify the binary output devices operate properly and that the normal positions are correct.

E. Verify that all analog output devices are functional, that start point and span are correct, and that direction and normal positions are correct including fail-safe positions. The Contractor shall check all control valves and automatic dampers to ensure proper action and closure. The Contractor shall make any necessary adjustments to valve stem and damper blade travel.
F. Complete software shall be installed and tested (dry run) prior to start-up.

G. Coordination with Test and Balance:
1. Provide training for the Test and Balance contractor on the tools needed to balance all equipment.
2. Provide software and field labor to correct BAS errors found during balancing.

H. Alarms and interlocks:
1. Check each alarm separately by including an appropriate signal at a value that will trip the alarm.
2. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
3. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.

I. Return the system to a normal operating state after each phase of start-up, commissioning and demonstration. Any points overridden, devices placed in manual position, setpoints adjusted, etc. are to be restored to normal operating condition prior to acceptance.

3.14 DEMONSTRATION AND ACCEPTANCE

A. Demonstration
1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests in accordance with the Start-Up and Commissioning portion of part 3 of this specification.
2. The tests described in this section are to be performed in addition to the tests that the Contractor performs as a necessary part of the installation, start-up, and debugging process as specified in the Start-Up and Commissioning portion of part 3 of this specification. The Engineer will be present to observe and review these tests. The Engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in the Submittals section of part 1 of this specification. The approved checklists and forms shall be completed for all systems as part of the demonstration.
4. The Contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the Contractor.
5. As each control input and output is checked, a log shall be completed showing the date, technician’s initials, and any corrective action taken or needed.
6. Demonstrate compliance with System Performance section of part 1 of this specification.
7. Demonstrate compliance with sequences of operation through all modes of operation.
8. Demonstrate complete operation of operator interface.
9. Additionally, the following items shall be demonstrated:
   a. DDC loop response. The Contractor shall supply trend data output in a graphical form showing the step response of each DDC loop.
The test shall show the loop’s response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.

b. Optimum start/stop. The Contractor shall supply a trend data output showing the capability of the algorithm. The change-of-value or change-of-state trends shall include the output status of all optimally started and stopped equipment, as well as temperature sensor inputs of affected areas.

c. Interface to the building fire alarm system
d. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the Engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and disk formats.

10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The Contractor shall be responsible for the hardware and software necessary to complete all tests.

11. If, during any of the demonstration process, the contractor is required to make corrections a total of three times, the Engineer can cancel the demonstration. The session will then be rescheduled, and the contractor will perform the demonstration again at their own cost. Continued occurrences will result in the contractor compensating the Engineer for visits during which the system was not ready for demonstration.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the Engineer and the owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the Contractor may be exempt from the completion requirements if stated in writing by the Engineer. Such tests shall then be performed as part of the warranty.

2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in the Submittals section of Part 1 of this specification.

C. Specification Punch List Review: The Engineer shall perform no more than two punch list reviews of the system to verify compliance with these specifications. Should the system not be acceptable as complete after the second review, the BAS Contractor shall agree to pay all additional expenses incurred by the Engineer in verifying system compliance at the Engineer’s current standard rate.

D. Contractor shall remove and replace, at their expense, all items which are not in compliance with the specification requirements.

3.15 CLEANING

A. The Contractor shall clean up all debris resulting from his/her activities daily. The Contractor shall remove all cartons, containers, crates, etc., under his/her control as
soon as their contents have been removed. Waste shall be collected and placed in a designated location.

B. At the completion of work in any area, the Contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, debris, etc.

C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material repainted to match the adjacent areas.

3.16 TRAINING

A. Provide training to occupants on the operation of the system.

PART 4 - SEQUENCE OF OPERATION

4.1 SCOPE OF WORK – GENERAL

A. Provide fully implemented application and controls necessary to accomplish the control sequences as follows in this part of the specification.
   1. This sequence of operation may require minor changes or fine-tuning in the field to achieve the owner's exact operational requirements.
   2. This Contractor will be responsible to coordinate with the owner and make any necessary software adjustments to achieve the intended results.

B. The following sequences are designed to describe the scope of control required. The Contractor is responsible to expand these sequences in complete detail, describing all modes of operation, including, alarm conditions, failure modes, start-up, shut-down, etc. Submitted sequences are expected to be detailed, showing algorithms and all "decision trees".

4.2 BROMMEL HALL – ORGANIC CHEMISTRY LAB – ROOM 226

A. Control Overview:
   1. Room 226 is designed for constant volume supply and constant volume exhaust.
   2. Supply airflow will be controlled by the Titus Alpha BACnet controller installed on air terminal unit TRH-2-23.
      a. The ATU controller will also maintain space temperature by modulation of the air terminal unit HW coil valve.
      b. All programming of the Titus Alpha BACnet controller shall be accomplished through the wall sensor interface LCD display and programming buttons.
   3. Exhaust airflow will maintained via system powered exhaust air valves that are preset for specific airflow. Exhaust fan FHE-19 will have a VFD programmed to a fixed speed to maintain desired exhaust static pressure.

B. Air Terminal Unit (Constant Air Volume Box) Control:
   1. The supply air terminal unit will operate continuously.
   2. Space Temperature Setpoints:
      a. The space temperature setpoints will be 70°F for heating.
b. The wall controller will allow for adjustments to space temperature setpoints.

3. Primary Air Damper Control:
   a. The ATU controller will be programmed to maintain a constant volume of air passing through the unit.
   b. The ATU controller shall monitor supply airflow via velocity pressure pickups at the inlet the unit and the controller shall be programmed to convert the velocity pressure to airflow rate.
   c. The primary air damper shall modulate to maintain the supply airflow at a constant rate.
   d. See schedules for specific airflow setpoints.

4. Space Temperature Control:
   a. The ATU controller will be programmed to maintain the space temperature at no less than the heating space temperature setpoint.
   b. The ATU controller shall monitor the leaving air temperature (LAT) of the ATU and directly control the ATU’s HW coil valve.
   c. When the space temperature drops below the space temperature setpoint, the ATU controller shall calculate the desired LAT setpoint required to satisfy the space heating requirements.
   d. The ATU controller shall modulate the HW valve open to maintain desired LAT setpoint.

C. Exhaust Air Valve Control:
   1. The exhaust air valves (EAVs) are system powered. They will be set to maintain specific airflows. See plans and schedules for details.

D. Exhaust Fan FHE-19 Control:
   1. Exhaust fan FHE-19 will have a VFD programmed to a fixed speed to maintain desired exhaust static pressure.
   2. To set the desired speed of for FHE-19:
      a. Ensure the supply fan is running and the supply ATU is operating to maintain its constant flow.
      b. Starting at a lower speed, gradually increase the speed of the exhaust fan VFD until all EAVs in Room 226 (as well as Room 238) are maintaining constant flow and start pinching down.
      c. Gradually back off on the VFD speed until one or more EAVs (in Rooms 226 and 238) modulate to full open position and the associated airflow begins to drop below setpoint.
      d. From the VFD speed at which one or more EAVs (in Rooms 226 and 238) are full open and no longer controlling, add 3% to that speed to determined final setpoint.

4.3 BROMMEL HALL – ORGANIC CHEMISTRY LAB – ROOM 238

A. Control Overview:
   1. Room 238 is designed for constant volume supply and constant volume exhaust.
   2. Supply airflow will be controlled by the Titus Alpha BACnet controller installed on air terminal unit TRH-2-16.
      a. The ATU controller will also maintain space temperature by modulation of the air terminal unit HW coil valve.
      b. All programming of the Titus Alpha BACnet controller shall be accomplished through the wall sensor interface LCD display and programming buttons.
3. Exhaust airflow will be maintained via system-powered exhaust air valves that are preset for specific airflows. Exhaust fan FHE-19 will have a VFD programmed to a fixed speed to maintain desired exhaust static pressure.

B. Air Terminal Unit (Constant Air Volume Box) Control:
1. The supply air terminal unit will operate continuously.
2. Space Temperature Setpoints:
   a. The space temperature setpoints will be 70°F for heating.
   b. The wall controller will allow for adjustments to space temperature setpoints.
3. Primary Air Damper Control:
   a. The ATU controller will be programmed to maintain a constant volume of air passing through the unit.
   b. The ATU controller shall monitor supply airflow via velocity pressure pickups at the inlet the unit and the controller shall be programmed to convert the velocity pressure to airflow rate.
   c. The primary air damper shall modulate to maintain the supply airflow at a constant rate.
   d. See schedules for specific airflow setpoints.
4. Space Temperature Control:
   a. The ATU controller will be programmed to maintain the space temperature at no less than the heating space temperature setpoint.
   b. The ATU controller shall monitor the leaving air temperature (LAT) of the ATU and directly control the ATU's HW coil valve.
   c. When the space temperature drops below the space temperature setpoint, the ATU controller shall calculate the desired LAT setpoint required to satisfy the space heating requirements.
   d. The ATU controller shall modulate the HW valve open to maintain desired LAT setpoint.

C. Exhaust Air Valve Control:
1. The exhaust air valves (EAVs) are system powered. They will be set to maintain specific airflows. See plans and schedules for details.

D. Exhaust Fan FHE-19 Control:
1. See Room 226 Control sequence for FHE-19 control.

End of Section 15975
DIVISION 15 - MECHANICAL

SECTION 15990
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All sections of Division 15 and 16 apply to this section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Air Systems:
      a. Variable-air-volume systems.
   2. Hydronic Piping Systems:
      a. Constant-flow systems.
   3. Laboratory fume hood airflow balancing.
   4. Existing systems TAB.
   5. Verifying that automatic control devices are functioning properly.
   6. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
J. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

K. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

L. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

M. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

N. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

O. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

P. TAB: Testing, adjusting, and balancing.

Q. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

R. Test: A procedure to determine quantitative performance of systems or equipment.

S. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Strategies and Procedures Plan: Within 60 days from Contractor’s Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 “Preparation” Article. Include a complete set of report forms intended for use on this Project.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
   1. Provide a draft TAB report within two weeks of completion. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.
   2. Provide the CxA and engineer with any requested data, gathered, but not shown on the draft reports.
   3. Provide a final TAB report for the engineer with details, as in the draft.

C. Sample Report Forms: Submit two sets of sample TAB report forms.

D. Submit two copies of special warranty specified in the “Warranty” Article of this Section.
1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by NEBB or AABC.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   c. TAB plan.
   d. Work schedule and Project-site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.


E. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every twelve months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 DELIVERY, STORAGE AND HANDLING

A. Not applicable.

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
1.9 WARRANTY

A. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. If TAB firm is an AABC member, an equivalent guarantee is acceptable. Guarantee shall include the following provisions:
   1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS - Not Applicable

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
   2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.
H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine strainers for clean screens and proper perforations.

M. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

N. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

O. Examine system pumps to ensure absence of entrained air in the suction piping.

P. Examine equipment for installation and for properly operating safety interlocks and controls.

Q. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at indicated values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to indicated values.

R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.
B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.
J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.6 PROCEDURES FOR LABORATORY FUME HOODS

A. Before performing laboratory fume hood testing, measure, adjust and record the supply airflow and airflow patterns of each supply air outlet that is located in the same room as the hood. Adjust the air outlet flow pattern to minimize turbulence and to achieve the desired airflow patterns at the face and inside the hood. Verify that adequate makeup air is available to achieve the indicated flow of the hood.

B. Measure, adjust, and record the airflow of each laboratory fume hood by duct Pitot-tube traverse with the laboratory fume hood sash in the design open position.
   1. Balance fumehoods to provide 100 fpm when the sash is open 18 inches.

C. After balancing is complete, do the following:
   1. Measure and record the static pressure at the hood duct connection with the hood operating at indicated airflow.
   2. Measure and record the face velocity across the open sash face area.
      Measure the face velocity at each point in a grid pattern. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter of the opening.
      a. For laboratory fume hoods designed to maintain a constant face velocity at varying sash positions, also measure and record the face velocity at 50 and 25 percent of the design open sash position.
      b. Calculate and report the average face velocity by averaging all velocity measurements.
      c. Calculate and report the exhaust airflow by multiplying the calculated average face velocity by the sash open area. Compare this quantity with the exhaust airflow measured by duct Pitot-tube traverse. Report differences.

3.7 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
   1. Measure and record the operating speed, airflow, and static pressure of each fan.
   2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
   3. Check the refrigerant charge.
   4. Check the condition of filters.
   5. Check the condition of coils.
   6. Check the operation of the drain pan and condensate drain trap.
   7. Check bearings and other lubricated parts for proper lubrication.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.
   1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
   1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
   2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
   3. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
   4. Air balance each air outlet.

3.8 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.9 TOLERANCES

A. Set system airflow and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus/Minus 10 percent.
2. Air Outlets and Inlets: Plus/Minus 10 percent.
3. Heating-Water Flow Rate: Plus/Minus 10 percent.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Word processor printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the data per the NEBB or AABC procedures manuals.

D. Instrument Calibration Reports:
1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

E. Keyed Plan
1. Provide 11"x17" reduction floor plans of the mechanical final construction documents. Mark on these plans the diffuse numbers keyed to the TAB report.

3.12 ADDITIONAL TESTS (Optional)

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

3.13 CLEANING

A. Not applicable.

3.14 CONTRACTOR STARTUP AND REPORTING

A. Not applicable.

3.15 DEMONSTRATION AND COMMISSIONING

A. The contractor will demonstrate up to 10% of measurements to confirm the report accuracy. If more than 10% of those readings vary by more than 10% from the report readings, the report will be corrected. With the corrected report the contractor will demonstrate a 10% sample of points chosen by the commissioning agent or engineer. This process will continue until the criteria are satisfied.

End of Section 15990
DIVISION 16 - ELECTRICAL

SECTION 16051
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Electrical equipment coordination and installation.
   2. Sleeves for raceways and cables.
   4. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Panels and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Penetration Firestopping."
PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

F. Demolition Execution:
   1. Disconnect electrical systems in walls, floors, and ceiling scheduled for removal.
   2. Remove abandoned wiring to source of supply.
   3. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
   4. Existing Electrical Circuits: Maintain existing system where necessary until new system is complete and ready for switch-over. Disable system only to make switch-overs and connections. Obtain permission from Owner at least
48 hours before partially or completely disabling system. Minimize outage duration.
5. Remove abandoned conduits back to source if ran exposed. Cut and cap abandoned conduits at first penetration if ran concealed within wall or floor.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry:
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Penetration Firestopping."

End of Section 16051
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
A. Base Bid: General Contractor provides: Grounding systems and equipment. Connection to existing building grounding system.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control reports.

1.4 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Chicago Building Code, Article 18-27-100, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.
C. Comply with City of Chicago Building Code (CCBC).

PART 2 - PRODUCTS

2.1 CONDUCTORS
A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

2.2 CONNECTORS
A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

PART 3 - EXECUTION

3.1 APPLICATIONS
A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
B. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 EQUIPMENT GROUNDING
A. Install insulated equipment grounding conductors with all feeders and branch circuits.

3.3 INSTALLATION
A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

3.4 LABELING
A. Comply with requirements in Division16 Section "Electrical Identification" Article for instruction signs. The label or its text shall be green.

3.5 FIELD QUALITY CONTROL
A. Perform tests and inspections.
B. Tests and Inspections:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
C. Grounding system will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.
E. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
   2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
   3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

End of Section 16060
DIVISION 16 - ELECTRICAL

SECTION 16073
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
A. Base Bid: General Contractor provides:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.3 DEFINITIONS
A. EMT: Electrical metallic tubing.
B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS
A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 QUALITY ASSURANCE
A. Comply with City of Chicago Building Code (CCBC).

1.6 COORDINATION
A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS
A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   3. Channel Dimensions: Selected for applicable load criteria.
B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.

PART 3 - EXECUTION

3.1 APPLICATION
A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by maximum spacings less than stated in CCBC. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION
A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified
loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Comply with requirements in Division 9 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

C. General Contractor to provide scope of work outlined in section 3.3 Painting.

End of Section 16073
DIVISION 16 - ELECTRICAL

SECTION 16075
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Identification for raceways.
   2. Identification of power and control cables.
   3. Identification for conductors.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.
   B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.
   B. Comply with City of Chicago Building Code (CCBC).
   D. Comply with ANSI Z535.4 for safety signs and labels.
   E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
   B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
   C. Coordinate installation of identifying devices with location of access panels and doors.
D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.4 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.
B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

H. Painted Identification: Comply with requirements in Division 9 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

E. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations,
terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-(13-mm-) high letters on 1-1/2-inch-(38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment/Devices to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer.
   b. Enclosed circuit breakers.
   c. Enclosed controllers
   d. Receptacle Outlets: Label with panelboard designation and circuit number.
   e. Lighting control switch: Label with panelboard designation and circuit number.

End of Section 16075
DIVISION 16 - ELECTRICAL

SECTION 16120
CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES
A. Base Bid: General Contractor provides:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS
A. EPDM: Ethylene-propylene-diene terpolymer rubber.
B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Field quality-control test reports.

1.5 QUALITY ASSURANCE
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Chicago Building Code, Article 18-27-100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
B. Comply with City of Chicago Building Code (CCBC).

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. General Cable Corporation.
B. Copper Conductors: Comply with NEMA WC 70.
C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.
2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AFC Cable Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
B. Use conductor not smaller than 12 AWG for power and lighting circuits.
C. Use conductor not smaller than 16 AWG for control circuits.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders: Type THHN-THWN, single conductors in raceway.
B. Branch Circuits Type THHN-THWN, single conductors in raceway.
C. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
D. Class 1 Control Circuits: Type THHN-THWN, in raceway.
E. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
E. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."
3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

C. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

End of Section 16120
DIVISION 16 - ELECTRICAL

SECTION 16130

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquidtight flexible metal conduit.

F. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.

C. Source quality-control test reports.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Chicago Building Code, Article 18-27-100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with City of Chicago Building Code (CCBC).
PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1.
B. IMC: ANSI C80.6.
C. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   1. Comply with NEMA RN 1.
   2. Coating Thickness: 0.040 inch (1 mm), minimum.
D. EMT: ANSI C80.3.
E. FMC: Zinc-coated steel.
F. LFMC: Flexible steel conduit with PVC jacket.
G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
   2. Fittings for EMT: compression type with insulated throat.
   3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
H. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
B. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Thomas & Betts Corporation.
      c. Wiremold Company (The); Electrical Sales Division.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. EGS/Appleton Electric.
7. RACO; a Hubbell Company.
8. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Metal Floor Boxes: Cast or sheet metal, fully adjustable, round.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Comply with the following indoor applications, unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: IMC.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Within Concrete Slabs Above Grade: IMC with concrete-tight fittings.
8. Within or Below Slab on Grade: Rigid steel conduit.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

B. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 16 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:
   1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
   2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer’s written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, as follows:
   1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
   2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
   3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by CCBC.

N. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC in damp or wet locations not subject to severe physical damage.

O. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

P. Set metal floor boxes level and flush with finished floor surface.

3.3 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

End of Section 16130
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Receptacles, receptacles with integral GFCI, and associated device plates.
   2. Snap switches.
   3. Floor service outlets, poke-through assemblies and multioutlet assemblies.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in City of Chicago Building Code, Article 18-27-100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with City of Chicago Building Code (CCBC).

1.6 COORDINATION

A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
   2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
   4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
   1. Back and side wired.
   2. Specification grade, heavy-duty type.
   3. High impact, chemical resistant smooth nylon face.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
   1. Back and side wired.
   2. Specification grade, heavy-duty type.
   3. High impact, chemical resistant smooth nylon face.

2.4 SNAP SWITCHES

A. General Description: Comply with NEMA WD 1 and UL 20.
   1. Back and side wired, terminals to accept up to #10AWG wire.
   2. Specification grade, heavy-duty type.
   3. Ground screw terminal.

B. Switches, 120 V, 20 A

2.5 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.

2.6 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.
D. **Power Receptacle:** NEMA WD 6 configuration 5-20R, unless otherwise indicated. Single gang hackbox and faceplate.

2.7 **INDOOR OCCUPANCY SENSORS**

A. **Manufacturers:** Subject to compliance with requirements and lighting controls system compatibility, provide products by one of the following:

1. Hubbell Lighting.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Sensor Switch, Inc.
5. Watt Stopper (The).

B. **General Description:** Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. **Operation:** Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. **Sensor Output:** Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. **Relay Unit:** Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. **Mounting:**
   a. **Sensor:** Suitable for mounting in any position on a standard outlet box.
   b. **Relay:** Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   c. **Time-Delay and Sensitivity Adjustments:** Recessed and concealed behind hinged door.
5. **Indicator:** LED, to show when motion is being detected during testing and normal operation of the sensor.
6. **Bypass Switch:** Override the on function in case of sensor failure.
7. **Automatic Light-Level Sensor:** Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. **PIR Type:** Single restrooms or spaces under 250 sq. ft. Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. **Detector Sensitivity:** Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. **Detection Coverage (Room):** Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. **Detection Coverage (Corridor):** Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

D. **Dual-Technology Type:** Multi-occupant restroom or spaces over 250 sq. ft. Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic/microphonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. **Sensitivity Adjustment:** Separate for each sensing technology.
2. **Detector Sensitivity:** Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight
moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s)

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm) high ceiling.

2.8 FINISHES

A. Color:
1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by CCBC or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:
1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of CCBC, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

G. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

End of Section 16140
PART 1 – GENERAL

1.1 Related Sections:
   A. Section 16220 – Communication Cabling Material List

1.2 Work Includes:
   A. Base Bid: General Contractor provides:
      1. Communications Cabling

1.3 General Requirements:
   A. Unless noted otherwise each drop location shall consist of two (2) data jacks and two (2) voice jacks mounted in a quad faceplate.
   B. There shall be no substitution of the materials listed for installation and/or the expected method of installation without the prior written approval of NEIU. Any changes in materials and/or installation from that shown on the drawings, Bid documentation, and General Specifications without written approval shall be the responsibility of the Electrical Contractor to correct, to the satisfaction and approval of the Project Manager, at no cost to Northeastern Illinois University.
   C. Throughout the drawings, bid documentation, and specifications, there are specified methods of workmanship, material installation, and support of cable and devices. The intent is to obtain a permanent installation of the specified materials and devices such that they stand up to normal building maintenance. In the event that the Electrical Contractor has a solid technical reason for objecting to the use of any material and/or method of installation as shown or specified, they are to report such an objection to NEIU for action.

1.4 Cabling Standards and Codes:
   A. All cabling is to be installed according to the latest TIA/EIA standards and the latest BICSI proposed installation procedures.
   B. All work and materials shall be in accordance with the City of Chicago Electric Code, (Latest Edition), Federal, State and local codes and all other bodies having jurisdiction with the installation practice. Compliance with the requirements of applicable laws, codes, regulations and ordinances shall not be construed as waiving any part of the drawings, Bid documents and/or specifications which may be in excess of the requirements set forth.
   C. The placement and wall mounting of all items requiring servicing, maintenance, and/or observation shall be placed with direct access from the floor without the use of a step, ladder, or the like.
PART 2 – PRODUCTS

2.1 Materials:
   A. There are three (3) acceptable manufacturers for the Category 6A copper cabling system. There are to be no mixing and matching of components outside of the manufacturers approved channel specifications. For the SYSTIMAX GigaSPEED X10D solution, use only SYSTIMAX cable and connectivity. For the IBDN System 10GX solution, use only Belden cable and connectivity. For Panduit 10Gig solutions, use only Panduit cable and connectivity. All piece parts are specified in Section 16200. No deviations from the specified materials will be accepted. Whichever solution is installed will require the appropriate manufacturer warranty.

   B. Materials used for the completion of the installation shall be new, the best of their respective kind, and manufactured for the purpose that they are being used.

2.2 Prohibited Products:
   A. Any materials that are considered to be unsafe to life or the environment, such as asbestos, are not to be used or installed.

PART 3 – EXECUTION

3.1 Workmanship:
   A. The Electrical Contractor shall perform all work required for the completion of the installation in a skillful and craftsman like manner.

   B. All installations are to be made secure, plumb, true, and square. Align all installations with adjacent existing conditions unless shown otherwise on the drawings, Bid documentation, and/or specifications.

   C. The installation of all materials and devices shall be in accordance with the latest manufacture’s published procedures, specifications, and recommended procedures.

   D. All materials shall be delivered in their original unopened packaging and stored in an enclosed secured area providing adequate protection from damage and/or loss. Damaged or deteriorated materials shall be removed from the building property immediately.

3.2 Cable Routing and Management:
   A. Primary cable routes are to be coordinated with NEIU for approval prior to installation.

   B. Any portion of the cabling system considered to be exposed to potential damage shall be protected utilizing innerduct or some other type of raceway as part of the original contract.

   C. Cable rings and/or J-hooks utilized for cable management and/or routing shall not have a diameter larger than 3”. All management rings and hooks shall not exceed 75% of their capacity.
D. Velcro straps are to be used wherever possible to manage cable. If plastic cable ties are utilized to secure cable, the ties are to be kept loose in order that they can easily be twisted around the cable bundle.

E. All cabling is to be routed parallel to structural walls. Where UTP Category-6A cable is being installed, the UTP data cable lengths are to be kept at two hundred ninety-five (295) feet or less. The Cabling Contractor shall give NEIU a written notice if a UTP data cable will exceed the two hundred ninety-five (295) foot length prior to installing the cable. Rerouting the cable will be reviewed. The rerouting of any cable installed that is over the two hundred ninety-five (295) foot limit will be at the Cabling Contractors expense.

F. The routing of all cable above any ceiling shall be properly managed and supported off of the ceiling supports. Management rings and/or "J" hooks are to be mounted to the building walls and ceiling truss system and the cables are to be routed within the management rings. The management rings and/or "J" hooks are to be spaced within five (5) feet of each other and minimal droop, (4" from parallel), of the cable is to occur between supports. If the cables cannot be kept within this minimal droop, additional supports are to be added.

G. Coax cable or shielded intercom/paging cable is not to be installed within the same management supports and/or routed with the UTP data cables. Separate management routes are to be installed.

H. Exposed cabling within the telecommunication Cabinet shall be neatly managed utilizing cable management wall brackets and velcro straps. The Cabling Contractor shall coordinate the exact location of the brackets with NEIU.

I. Cable routing shall be such that the cable is not closer than (6) six inches from light fixture ballasts, motors, transformers and/or any other device capable of emitting RF noise.

J. Cables not indicated within the design documents as being spliced, are not to be spliced or extended by any means without written approval. Short cables are to be completely removed and a new cable installed at the Cabling Contractor's expense. Cables are to be continuous from drop location to patch panel or wiring block.

K. Fiber Optic Cable should be pulled through and housed in a separate raceway from Category 6 twisted pair cable or any other cabling. This is done to prevent damage and potential strain on the fiber optic cabling.

3.3 Cable Termination:

A. Unshielded Twisted Pair (UTP) Cable:
1. Minimal cable jacket shall be removed for termination per the manufacturer's specifications.
2. The twist of each pair shall remain natural to final termination. The person terminating is not to remove twist from the pairs after the jacket has been removed.
3. Electrical Contractor shall refer to the manufacturer's recommended procedure for terminating to the connector.

B. Coax Cable:
1. All coax cables are to be terminated using "F" type end connectors.
3.4 Coordination of Installation:

A. The Electrical Contractor shall coordinate with the Owner's General Contractor and NEIU in reference to the installation of materials, devices, and wiring to ensure proper location and function of the installation.

B. The Electrical Contractor shall coordinate their work with all other contractors working the site. Any conflict with the installation and completion of the cabling infrastructure with other contractors working the site is to be noted to NEIU for resolution.

C. The Electrical Contractor shall coordinate all arrangements with the Owner pertaining to:
   1. The use of facilities for storing materials
   2. Working hours
   3. Refuse disposal
   4. Security
   5. Ownership of salvage materials
   6. Material and tool storage on site
   7. Parking areas
   8. Access to secured areas
   9. Any other items of mutual interest

3.5 Cutting and Patching:

A. The General Contractor shall coordinate all cutting of structural members with NEIU prior to doing the work. Written approval will be required for all cuts and/or cores that affect any structural members, the safety of the project, or the work of other contractors on the site.

B. Where cutting is required to facilitate the installation, the General Contractor shall provide the cut as part of the original contract charge.

C. Patching and the repair of damage to finished surfaces shall be performed by the applicable trade for the material to be patched or repaired. The procedure for the repair is to be coordinated and approved with Architect prior to doing the work. The cost of repair is not to be added to the contract price and is the responsibility of the General Contractor.

D. The General Contractor shall restore all finished surfaces to their original condition if damaged during the installation. Refinish the entire surface as necessary to provide an even finish that is acceptable to the Owner.

3.6 Floor Cores and Wall Openings:

A. The General Contractor shall provide all additional conduit sleeved floor cores and wall openings that are not provided for their own work. All cores and openings shall be coordinated with the Architect. All cores and openings shall be made with a drill and minimal damage to existing surfaces. Cores and openings through fire rated walls shall be temporarily fire stopped when not being worked.

B. All cores and openings are to be sleeved utilizing a metal conduit properly sealed between the outer conduit surface and the hole. The conduit sleeve is to extend a minimum of 3" from the wall surface and be firmly supported to prevent movement.
Each end of the conduit sleeve is to have a standard bushing for the protection of the cables routed within.

3.7 Labels:

A. All cables are to be individually labeled at each end. Labels shall be wrap around, non smear type so that the print is covered by a clear tape. Labels are to be secured to the cable jacket.

B. Labels at the drop location faceplate shall be machine made and placed appropriately. Lettering shall be 3/16” high, bold type. Hand written labels are not acceptable.

C. Labels at the patch panel shall be self adhesive type made to secure to a metal surface. Label print to be machine made, 3/16” high, bold type. Hand written labels are not acceptable.

D. All drop locations shall be labeled.

3.8 Cable Testing:

A. Cables are to be tested after the installation is complete. If for any reason, the drop location raceway and/or faceplate is removed for additional work of any nature, the drop location is to be retested if previously tested. All cables associated with the drop location are to be retested. The cost of retesting is the responsibility of the Electrical Contractor.

B. Voice/ Data - Unshielded Twisted Pair (UTP) Cable:

1. Each UTP Category-6A voice and data cable installed shall be tested and a test result printout sheet shall be furnished at the completion of the project.

2. The test shall be performed after the final cable and device termination has been completed and the faceplate installed. The test shall be of the "Permanent Link" from completed end to completed end.

3. The test shall be conducted according to the latest draft of TIA/EIA 568B.2 Addendum 10 utilizing a scanner that will generate at least a 500 megahertz signal on all pairs of the cable and test each pair of the cable for:
   a. Pair mapping
   b. Cable length
   c. Attenuation
   d. Near-End-Cross Talk (NEXT)
   e. Attenuation to Cross Talk Ratio (ACR)
   f. Impedance
   g. Capacitance
   h. Loop Resistance
   i. Power Sum Alien Near-End Cross Talk (PSANEXT)
   j. Power Sum Alien Far-End Cross Talk (PSAFEXT)
   k. Power Sum Attenuation to Alien Crosstalk Ratio at the Far End (PSAACRF)

4. Each test result shall indicate the cable number, test date and tester name. All test results are to be submitted to Architect in a neat, clean and orderly nature within a three ring binder. The test sheets are to be divided by panel and in numeric order. Dividers are to be placed between each panel's test sheets.

5. No hand written test results will be accepted.
C. Coax Cable:
   1. Each coax cable shall be tested for continuity and correct routing.
   2. No hand written test results will be accepted.

3.9 House Keeping:

A. The General Contractor shall take all necessary precautions and provide all necessary protection and enclosures to insure that dust and debris created as a result of the installation does not get out of the work area and into other parts of the building(s). If the cleanup is not acceptable to the Owner, Northeastern Illinois University will have the option to hire a janitorial firm to properly clean the area and back charge the General Contractor.

B. The General Contractor shall have on site a portable shop vacuum cleaner capable of cleaning up all debris and dust caused by the installation. All finished surfaces are to be kept clean of any installation debris and dust.

C. The General and Electrical Contractors shall, at all times, keep the premises free from the accumulation of waste material and/or rubbish caused by their installation work. All waste material and/or rubbish shall be suitably and legally disposed of by the General Contractor, at their expense, off the building site.

D. The areas of work are to be cleaned of any and all installation dust and debris at the end of each day's work. Drop cloths are to be used to protect all furniture from damage, and surfaces are to be cleaned to their existing conditions.

E. The Owner must approve the use of a dumpster on site prior to placement by the General Contractor. Northeastern Illinois University and/or General Contractor's disposal containers are not to be utilized without authorization from the Project Manager.

F. The General Contractor shall provide and maintain suitable barriers to regulate access, to assure public safety and to protect the work in progress.

G. At the completion of the project, the General and Electrical Contractors shall: a) Remove all their waste materials and rubbish from and about the installation site; b) Remove all their tools, installation equipment and surplus materials and c) Leave finished areas free of installation dust and non-finished areas broom clean.

End of Section 16210
PART 1 – GENERAL

1.1 RELATED SECTIONS:
   A. Section 16210 – Communication Cabling Specifications

1.2 WORK INCLUDES
   A. Base Bid: General Contractor provides:
      1. Communications cabling and wiring devices

1.3 ITEM DESCRIPTION
   A. This cabling specification is written around an Augmented Category 6 infrastructure design. Therefore, no substitutions or brand mixing shall be allowed among any data signal carrying devices, at any point within the 100-meter channel.

   B. In addition, all link and channel testing must be completed by a contractor that is certified to perform the installation of the selected solution. This includes the performance of the additional testing parameters required of an end-to-end 10 Gigabit link or channel. The contractor will also be required to procure and make use of cable scanners designed to perform these Augmented Category 6 tests, such as the Fluke Model DTX-1800 or other current model with a bandwidth in excess of 500 MHz.

1. DATA CABLE: Unshielded Twisted Pair (UTP), Category-6A, 4-pair, non-plenum rated, 22 or 23 AWG. Solid copper. Cables to be of different jacket color to identify being Data-1 Blue, Data-2 Yellow or White. Jacket colors to remain the same throughout installation.

   Preferred Manufacturer: Panduit (10 Gig)
   Manufacturer Part# PUR6X04BU-UY (blue)
   Anixter Part # CM-00423PND-10G-06 Blue

   Acceptable Manufacturer: SYSTIMAX (GigaSPEED X10D)
   Manufacturer Part # 1091 Category 6A Cable, Non-Plenum
   Anixter Part # CM-00424X10D-10-06 (Blue)

2. VOICE CABLE: Unshielded Twisted Pair (UTP), Category 6A, 4-pair, non-plenum rated, 22-23 AWG. Solid copper. Cables to be of different jacket color to identify being Voice - I, Voice - 2, or Voice (Gray<or blue or yellow or white> Jacket color). Jacket color to remain the same throughout installation.

   Preferred Manufacturer: Panduit (10 Gig)
   Manufacturer Part # PUR6X04WH-UY (white)
   Anixter Part # CM-00423PND-10G-01 (White)

   Acceptable Manufacturer: SYSTIMAX (GigaSPEED X10D)
   Manufacturer Part # 1091 Category 6A Cable, Non-Plenum
3. UNSHIELDED TWISTED PAIR (UTP) PATCH PANEL FOR DATA & VOICE

48-Port Patch Panel fully loaded 110 terminations, T568A/B, 19” Rack Mount, Cat6A
Description: 48 Port fully loaded 110 - type Patch Panel, 2RU
Preferred Manufacturer: SYSTIMAX
Manufacturer Part #: 1100GS5-48
Anixter Part #: 323250

Description: 48 Port fully loaded 110 - type Angled Patch Panel, 2RU
Preferred Manufacturer: SYSTIMAX
Manufacturer Part #: 1100AGS5-48
Anixter Part #: 323252

Description: 48 Port fully loaded 110 - type Patch Panel, 2RU
Acceptable Manufacturer: Panduit
Manufacturer Part #: DP486X88TGY
Anixter Part #: 307301

Description: 48 Port fully loaded 110 - type Angled Patch Panel, 2RU
Acceptable Manufacturer: Panduit
Manufacturer Part #: DPA486X88TGY
Anixter Part #: 311386

Description: 48 Port fully loaded 110 - type Patch Panel, 2RU
Acceptable Manufacturer: Belden
Manufacturer Part #: AX102296
Anixter Part #: 309765

4. UNSHIELDED TWISTED PAIR (UTP) PATCH PANEL FOR TIE-IN TO VOICE HOUSE PAIRS. Refer to phone switch manufacturer and/or appropriate neiu personnel regarding punch-down requirements.

When implementing Category 6A solutions, please refer to the above patch panel options even for voice applications. Number of ports will vary per closet.

Acceptable Manufacturers: SYSTIMAX, Belden or Panduit

5. WIRE MANAGEMENT PANEL (horizontal): 1.75" high by 19" wide, with distribution rings, rack mountable horizontal wire management panel for cable management within the cabinets

Preferred Manufacturer: SYSTIMAX
Manufacturer Part #: HCM1U
Anixter Part #: 292028

Acceptable Manufacturers: Panduit
Manufacturer Part #: CMPHF1
Anixter Part #: 221616

6. 110 TERMINATION BLOCK: 19” rack mount panel kits
Preferred Manufacturer: SYSTIMAX
Manufacturer Part # 110AW2-100, 100-Pair w/Legs
Anixter Part # 154069

Acceptable Manufacturer: Panduit
Manufacturer Part # GPB484R4WJ 192-Pair, With Trough
Anixter Part # 213000

Acceptable Manufacturer: Ortronics
Manufacturer Part # 110ABC6100, 100-Pair
Anixter Part # 237857

7. DATA & VOICE PATCH CORDS, Cat 6A (MUST MATCH CHANNEL)

NOTE: Adhere to the following for all applications:

Use SYSTIMAX (preferred) GS10E Modular Patch Cords for GigaSPEED X10D Solution
For example:

Anixter # MM07-X10D-06 7ft, blue; Manufacturer # CPC7732-02F007
Anixter # MM10-X10D-06 10ft, blue; Manufacturer # CPC7732-02F010
Anixter # MM14-X10D-06 14ft, blue; Manufacturer # CPC7732-02F014
Anixter # MM20-X10D-06 20ft, blue; Manufacturer # CPC7732-02F020

Use Panduit TX6 10 Gig Patch Cords for 10Gig Solution
For example:

Anixter # MM05-PA10G-06 5ft, blue; Manufacturer # UTP6X5BU
Anixter # MM07-PA10G-06 7ft, blue; Manufacturer # UTP6X7BU
Anixter # MM10-PA10G-06 10ft, blue; Manufacturer # UTP6X10BU
Anixter # MM15-PA10G-06 15ft, blue; Manufacturer # UTP6X15BU
Anixter # MM20-PA10G-06 20ft, blue; Manufacturer # UTP6X20BU

Use Belden 10GX Modular Patch Cords for their 10GX Solution
For example:

Anixter # MM07-BNT10G-06 7ft, blue; Manufacturer # AX360015
Anixter # MM10-BNT10G-06 10ft, blue; Manufacturer # AX360016
Anixter # MM15-BNT10G-06 15ft, blue; Manufacturer # AX360017
Anixter # MM25-BNT10G-06 25ft, blue; Manufacturer # AX360018

Note: Must specify lengths (typical is 3’, 5’, 7’, 10’, 14’ and 20’)

Note: Must specify colors (Off white, Black, Red, Green, Yellow, Blue)

1.4 TYPICAL DUPLEX DATA DROP LOCATION & ASSOCIATED ITEMS (Surface Raceway)

A. DUPLEX RECEPTACLE DEVICE PLATE: Device plate for 4000 series two - piece steel raceway, Gray. (By Others)

Acceptable Manufacturers: Wiremold
Part # G4048B

B. DATA JACK SINGLE RJ45 JACK Cat 6A, 8P8C, MODULAR SNAP-IN, DATA-I Blue & DATA-2 Yellow
Preferred Manufacturer: Panduit Mini-Com TX6 10Gig (CAT 6A) Module
Manufacturer Part # CJ6X88TGBU Blue
Anixter Part # 307322
Manufacturer Part # CJ6X88TGYL Yellow
Anixter Part # 307324
Manufacturer Part # CJ6X88TGIW White
Anixter Part # 307317
Manufacturer Part # CJ6X88TGI Gray
Anixter Part # 307320

Acceptable Manufacturer: SYSTIMAX GigaSPEED X10D Jacks (CAT 6A)
Manufacturer Part # MGS500BH-318 Blue
Anixter Part # 286395
Manufacturer Part # MGS500BH-123 Yellow
Anixter Part # 286183
Manufacturer Part # MGS500BH-262 White
Anixter Part # 286392
Manufacturer Part # MGS500BH-270 Gray
Anixter Part # 286393

Acceptable Manufacturer: Belden 10GX Module (CAT 6A)
Manufacturer Part # AX102277 Blue
Anixter Part # 309763
Manufacturer Part # AX102275 Yellow
Anixter Part # 309761
Manufacturer Part # AX102269 White
Anixter Part # 309758
Manufacturer Part # AX102269 Gray
Anixter Part # 309757

C. VOICE JACK SINGLE RJ45 JACK Cat 6A, 8P8C, MODULAR SNAP-IN
CHECK w/NEIU FOR COLOR APPROVAL

Please select from the list of approved RJ 45 jacks above.

D. MODULE ICON TABS:
Voice and data color-coded tabs for port identification.

(Data-1) "Blue"/Data (Voice-1) "White"/Voice
(Data-2) "Yellow"/Data (Voice-2) "Gray"/Voice

Data and Voice Icon Tab colors must match the Outlet color.

1.5 TYPICAL DATA WALL MOUNT DROP LOCATION & ASSOCIATED ITEMS

A. 4 PORT SYMMETRICAL FACE PLATE: 4 Port symmetrical plastic face plate will accept up to four jacks and/or blank modules. Check with NEIU for color approval.

Preferred Manufacturer: Panduit
Manufacturer Part # UICFP4S (stainless steel)
Anixter Part # Inquire

B. DATA JACK SINGLE RJ45 JACK Cat 6A, 8P8C, MODULAR SNAP-IN, DATA-1 Blue & DATA-2 Yellow

Preferred Manufacturer: Panduit Mini-Com TX6 10Gig (CAT 6A) Module
Manufacturer Part # CJ6X88TGBU Blue
Anixter Part # 307322
Acceptable Manufacturer: SYSTIMAX GigaSPEED X10D Jacks (CAT 6A)
Manufacturer Part # MGS500BH-318 Blue
Anixter Part # 286395
Manufacturer Part # MGS500BH-123 Yellow
Anixter Part # 286183
Manufacturer Part # MGS500BH-262 White
Anixter Part # 286392
Manufacturer Part # MGS500BH-270 Gray
Anixter Part # 286393

Acceptable Manufacturer: Belden 10GX Module (CAT 6A)
Manufacturer Part # AX102277 Blue
Anixter Part # 309763
Manufacturer Part # AX102275 Yellow
Anixter Part # 309761
Manufacturer Part # AX102269 White
Anixter Part # 309757
Manufacturer Part # AX102269 Gray
Anixter Part # 309757

C. VOICE JACK SINGLE RJ45 JACK Cat 6A, 8P8C, MODULAR SNAP-IN
CHECK w/NEIU FOR COLOR APPROVAL.

Please select from the list of approved RJ 45 jacks above.

1.6 TYPICAL VOICE DROP LOCATION & ASSOCIATED ITEMS

A. DUPLEX RECEPTACLE DEVICE PLATE: Device plate for 4000 series two piece
steel raceway, Gray. (By Others)
Acceptable Manufacturers: Wiremold
Part # G4048B

B. BLANK INSERT MODULE: Blank insert to be used for coaxial & voice drop locations.
Blank inserts color must match Outlet color.
Preferred Manufacturer: Panduit
Manufacturer Part # CMBEI-X (ivory)
Anixter Part # 266823
Acceptable Manufacturer: SYSTIMAX
Manufacturer Part # M20AP-XXX (-246 = ivory)
Anixter Part # 145936 (ivory)

C. MODULE ICON TABS: Voice and data color coded tabs for port identification.
(Data-1) "Blue"/Data       (Voice-1) "White"/Voice
(Data-2) "Yellow"/Data    (Voice-2) "Gray"/Voice

Data and Voice Icon Tab colors must match the Outlet color.

1.7 TYPICAL DOGHOUSE STYLE DROP LOCATION & ASSOCIATED ITEMS
A. If required to use in the building, please consult NEIU/University computing.

1.8 LABELS: Electrical Contractor to furnish and install printed labels utilizing the Panduit Ultimate ID software (P/N: UISW), hand written labels are not acceptable. Lettering to be ¼” to 3/8” high, bold type. Labels are to be positioned at each end of all the cable jackets between 4” and 8” from termination point, on the workstation drop location device plates, and on the patch panel device plates above each connector point and on every faceplate as required. Labels are to be self-adhesive backed, smear resistant, and not easily removed. Numbering Scheme will be provided by the University Computing Services, see sketch “NEIU-052109-01”. All exposed conduit and cables shall be labeled.

Typical labeling scheme for workstation outlets will be as follows:

1 space for closet identification – “A”, for example
1 space for TR patch panel identification – “B”, for example
3 spaces for room number location or workstation location number – “123”, for example
  Note: for wireless locations, the room or workstation numbers shall be preceded by a “W” – “W123” for example
Typical labeling scheme for TR Panels will be as follows:

Common Label for each panel Identifying the Rack and Panel – “AB,” for example
Below each port:
4 spaces for closet room number location – “1234”, for example
3 spaces for room number location or workstation location number – “123”, for example
Note: for Wireless locations the room or workstation numbers shall be preceded by a “W” – “W1234” for example

See detail “NEIU-052109-01” for example

Acceptable Label Printer Manufacturers: Panduit or approved equivalent
1.9. DOCUMENTATION

Electrical Contractor must provide properly detailed documentation for jack location with room numbers and related information. Documentation should include information about cable/fiber routing and raceways. Documentation should be on paper and Visio or CAD.
1.10 MISCELLANEOUS MATERIALS:
All miscellaneous materials, supports and associated hardware required for a complete installation of the items listed above are the responsibility of the Electrical Contractor to furnish and install.

Acceptable Manufacturers: Materials are to be of the same manufacturer unless not available from that manufacturer.

After the acceptance of the project, vendor must provide a detailed list of items for approval by NEIU computing.

End of Section 16220
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Fusible switches.
   2. Nonfusible switches.
   3. Molded-case circuit breakers (MCCBs).
   5. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current ratings (interrupting and withstand, as appropriate).
   4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Field quality-control reports.
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Chicago Building Code, Article 18-27-100, by a qualified testing agency, and marked for intended location and application.

C. Comply with City of Chicago Building Code (CCBC).

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Owner's written permission.
   4. Comply with NFPA 70E.

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified
fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, 240 or 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
4. Square D; a brand of Schneider Electric.
B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.


E. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
   4. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   5. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.4 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
   3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
   4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
   5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
   5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 16 Section "Electrical Identification."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Division 16 Section "Overcurrent Protective Device Coordination".

End of Section 16410
DIVISION 16 - ELECTRICAL

SECTION 16511
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDES

A. Base Bid: General Contractor provides:
   1. Interior lighting fixtures, lamps, and ballasts.
   2. Lighting fixture supports.

1.3 DEFINITIONS

A. BF: Ballast factor.
B. CCT: Correlated color temperature.
C. CRI: Color-rendering index.
D. HID: High-intensity discharge.
E. LER: Luminaire efficacy rating.
F. Lumen: Measured output of lamp and luminaire, or both.
G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
   1. Physical description of lighting fixture including dimensions.
   2. Emergency lighting units including battery and charger.
   3. Ballast, including BF.
   5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
   6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
      a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include replacement part list.

C. Installation instructions.

D. Field quality-control reports.

E. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

F. All ballasts shall originate from one manufacturer.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in Chicago Building Code, Article 18-27-100, by a qualified testing agency, and marked for intended location and application.

C. Comply with City of Chicago Building Code (CCBC).

1.6 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Fluorescent-fixture-mounted, emergency battery pack: One for every 50 emergency lighting unit.
   4. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
   5. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:
   1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
      a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
      b. UV stabilized.

G. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp and ballast characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
      c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
      d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
      e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
      f. CCT and CRI for all luminaires.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:
   1. Comply with UL 935 and with ANSI C82.11.
   2. Designed for type and quantity of lamps served.
   3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.90 or higher.
11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires controlled by occupancy sensors shall have instant-start ballasts.

C. Electronic Programmed-Start Ballasts for T8 Lamps: Comply with ANSI C82.11 and the following:
   1. Automatic lamp starting after lamp replacement.

D. Single Ballasts for Multiple Lighting Fixtures: Factory wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.

E. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
   1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
      a. High-Level Operation: 100 percent of rated lamp lumens.
      b. Low-Level Operation: 30 percent of rated lamp lumens.
   2. Ballast shall provide equal current to each lamp in each operating mode.
   3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

F. All ballasts shall originate from one manufacturer.

G. Ballasts shall be electronic type from the following manufacturers: GE Ultramax High-Efficiency Electronic Ballast (Instant Start).

2.4 FLUORESCENT LAMPS

A. Fluorescent lamps shall be provided in accordance with the following:
   1. Straight fluorescent lamps shall be: GE F32T8/SP N41/RS. Lamps shall have a correlated color temperature of 4100 K with color rendering index of 80.
   2. Initial lumens shall be 2800 or lumens maintenance shall be rated at 90% at 40% of rated life.
   3. Average rated life shall be 27,000 hours when operated with rapid start ballasts. Average rated life is based on 10 hours of operation per start.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 16 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:
   1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
   2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
   1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.
   2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
   3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

E. Suspended Lighting Fixture Support:
   1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
   3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
   4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Division 16 Section "Conductors and Cables."
3.2 IDENTIFICATION
A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Division 16 Section "Electrical Identification."

3.3 FIELD QUALITY CONTROL
A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE
A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING
A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
   1. Adjust aimable luminaires in the presence of Architect.

End of Section 16511